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THE

ELECTRICAL WORLD:

A WEEKLY REVIEW OF CURRENT PROGRESS IN ELECTRICITY AND ITS PRACTICAL APPLICATIONS.

VOLUME XXXII.

FROM JULY 2 TO DECEMBER 31, 1898.

107694
27/1/11

NEW YORK:
THE W. J. JOHNSTON COMPANY,
9 MURRAY STREET.

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The Electrical World.

VOL. XXXII. NEW YORK, JULY 2, 1898. No. 1.

PUBLISHED EVERY SATURDAY BY

THE W. J. JOHNSTON COMPANY,

9 Murray Street, New York.

Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York.

New England Office, 620 Atlantic Ave., Boston.

Western Office, 936 Monadnock Block, Chicago.

Philadelphia Office, 929 Chestnut Street.

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THE ELECTRICAL WORLD,

9 Murray Street, New York.

VOL. XXXII. NEW YORK, JULY 2, 1898. No. 1.

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THE CONVENTION OF THE INDEPENDENT TELEPHONE ASSOCIATION.

During the past twelve months legal disturbances in the telephone field have been noticeably few, and the independent telephone movement has expanded with little let or hindrance. The fear and uncertainty that pervaded the telephonic atmosphere prior to the organization of the Independent Telephone Association in Detroit last year seems to have been dispelled, and the independent movement has been marching on in a peaceable conquest. The threats of offensive action on the part of the older company which so long hung over the spirit of independence seem to have quieted down, and it is but reasonable to suppose that the unpleasantness has been largely neutralized by the defensive attitude of the national independent organization, which is composed of men firm in their belief in the justice of the cause for the defense of which they are banded together.

At last year's meeting it was shown that at that time there were in use between 150,000 and 175,000 independent telephones, supplied by about 1200 exchanges. This information was no doubt a very gratifying surprise to even many of the members themselves, and when the report of progress during the first year of the association's existence is added to it we will without question witness a splendid result of harmonious co-operation in a worthy cause. Interests of such vast magnitude as independent telephony has proved to be must needs be protected against the attacks of an older and more strongly intrenched competitor. The Independent Association exists for a well designed purpose, and that it is doing efficacious work is evident from the actual progress that has been made in the independent field during the past year, with so little molestation.

IMPROVEMENTS IN TELEPHONE EXCHANGE SYSTEMS.

Probably the greatest improvement in telephone exchange work made during the past few years is the development of various so-called common-battery systems, by which the troublesome primary battery at the subscriber's instrument is done away with and all subscriber's microphones are supplied with current from one common source, generally a storage battery, at the central exchange. Associated with this improvement, which necessitates the use of battery current on the subscriber's line, is the elimination of the hand generator at the subscriber's instrument, the signaling to the central exchange being readily effected by a variation of the resistance of the line, caused by the motion of the telephone hook or any other manipulation on the part of the subscriber, the corresponding change of current affecting generally a relay at the exchange, which in turn operates the signal. The most up-to-date form of this signal is the miniature lamp, its advantages being that it has no moving parts, that it is instantly restored on the removal of the current and that it requires very little space on the board.

The enormous banks of these relays, with their two extensive systems of wiring, one on the line and one on the lamp side, are, to be sure, somewhat troublesome, but no more so than the corresponding banks of self-restoring drops which they replace. A further improvement, which may be confidently hoped for, is the substitution for these relays and low-voltage lamps of fine filament lamps directly in the line circuits. Incandescent lamp works now turn out filaments which incandesce with 300 milliamperes or even less, and could no doubt make the filament much finer in the short lengths and low-candle powers and low economies allowable in this work. Such filament would of necessity be cut into the lines instead of bridged across them as are the relays now used. With these visual signals mounted, as both convenience and simplicity would suggest, adjacent to their respective answering jacks, one multipling of the boards would be done away with.

Common battery systems are not as yet developed to work as well as the more old-fashioned individual battery systems, owing to the insertion of the comparatively high resistance of the line in the microphone circuit. There are various ways of partially overcoming this, varying from the use of a simple shunt about the microphone to the use of a storage battery charged over the wire when the latter is not in use for talking. Systems that require the use of more than two individual wires to each subscriber may be set down as impractical, and even those requiring the use of a common lead in addition to the separate line and return of each subscriber are objectionable.

WATER POWERS IN NORTHERN LATITUDES.

It may be recalled that when the great power plant at the Lachine rapids, near Montreal, was opened about a year ago, there was some feeling of uncertainty as to the continuous working of water powers in latitudes where the winter temperatures are so low as in that part of Canada. It is fairly demonstrated from the past winter's operation of the Lachine plant that this fear was without adequate foundation, as no trouble from anchor ice was encountered and the service of the installation was not hampered in any way by ice during the winter season. A large part of the available water power in the eastern part of America is in northern latitudes where the winters are of great severity, and it is as important as it is pleasant to know that there seems to be no reason to anticipate stoppage of the power from ice. The industrial development of Canada will probably keep pace with the utilization of the magnificent water powers with which it is so abundantly endowed, the climatic and other conditions apparently marking Canada as a region in which manufacturing will one day be the principal industry. The projected railway to the Hudson Bay region will open a country full of water power awaiting development and utilization, and this region is not so far from the centres of population and the points of trans-shipment for export as some others now enjoying a large manufacturing trade.

With the continual growth of electrolytic methods for the extraction of metals and the manufacture of mineral products the importance of water powers, even in comparatively inaccessible regions, is vastly enhanced. This is especially the case in a region of high-priced coal such as Canada, and it is to be hoped that the encouraging success of some recent great installations for the electrical de [illegible]

ELECTROLYTIC [illegible]

[illegible]

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ductivity higher than that of copper. It has been obtained without great difficulty by the electrolysis of a double glucinum-sodium fluoride. What use can be made of it will, of course, be largely determined by the price at which it can be produced, but its lightness, resistance to oxidation, and high conductivity mark it as useful to the instrument maker and for many purposes where the combination of these qualities will be found desirable.

Sodium, which has found a considerable application in the arts, is now generally made by an electrolytic process, the chloride being used as the electrolyte and chlorine made as a by-product. The price of this metal has been reduced very greatly, and its usefulness correspondingly extended since the introduction of the electrolytic method of manufacture. Phosphorus, while not a metal, is another electrolytic product of great importance, its principal use being in the manufacture of matches, in which large quantities are consumed.

Perhaps the most important electrolytic product is copper. This is either reduced directly from its ores or refined by the electrolysis of anodes of the crude metal, enormous works of both kinds being in operation in many parts of the world. The increasing demand for copper of high conductivity, which is another way of saying of great purity, has made a ready market for the electrolytic product and contributed greatly to the extension of such processes. Aluminum as an electrical product is too well known to require further mention here. Electrolytic lead is now an article of staple manufacture and of great importance. The lead is not often directly reduced from its ore by electrical means, but, as the metal is almost always more or less contaminated by foreign and injurious impurities, its refinement by some process is generally necessary. Of the various methods adopted for refining lead none are more promising and important than those based upon electrolytic action.

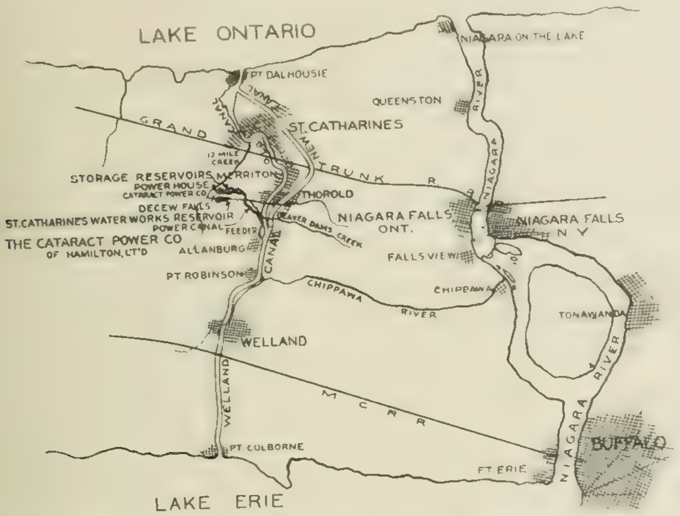
THE SEARCH LIGHT IN WAR.

An instance of the value of the search light in war was shown during the recent occupation of the shores of Guantanamo Bay by the American marines. The camp of this force was greatly annoyed at night by persistent firing from the dense thickets surrounding it, and as the nights were very dark no effective reply could be made. The search lights of two or three vessels lying in the bay were turned upon the woods in which the Spanish sharpshooters were concealed, with the result that they were located and driven out with comparative ease.

Probably the first use of search lights in actual warfare was during the landing of the Japanese forces near Seoul, Korea, at the beginning of the late war between Japan and China. On this occasion they were found to be exceedingly effective, not only in illuminating the shores and waters where the landing was taking place, but also in terrifying the semi-savage soldiery defending the coast. While it is not likely that the search light will be found useful in this way during our present war, there is no doubt that it has already proven its capacity as an effective addition to the materials of warfare in more than one instance. Its use, confined hitherto almost entirely to naval operations, should be extended to land warfare as well, and it is easy to see how effective the powerful beam might prove to be in night operations ashore, either in guarding against surprise, finding and relieving the wounded after a battle, burying the dead, constructing fortifications, or deceiving and blinding the enemy. Portable search light outfits are in use in the continental European armies, and may be easily and rapidly constructed. Such an outfit, consisting of a light vertical boiler mounted on a wheeled truck, a small high speed engine and direct connected dynamo, and the projecting apparatus, can be operated in any region where there are fair roads, though it is likely that it would be of but little use in the mountainous country of southeastern Cuba.

The Cataract Power Company's Transmission Plant.

The Cataract Power Company, Hamilton, Ont., is engaged in a work of great magnitude, and will, when its plans are carried to fruition, generate electricity on a large scale, with a view to supplying electric light and power at any point along the route of the line, which runs from St. Catharines to Hamilton, a distance of 35 miles. Much interest is being taken in the scheme, owing to the fact that it is the first attempt in Canada to transmit power at such a distance.



Map Showing Source of Supply and the Proposed Canal

The plan of the company is to obtain a water supply from the old Welland Canal at Allanburg, and carry it by means of an artificial channel, 4½ miles in length, to the brow of the mountain overlooking Twelve-Mile Creek, just east of DeCew Falls and about 2 miles from St. Catharines. At DeCew Falls a very large reservoir is in course of construction, and other storage reservoirs are being built between DeCew Falls and Allanburg, so as to provide an abundant supply of water. The water will be carried to the power house from the reservoir through pipes 8 feet in diameter, the fall being 275 feet. The power house has already been erected at DeCew Falls.

Fig. 2.—Aqueduct Over Beaver Dam Creek.

The old and new canals come together near the village of Allanburg, and it is near the junction that the tap is made to permit of the water being utilized for the driving of the power generators at DeCew Falls.

In Fig. 1 are shown the head gates at the intake, of which there are two. From the head gates the water is conducted through an artificial channel or canal. For a distance of 2 miles from the intake the canal is now practically completed. About 2 miles from Allanburg a large aqueduct has been erected for the purpose of carrying the water across the creek, as shown in Fig. 2. This aqueduct is a wooden flume 600 feet in length, with an inside diameter of 8 x 8 feet, and is supported by a steel truss. Considerable work is yet to be accomplished to carry the water from the flume to the brow of the mountain, and to do this numerous small bridges are in course of construction. It is the intention of the company to provide three large storage reservoirs, one of which is already completed. These will contain sufficient water for two days' operations, and the danger from frazil or small particles of ice getting into the water wheels will be provided against. There will also be built at the brow of the mountain a concrete wall 600 feet in length and 15 feet high. A cutting 38 feet deep and 14 feet wide was made in the rock at the top of the bank, in which the pipe line will be placed. This cut, together with a view of the power house, is shown in Fig. 3. The distance from the top of the mountain to the base of the power house is 900 feet, the vertical height being 275 feet, as already noted. This gives a head nearly double that of Niagara Falls, and a pressure of 135 pounds to the square inch.

The foundation for the pipe line is made of stone, with a pier and drain every 12 feet. At the top of the line the pipe is three-eighths of an inch in thickness, gradually increasing to 1 inch. It is a circular steel tube, the first section being 9 feet in diameter, and then it diminishes to 8 feet 6 inches, 8 feet, and finally 7 feet 6 inches. The pipe was constructed by the Hamilton Bridge Company, and is said to be an excellent piece of work.

The power house is located on the bank of Twelve-Mile Creek, into which the water will discharge directly. It is 175 feet long by 40 feet wide, the walls being 30 feet in height. The framework is of steel filled in with brick. The roof is covered with lap seam metal and the floors are of concrete 3 inches thick, but where the generators and turbines will be located it will be laid to a depth of 12 feet. At the present time no machinery has been installed, except a large traveling crane. Four generators will be placed on the north side, as well as two exciters. All of the electrical apparatus is being constructed by the Royal Electric Company, of Montreal, and is now nearing completion at the company's works. The water wheels are of special design, and were built by the Stilwell-Bierce & Smith-Vaile Company, Dayton, Ohio. They have steel fly wheels weighing 7½ tons each, the total weight of case and turbine being 30 tons.

Fig. 1.—The Head Gates.

At the power house current at a pressure of 22,500 volts will be generated and transmitted to the transformer station at Hamilton, where it will be reduced by step-down transformers to 2500 volts. The pole line has been completed for a distance of about 25 miles.

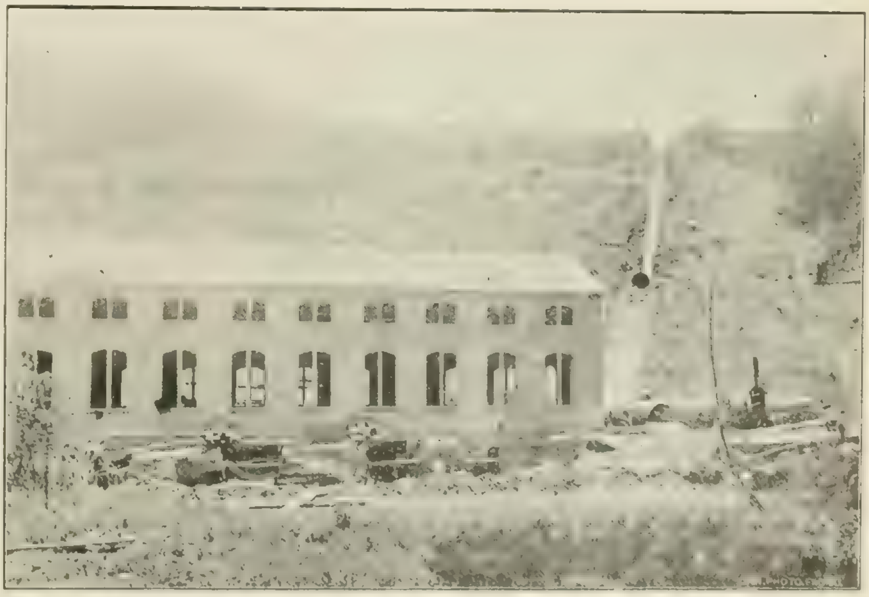


Fig. 3.—Power House and Pipe Line.

Cedar poles 35 feet long are being used, with heavy cross arms and locust pins boiled in linseed oil to extend their life and increase their insulating qualities. A neat angle iron brace gives additional support and strength to the cross arms. Porcelain insulators tested at a very high pressure will support the conductors, which will comprise four separate strands of No. 4 B. & S. copper wire. The poles are placed 90 feet apart, and about 2000 of them will be set in the distance between the two places.

The transformer plant at Hamilton is 50 x 100 feet, and in construction will be similar to the power house. It is now nearing completion.

The cost of the completed work, it is stated by the "Canadian Electrical News," from which journal we obtained most of the foregoing facts, will be about $600,000. The company expects to transmit current for lighting and power purposes to Hamilton before the close of July. The general manager of the Cataract Power Company is Mr. H. R. Leyden, late of the Royal Electric Company, and Mr. T. E. Hillman is the engineer in charge.

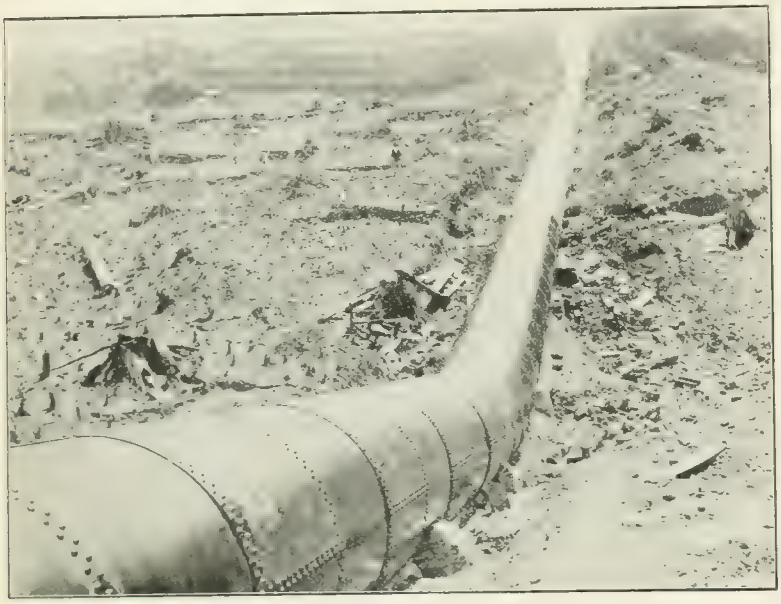


Fig. 4.—Pipe Line Showing Hill.

Prospective Water Power Development at the Head of Lake Superior.

In connection with the recent visit of the Northwestern Electrical Association to the cities at the head of Lake Superior, a brief account of the proposed development of the mammoth water power existing near these points may be of interest.

The St. Louis River, which flows into the western tip of Lake Superior, has a length of about 125 miles and is fed by a number of smaller streams which have their sources on the upper plateaus north of the lake and at an elevation of about 1000 feet above it. Reaching a point about 20 miles from Duluth, the river flows in a series of rapids with a total fall of about 450 feet in a distance of 5 miles. The utilization of these falls has long been proposed, but never accomplished, partly on account of the scattered and inaccessible location of the falls and partly on account of the variation in the flow, the river being quite torrential at certain times, especially [illegible] in seasons of drought or continued freezing.

[illegible] problems [illegible] around the [illegible] of the [illegible] by means of dams could be utilized for storage purposes [illegible] of perhaps [illegible] an available storage [illegible] cubic feet or an equivalent [illegible] during the period [illegible]ter. By this means the minimum flow of the river at the rapids could be raised from its present volume of about 1000 feet per second to about twice that amount.

The dam mentioned would be about 1300 feet long at the crest, with a maximum height of about 30 feet for a short part of its length, and would probably be constructed of crib work filled with loose stone. There would also be required a canal to connect the new watershed and storage reservoir with one of the tributaries of the St. Louis River.

For the utilization of the maximum available head at one convenient location, the company proposes to construct around the falls above mentioned a canal about 22 miles in length, ending at a point on the hills immediately back of Duluth, from which water would be taken in closed pipe lines to a plant at the river side below, giving a head of about 600 feet. This, with the flow of 2000 feet per second, would develop efficiently about 100,000 horse-power. The power canal mentioned would be of sufficient size to pass this water with a velocity of about 3 feet per second, or, in other words, it would have a cross section below the water level of 667 square feet. It is proposed to make this an earthwork canal, following closely the profile of its own gradient through the hilly country and crossing whatever valleys are unavoidable by following their sides back to points where they could be conveniently crossed by means of masonry or concrete dams on the low side, backing up the water in these valleys for storage purposes and absorbing in this manner the flow of all streams crossing.

Estimates have been made, based on careful surveys, both for this complete plan and others more modest, based on the construction of a shorter canal for the use of a lower head or the utilization direct of the various falls by means of scattered power houses. These estimates run from about $1,500,000 for the simpler plans to $3,500,000 for the complete plan, with mechanical and electrical apparatus for the development of 25,000 horse-power. While the local development of power at the various rapids and falls on the river would give sufficient power for all immediate demands, the later development of the whole head by means of a canal would render all such local plants valueless, hence the advisability of starting in the extensive way proposed.

It is estimated that 20,000 electrical horse-power could be marketed which, if sold at $40 per hp year, would bring an annual revenue of $800,000, and that an income of about $150,000 annually could also be derived from the transportation of pine timber, making an annual income of almost $1,000,000.

The market for power is exceptionally good, there being two extensive street railway systems, two extensive lighting systems, and a large number of elevators, flour mills, etc., all now using bituminous coal at a cost of $2.25 per ton.

Convention of Railway Telegraph Superintendents.

The annual meeting of the Association of Railway Telegraph Superintendents of America was held at the Hotel Dellone, Omaha, Neb., on June 15 and 16. There was a large attendance, and several papers of special interest to the members were read by different ones of their number. The election of officers for the ensuing year resulted as follows: President, W. W. Ryder, of the Chicago, Burlington & Quincy Railroad, Chicago; vice-president, L. B. Foley, of the Delaware, Lackawanna & Western Railroad, New York; secretary-treasurer, P. W. Drew, of the Wisconsin Central Railway, Milwaukee, Wis. The next convention will be held at Wilmington, N. C., on June 19, 1899.

Following is a list of the papers read: "Unnecessary Telegraphing," by Mr. C. S. Rhodes; "Railway Telephone Service," by E. A. Chenery; "Telegraph Construction and Maintenance," by Kenneth Mackenzie; "The Telegraph Block System," by H. C. Hope.

At the second day's meeting, Mr. Wendell Baker, of the Long-Distance Telephone Company, New York, described the extensive telephone system of the Pennsylvania Railroad Company, which connects its main offices in Philadelphia with its branch offices in the cities of Philadelphia, New York, Harrisburg, Altoona and Pittsburg; in all of which points prompt connections can be made with the railroad offices or public exchange customers.

The committee on low-resistance-relay experiments made its report on its work in determining the relative advantages of relays of low resistance and standard relays, of which the resistance is 150 ohms. The committee states that in every instance where low resistance relays have been experimented with the wires work much better. The committee was ordered to render a supplementary report at the 1899 meeting.

Lightning Arresters.[x]

BY A. J. WURTS.

My attention has been called to the large number of inquiries that have been made within the last year or so with reference to the protection of electrical apparatus against lightning. At the late Electrical Congress held in Geneva a little more than a year ago a special effort was made to obtain information on this subject, and about a year ago one of the electrical societies in Berlin offered a considerable prize to its members for the best paper on lightning arresters. Not very long ago the president of a very large electric plant wrote to me and asked whether I thought it possible to absolutely protect a plant against lightning. I answered that I thought it could be absolutely protected against all ordinary effects of lightning, although there are exceptions, of course. Quite recently I have noticed a small article[**] in one of the electrical papers referring to a meeting held in Johannesburg, South Africa, and to a paper read there on lightning arresters, where the impression seemed to prevail that the subject was not very well understood.

A. J. Wurts.

This subject deals largely with the static spark. In the lightning we see it in its grandest and most beautiful form. It is important in discussing a subject of this kind, which has been treated both in practice and in the laboratory, to establish the value of the laboratory experiments. The question is this: Are the experiments and the deductions that we obtain working with a static machine fair in connection with lightning arresters which we use in our electric light plants? It seems to me that they are. The phenomena that we observe in the laboratory correspond with those which we obtain from a static discharge from our wires. In practice, during a thunderstorm the discharge does not occur from any one particular point. It will occur from this point or that point, according to the conditions. In the laboratory tests I have sent discharges into one of two parallel wires and found that they may jump to the other almost anywhere along the wire. It seems to be because the static charge, which is in the wire during a thunderstorm, surges back and forth in such a way that the waves collide with each other. To illustrate, take a trough of water and lift one end of it; lower it, and the water will surge back and forth in the trough. Raise the end of that trough again, and you get another set of waves. Under certain circumstances the waves will collide, pile up and cause a splashing; under other circumstances, owing to a balancing of the waves, a smooth place will be formed. That is similar to what occurs in the wires. There is a splashing, and the static discharge tends to jump from the wire at those points where the splashing occurs. It seems to me that the wires are charged by conduction from the atmosphere, because they become charged, not only during thunderstorms but also during perfectly clear weather. The wire becomes a part of the electrically charged atmosphere, and, as I have explained, sparks tend to jump from the wire to the ground through any path that they can find.

What is the easiest path for these discharges, and how shall we judge one kind of lightning arrester from another? I wish to speak particularly of two types, one using a spark gap and a resistance in series with that spark gap, the other several spark gaps without any resistance in series with them. The former is on the market now, and it is said of it that the insertion of this resistance decreases the necessity of spark gaps; that is to say, by inserting a resistance a smaller number of spark gaps may be used than could be without the resistance. The question is which one of these paths will offer the least resistance to disruptive discharges. In experimenting in the laboratory I have determined the resistance of lightning arresters by placing in shunt to any given one a variable spark gap. The path of the lightning will depend upon the length of this shunt spark gap. If that gap is closed, the discharge will evidently take that path, and will avoid the lightning arrester, and by increasing the length of the shunt gap until the discharge will pass either through the arrester or through the shunt gap, a point is reached by which the resistance which the lightning arrester offers to the passage of the disruptive discharges may be measured. The length of the spark gap obtained is the measure of the resistance of that lightning arrester.

I have seen several statements in the papers to the effect that the lightning arrester should have a low breaking down E. M. F., that is, if the lightning arrester is to be connected to a 1000 volt circuit it should break down at about 2000 volts. The lightning arrester, as a conductor of disruptive discharges, has nothing to do with the E. M. F. of the dynamo. As far as conducting the discharge away is concerned, if 2000 volts are applied to that arrester using a series resistance the breaking down E. M. F. will be just the same, no matter what that resistance is. It may be 100 ohms in connection with that spark gap, or a million ohms, and it will not make a particle of difference about the breaking down E. M. F., but the resistance will make a great deal of difference as regards the lightning. That form has been called the short gap lightning arrester. It is a very attractive name, and certainly it intimates at once that that offers a very easy path to the passage of disruptive discharges. That is not, however, the case. If we take such a lightning arrester and measure its resistance to the passage of disruptive discharges by means of the shunt gap, and then measure in the same way the resistance of three-spark gaps in series, the dimensions of the gaps in every case being the same, it will be found that the equivalent gap of the device with the series resistance is three times as large as the equivalent gap obtained by the three-gap arrester. The resistance, which is connected in series with these spark gaps, is said to be a low resistance. By what right can anybody call that a low resistance? It is low, compared with what? Lightning arresters, as ordinarily installed, are connected to the overhead wire and to the ground by means of fairly large copper wires of very low resistance, not more than an ohm or so at all events, and the joints are soldered. It seems to me very curious then that in such a path we should connect a resistance of quite a good many ohms. The only standard for the resistance of a lightning arrester is the ease with which it will conduct disruptive discharges to earth, with absolutely no reference to ohmic resistance or breaking down E. M. F.

Lightning is oscillatory, and is not a single passage from cloud to earth. Twelve oscillations have been counted in lightning discharges, and the discharges which we get from our wires have corresponding oscillations. They are consequently resisted by self-induction, but why should they pass with so much difficulty through an ohmic non-inductive resistance? There is a great difference between the static discharge and the dynamo current. The dynamo current is more of a gentle force, and can be likened to the force of wind moving water; the lightning discharge can only be likened to the blow of a hammer or the flight of a bullet. If we have a large pane of glass, ordinary wind will not break it, but a bullet will find no difficulty in piercing it. It is a somewhat analogous force that we are dealing with, and, as I have described the discharge is oscillatory, swinging back and forth. Suppose, to carry out the analogy, we have a body swinging back and forth, and in the path of that swing a pane of glass. That body, in its first motion, will smash the glass, and will then vibrate back and forth until it comes to rest without further resistance. In the place of the pane of glass let us substitute a vessel of water, so that the body that swings back and forth will have to pass through the water. The water is not removed, and the body has got to pass through the water and meet that resistance each time. I liken that water to this non-inductive resistance in series with the spark gap and lightning arrester. The discharge has to pass down through that resistance, up and down, up and down, each time, and the ease with which the discharge passes through it is thereby affected. But with the spark gap the air is smashed, the discharge bores a hole right through the air, as a bolt does through jelly; the resistance is removed. The air has practically an infinite resistance as far as ohmic resistance is concerned, but this discharge bores a hole through the air, and that stays there during these oscillations. That is the reason in my mind for saying that the equivalent spark gap for the arrester with the resistance is so much larger than the equivalent spark gap of the other—in spite of there being three gaps to one. The best path,

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[*] Abstract of an address before the Northwestern Electrical Association, June, 1898.

[**] See The Electrical World, May 28, 1898.

in my judgment for disruptive discharges, is a path with no ohmic resistance, but with simply a spark gap or several spark gaps. The discharge will smash the air and form at once a free path for the oscillations.

I desire to make a few quotations from and comments on some recent articles contained in electric journals, and also from some of the underwriters' rules. One article makes the following statement: The use of better materials in electrical work, paradoxical as it may seem, has undoubtedly increased the trouble from lightning. A poorly insulated circuit, such as suffices for 110 or 220 volt work, allows plenty of opportunities for static charges to leak off or discharge to the ground, but the higher grades of dielectrics and the care taken in the insulation of high tension apparatus, keep such circuits so well separated from the ground that the lightning has to break something to find a path."* What is the authority for any such statement as that? The discharge does not leak down through poor insulating material. It will punch a hole every time it gets a chance. I know of many old dynamos that have poor insulating material on them; that is, such material as would not be used at the present day in the construction of a dynamo, and the discharge goes through it every time, making a pin-hole, and the dynamo current follows. If the discharge will leak down through poor insulating material, why does it not leak down through all the incandescent lamps turned on, through the heavy copper wire connection by metallic strips or wires having a conductivity not less erators? It does not do it. The moment the lightning flash occurs the tremendous electrical strain is broken, and the charge tends to establish a new equilibrium, and gives the disruptive discharge every time.

Referring to the rules and requirements of the National Board of Fire Underwriters, I wish to call attention to a point or two. In reference to lightning arresters they say: "Lightning arresters must be connected with a thoroughly good and permanent ground connection by metallic strips or wires having a conductivity not less than that of the No. 6 B. & S. wire, which must be run as nearly in a straight line as possible from the arresters to the earth connection." Why should the Board of Underwriters make such a rule as that, to connect a good-sized copper wire from a line through the arrester, if we are going to put in the arrester an ohmic resistance many times that of the arrester circuit.

In another place they say: "Lightning arresters must be mounted on non-combustible bases, and must be so constructed as not to maintain an arc after the discharge has passed, and must have no moving parts." I would suggest that it would be well to add: And must offer a low resistance to the passage of disruptive discharges.

The Electrical Industries of Sault Ste. Marie.**

BY F. H. CLERGUE.

After welcoming the association to the town, the author spoke as follows:

The progress of electricity has developed this one fact which is familiar to all of those who are practically conscious of the progress of that science, and that is that the power necessary to develop light, heat or electricity, or any other manifestation of force, must be produced by some method more economical than that of steam power, if it is to be applied to those commoner uses of mankind, such as the production of necessary articles of low intrinsic value which the civilized races put most to their uses—the metals.

We now have before us the manifestation that it is cheaper today to smelt common iron worth $12 a ton in an electric furnace than it is to use coke at $4 a ton for that purpose, to produce the same degree of heat. That is a remarkable statement, but it is proven in the twin cities of the Sault.

You are on a journey of great consequence to the region you visit. It is of importance to the community that you should understand what are our relations to the industry which you especially represent. When you pass these locks you will have crossed the threshold of the most important storehouse of wealth on the face of the globe.

The author then referred to the enormous wheat district tributary to Lake Superior, the tremendous quantity of lumber available in the wilderness of Canada north of the lakes, and spoke as follows of the metals:

It is a fact shown by statistics that out of this lock, through which you pass to-morrow, there went last year out of Lake Superior 4,000,000 tons more of iron ore than all Great Britain made into pig iron in twelve months of the same year. The greatest in extent and purest in quality of all the iron ore beds ever discovered are those on the shores of Lake Superior. Steel rails in the United States are produced at a cost of from $4 to $5 a ton less than they are in England. It is a fact that at the Sault the first necessary ingredient, except ore, for the production of coke pig iron, viz., coke, could be delivered to smelters here at Sault Ste. Marie at half a dollar a ton less than coke costs delivered to smelters in Great Britain. Steel plates for ship building on the shores of these lakes are produced and delivered at $7 a ton less than in Great Britain. It is true also that within five years the centre of iron ship building will not be in England, but in America. It is true that on these great lakes, at Chicago, Cleveland and at Superior, iron ship building can be done at a cost of several dollars less per ton than is possible in Great Britain.

The next metal in importance is copper. Except the Anaconda mine in Montana, the largest and most productive mines in the world are those you are about to visit to-morrow at Houghton. These copper mines are of native metal, and the only separation required is a purely mechanical one, which means simply the separation of the rock from the metal. It is true, however, that the copper metal, when separated, contains a very appreciable and very valuable percentage of silver. That silver, however, except where it is found in the veins of copper as native silver, has not yet in that region been utilized, and consequently if you were to take down the copper wires of this town and make an analysis of them you would find that the percentage of silver is so large that with silver at a dollar an ounce, you could afford to take the copper wire down and extract the silver. The only practical way of separating the silver from the copper at a profit is by electrolysis, such is is used at the Anaconda mines. We have recently at our works been approached by some of the principal owners of those mines in the Calumet and Hecla regions, with the suggestions that we receive that ore here and treat it by electrolysis. As a result of that inquiry I had an investigation made and the result is that we are now preparing a 10,000-hp apparatus to be applied to the treatment of the ores of the region in which you are now to make a visit; and if our calculations do not disappoint us we expect to use not less than 30,000 horse-power in the reduction of the ores of the Calumet and Hecla district for the purpose of securing the silver contained.

After copper and iron in the series of metals of low cost, that which has at the present time attracted the most serious attention is nickel. Those of you who have given any attention to metallurgy know very well that the American warships, now engaged in trying to settle a little disagreeable difficulty, are clad with a plate called nickel steel. You will also probably know that the American projectiles which are being used to batter down the forts of the enemy are also made with a nickel-steel casing. The reason why nickel is used for that purpose is the fact that a small admixture of nickel, as 2½ to 3 per cent., in a large admixture of iron, if made into steel and properly tempered, produces a substance very remarkable in its tenacity and in its strength against penetration. The United States Government made a very careful investigation of the subject several years ago and as a result adopted that class of armor plate for their modern navy, and for that reason it is claimed by the advocates of the present American navy that they can stand a battering which no other navy could endure and live.

The copper region I refer to is distant from here only about 100 miles; the iron region 200 and 300. The nickel region exists in the territory of Canada, about 150 miles from here. The present process of treating that ore for use in the arts and for the manufacture of nickel steel and other purposes, has been to treat the ore by chemical processes, by which the crude ore from the mine has separated from it first the silver which it contains in large quantity; second, the copper in smaller quantity, and third, the nickel which is the chiefly valuable ingredient. That product costs actually perhaps 20 cents a pound and the present market price is about 30 cents a pound.

Among other ores which we have tested by electrical processes were, of course, those of the nickel district, and we subjected the product to a series of experiments for the production of ferro nickel and nickel steel directly from that ore. This took some years of investigation, and we made careful inquiry among European metallurgists of skill and experience. But the experience of foreign nations in metallurgical processes, as applied to electricity, has been very limited, and we found little advice to be had, and we were obliged to begin here "de novo" to conduct experiments without scientific advice. The consequences of our experimentation so clearly indicated success that during the past winter I thought it was safe to approach the users of nickel steel and ferro nickel to ascertain what market we could secure for this product. The well-known house of Krupp, in Essen, Germany, is the principal user of this commodity in the world, as in the manufacture of guns and armor its output far exceeds that of any other concern. I visited these works and after a rather technical and scientific discussion of the proposed new product I succeeded in imbuing the scientific staff of that great establishment with the belief that our product would be a success, and with sufficient assurances from them of a market for the product, I returned to our works and continued those experiments. The result has been that within the present week I have received cable advices from Krupp's works, announcing its test of the product of our electrical furnaces here in the line of ferro nickel and nickel steel, and they state to us that their technical and practical tests of our production have been satisfactory, and a contract which I had already negotiated with them, dependent upon the samples proving satisfactory, was by cable confirmed, and we are now about to put 20,000 horse-power on the America side to this new use, the production of ferro nickel and nickel steel.

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*See Electrical World, June 11, 1898.

**Abstract of an address delivered before the Northwestern Electrical Association, June 21, 1898.

Among the industries which we have also fostered and developed here has been the production of calcium carbide. Acetylene gas you are all familiar with, and to-morrow morning, by the courtesy of the owners of those works, you will have an opportunity of making an examination of the process as in use here. That is another illustration, and a very strong one, of what patient application can accomplish in the science to which you are devoting your lives. Calcium carbide, as produced in the electrical furnaces of two years ago, was not a commercial commodity, because it could not be produced at a price which would permit of its use as an illuminating material in competition with ordinary electric lighting, or with ordinary gas. That was the condition of that industry when it first attracted our attention. We secured the services of some people very practical in your science, and chemists to afford necessary chemical assistance, and began not only a scientific but a practical test of what could be accomplished in the electric furnace in the production of calcium carbide. The result of a year or fourteen months' operation was the invention of a furnace by our electrical engineer, who will read a paper to you during some session of your convention, and this process has resulted in the reduction of the cost of calcium carbide nearly 200 per cent. The result of those experiments has been the organization of a company called the Union Carbide Company, which has effected a combination of all the calcium carbide interests of this continent, capital $4,000,000, and a contract between our company and the Calcium Carbide Company has been made for a period of twenty-five years, for the use of 20,000 horse-power and additional from our canal.

While we began in the electrical industry here in the development of new electrical processes, only two or three years ago, we have already accomplished this much, that we are under contract to deliver 40,000 horse-power for electrical uses, all to be supplied within two years. We have already developed on the Canadian side 20,000 horse-power and are about to undertake the construction of another canal on the Canadian side to produce 50,000 horse-power.

It is the fall of 20 feet from Lake Superior to Lake Huron that has created the existing enterprises here, and which gives us such great hope for the future industrial prosperity of this region.

Cutting Submarine Cables.

The daily press lately have published statements to the effect that Spain has threatened to retaliate by severing the cables between the United States and Europe, in case the United States interrupted telegraphic communication with the Spanish West Indian colonies. In a recent issue of the London "Electrician" the futility of such an attempt was pointed out. It would only result in injury to neutral property, without effecting the desired object, and would inevitably lead to heavy claims for damages, to say nothing about the practical impossibility of breaking some twelve or thirteen cables before those first severed are repaired. It is stated on the authority of one of the Atlantic cable companies that it has transmitted readable code words through a cable 500 miles long, broken about midway, by means of apparatus invented by Mr. A. C. Brown.

General Distribution from Central Stations by Direct Currents—II.

BY LOUIS A. FERGUSON.

Uniformity of pressure throughout an incandescent electric lighting system is absolutely essential to commercial success. To accomplish this different methods have been proposed at different times. It often happens that the original plan of distribution, laid out by the constructing engineer, does not meet the requirements, after several years' growth of the business, for in all cities lighting business may localize at certain special points, and so demand a remodelling of the existing system of conductors, or require some means of correcting for the inequalities of pressure that are due to the unevenly distributed load.

In the Edison systems built prior to 1890, it was customary to introduce in series with each feeder a resistance box, with capacity to carry the entire current of the feeder and of resistance much greater than that of the feeder itself. The resistance box is commonly known as a feeder equalizer. From the end of each feeder where it connected with the mains a set of pressure wires was run back to the station and there connected to pressure indicators. The method of regulating was to designate the feeder supplying the most important district in the system, the standard feeder, and to keep its pressure constant, say 110 volts. Each pressure indicator of the other feeders was differentially wound, so as to receive the pressure of the standard feeder as well as the pressure of its own feeder. When there was any difference of pressure between the standard feeder and a given feeder, the latter's indicator needle would deflect to one side or the other according as the pressure on that feeder was higher or lower than the standard, and if equal to the standard, the indicating needle would stand in the centre. If, then, any indicator showed that its feeder was low in pressure, some resistance would be cut out of its feeder equalizer, and, the resistance diminishing, the volts loss on the feeder would then become less, and thus the feeder could be brought to the same pressure as the standard. If the pressure of the feeder were high, the operation would be the reverse.

With this method of regulation, the entire output of the station must be at such pressure at the station switchboard as will permit the delivery of the correct pressure at the end of that feeder, the product of whose load and resistance is greatest in the system. There are some large stations in America operating to-day on this plan of regulation, notwithstanding that it is an expensive and troublesome one. Another method of regulating, which may be employed where the load is fairly well distributed, is by cutting out the feeders which are high and forcing the current to travel through the remaining feeders and the mains, thus increasing the fall of pressure to the end of the feeders which were formerly high.

The only economical and safe way to regulate in a city where the distances are not abnormally great, and where the load is fairly well-distributed, is to so design the conducting system that it will be self-regulating; that is, so that it will require no change of the resistance of feeders or anything of the kind. A good conducting system should have an ample number of feeders reasonably close together, and the connecting mains should be of generous cross-sectional area.

A valuable adjunct to a station, where there are one or two straggling feeders of great length so located that they cannot be interconnected with the general system so that they may benefited by such connection, is what is known among the Edison companies as the "booster." The "booster" is a direct-current dynamo wound for a large current and low voltage, and is used for raising the pressure of the station and of the feeders which are ordinarily low. The booster dynamo should be series wound and so designed that its voltage will be proportional to the current passing through it, the speed remaining constant. It is connected in series with the feeder, whose pressure is to be raised, and is belted to or directly connected with a motor which drives it at the speed for which it is designed. Its action is as follows: The current passing out on the feeder also passes through the field and armature of the booster dynamo, and an E. M. F. is thus added to that already existing on the feeder due to the dynamos of the general system. As the load on the feeder increases, the E. M. F. of the booster dynamo increases proportionately, and adds to that of the feeder, thus overcoming the loss of pressure due to the increased current in the feeder, which enables the feeder to deliver the proper pressure at its mains. The booster may also be employed to raise the pressure of a number of feeders which are connected to an auxiliary bus-bar. In this case, the booster would be connected between the main bus and the auxiliary bus, and would carry all the current of the auxiliary bus, raising the pressure of it as its load increases, and decreasing as the load decreases, as described in the case of the single feeder.

In some central stations two or more potentials or pressures are used, certain dynamos working on a bus-bar at one pressure and the other dynamos working on another bus-bar at different pressures. This method is only economical when the dynamos can be worked very near the maximum load, which is not often the case. In some cities the dynamos in central stations or machinery or storage batteries in sub-stations feed into one general system at different points, each station or sub-station operating at such pressure as will deliver the same voltage at the feeder end of the mains. This is, without doubt, the method to be recommended as giving the best efficiency and assuring reliability of service throughout the system. With the method proposed, in case of accident to any one station, either by fire or lack of water supply, the whole system will not be shut down, but each station will take its share of load which comes from the shutting down of the disabled station.

Municipal legislation in all large cities requires, and very justly so, that the wires for the distribution of electricity for lighting and power purposes should be laid underground. The Edison companies throughout the country use a standard system of underground, the mains and feeders consisting of japanned iron pipe in which are three solid copper wires or rods insulated from each other and from the iron pipe by an asphaltum compound. These pipes, or "tubes," as they are commonly called, are 20 feet in length, the copper conductors projecting 3 inches on each end, making the total length of each pipe 20 feet 6 inches.

The copper conductors are connected together by means of a flexible coupling, composed of a stranded copper cable about 8 inches in length, and having copper terminals on either end, and which are provided with a circular opening of such diameter as will permit the reception of the copper conductor of the tube. The copper terminal is heated by the flame from a blow lamp, and the copper conductor is soldered into the terminal.

After the three couplings are connected, an iron ball clamp is bolted onto the tube near the end, and a cast-iron, oval-shaped coupling box is laid over the copper joint and fastened together by bolts and nuts. The coupling box is then filled with hot insulating compound, and after this has settled by cooling, the box is again filled and the opening covered by plugs.

At each street intersection these tubes enter a junction box. The junction box is a cylindrical cast-iron box, in the centre of which is a cast-iron upright standard carrying three rings of flat copper bar. To one of these rings all of the positive conductors are connected, to another ring all the negative conductors, and to the remaining ring all of the neutral conductors are connected in a similar manner.

Many of the junction boxes are fed by a feeder direct from the central station, the feeder, when Edison tubes are used, being laid in the same manner as the mains before described. The feeders in a three-wire system consist of three conductors, as in the case of mains, with the exception that one conductor which is used as a neutral has usually one-third the area in cross-section of either of the two other conductors. Feeder tubes are made in various sizes, from 250,000 centimeters up to 3,000,000 centimeters. Each feeder tube also contains three small insulated copper wires, which are connected in each coupling box to the corresponding wires in the next tube, thus making a continuous circuit from the feeder end in the junction box at street intersection back to the station. At the generating station these wires connect with a pair of voltmeters, and at the end of the feeder they are connected through flexible straps to the copper rings of the junction box, thus giving in the station the pressure or difference of potential at the feeder end. By means of the coupling boxes the system becomes one grand network of conductors connected together and fed at many points by feeders from the central station, similar to that of a well designed gas or water system in a large city. By means of this network of pipes the electrical pressure is equalized throughout the system, and the current is distributed properly among the feeders. Every mechanical and electrical detail of the system is most carefully worked out and absolutely interchangeable, and it is without question, when cables are used for the feeders, the most complete, most easily operated, and most permanent underground system yet devised for the distribution of electricity for large cities using a direct-current system of 500 volts and under. With this system the customers are almost absolutely certain to have continuous service, as they are fed from two points under ordinary conditions, and should the main in their block burn out, it is nearly always possible for the company to feed the customers from one or another junction box. The method of coupling affords a perfect house-to-house system of distribution, and renders the placing of services a very easy and simple matter. The system is very easily laid down, and its maintenance compares favorably with other methods of distribution.

The maintenance of good pressure regulation at the customers' meter is very much more easily effected with an interconnected direct-current distribution such as has been described, than with the ordinary alternating-current central station system, such as has been exploited in this country. Owing to the parallel operating of direct-current dynamos and distribution systems, the fluctuations in the pressure, due to change over from one machine to another, so prevalent in the ordinary American alternating-current central station, and so annoying to customers, are eliminated, and a carefully operated direct-current central station should show a pressure chart with an average deviation from the mean of less than 1 volt.

It is possible, of course, and often the careless practice in direct-current stations to have bad fluctuations of pressure at the times of change-over, and also irregularities at other periods, but there is absolutely no excuse for their existence in a well-operated and well-planned direct-current system.

The parallel operating of the generators greatly simplifies the maintenance of uniform pressure regulation at the lamps, since when several units are connected to the common bus-bar the regulation for the entire system may be effected by careful attention to one unit, whereas in alternating-current stations where the generators do not operate in parallel it is necessary, in order to even approach the uniformity of pressure regulation which exists in direct-current systems operating in parallel, to regulate the pressure accurately on each unit, which is seldom done in practice. Besides the better regulation possible with parallel operating of the dynamos, a further distinct advantage is derived from the economy effected by proper division of load among the units in the stations, this being particularly marked when the distribution systems are also interconnected. Each unit, irrespective of size, may be usefully and efficiently employed at the period of maximum load, and the amount of idle or uneconomically employed investment is reduced to a minimum.

To illustrate the comparative accuracy of regulation obtainable in an interconnected direct-current system, and in the ordinary type of independent circuit alternating-current system, let us refer to the pressure charts shown in the accompanying diagrams:

Chart No. 1 represents the pressure for twenty-four hours on the direct-current distribution system in the business district of Chicago, the average deviation from the mean pressure is less than 1 volt.

Chart "H" represents the pressure on one of the circuits of a single-phase, house-to-house transformer, alternating-system in Chicago.

Chart "M" represents the pressure regulation of an alternating-current system on a long avenue, where are used primary feeders with four 15-kw transformers, the secondaries in multiple on the three-wire system.

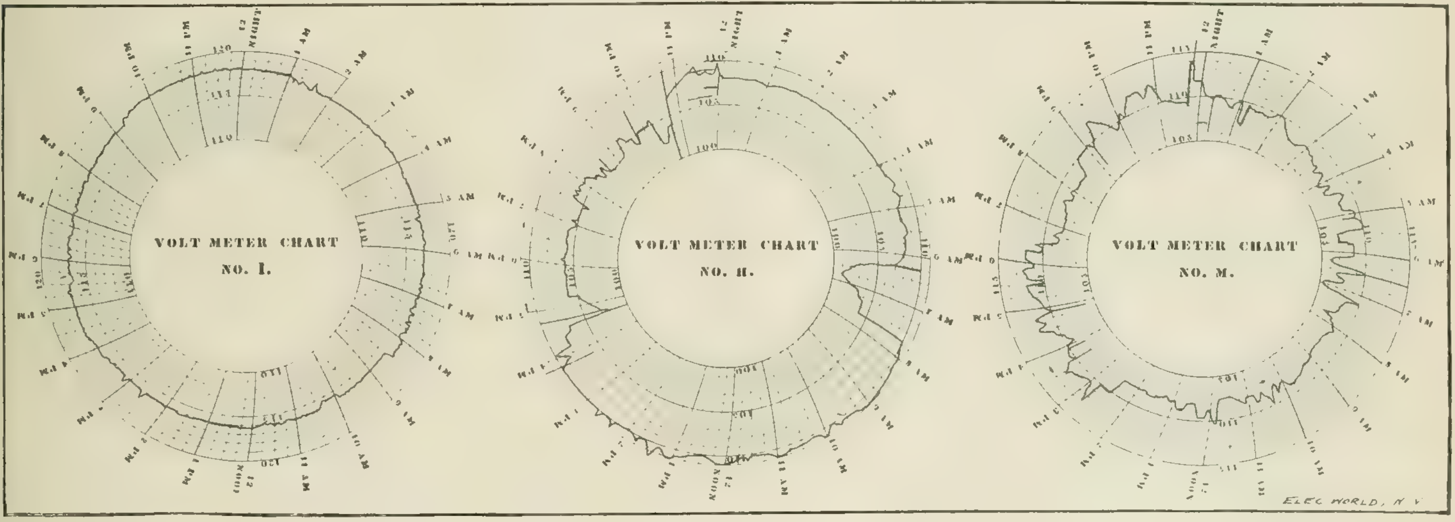
If the engineer, designing a system employing alternating current in the distribution, expects to obtain first-class pressure regulation, he must follow those lines laid down by the engineers who have developed the modern direct-current distribution system. The distribution system of mains should be interconnected, forming one grand network of conductors with large transformers located at points where feeders would terminate if it were a low tension direct-current system, and to these transformers should be brought the primary feeders from the central station, provided with boosting transformers or induction regulators. Pressure wires from the secondaries of the transformers should be brought back to the station, so that the pressure on the ends of the mains may be known and properly controlled. Such a system is described in the paper by Mr. Wagner, and I am sure he will agree with me when I say that the single-phase, house-to-house transformer, separate circuit alternating-current system, such as has been generally exploited in this country, has nothing to recommend it to the central station manager, either from a purely engineering or financial standpoint, although it has fulfilled its mission as a pioneer in the introduction of electric lighting in scattered districts.

One of the advantages to be derived from the use of direct current distribution as distinct from alternating-current distribution, is the employment of storage batteries. They may be adopted for use in various ways, in sub-stations in outlying districts where the load factor of the district is very small, in the central stations themselves to deliver the entire output during period of minimum load, at the centres of distribution for discharging during the peak, or as auxiliaries in rotary transformer sub-stations for discharge use at the time of the maximum load in the main central station. In addition to any one of the various ways in which the battery may be employed, it always acts as a reserve, guaranteeing the consumer good service, in much the same manner as a bank surplus is a guaranty to the depositors in cases of financial emergency.

Storage batteries, when installed in central stations or centres of distribution, are usually connected to the main bus and allowed to float on the system taking a charging current from the bus or discharging into the bus according to the load on the system, the generating units being worked at such load as will insure the best efficiency of the entire system.

Batteries are economically valuable in connection with the distribution of direct current in systems whose load curve has an average peak width of not more than two hours, since the investment required for storage batteries to carry the peak having an average width of less than two hours is less than the investment required in steam and electrical machinery to do the same work. The storage battery also has the same value that exists in the case of moving machinery as a reserve in meeting sudden increases of load, provided such increase of load does not continue for a sufficient period to wholly discharge the battery and insufficient time remain for recharging before the ordinary load peak of the system appears at the regularly appointed time. Such a condition is rarely, and I might say almost never, met with, although in rare instances we may approach this condition.

The steam and electrical machinery is rated by the horse-power or kilowatt, and the duration of the load peak does not influence the value of the investment, since the machinery may be operated for the full twenty-four hours at its maximum capacity. The storage battery, however, is rated by the horse-power or kilowatt hour, and the investment is nearly directly proportional to the number of hours during which it discharges the maximum capacity, so that if we required the battery to be prepared to carry the full peak prolonged for seven or eight hours every day the investment in battery would be enormous as compared with steam and electrical machinery to furnish the same kilowatt hours' output. Illustrative of such contingency, let me refer you to the load diagram marked "D," representing the load in the business district of Chicago, December 20, 1897. This is a very extraordinary curve, illustrating the limitation of the storage battery and the possibility of its being rendered ineffective had the early morning peak extended to the arrival of the regular afternoon peak, without affording sufficient time for recharging the battery.



Pressure Charts.

The storage battery has a very distinct value, which is seldom recognized and employed to its full advantage, when located at the central distributing point of a system with feeders radiating to various points in the network. The battery may be provided with two or more end cell switches, so arranged that they may be connected in multiple and feed into the main distributing feeder bus, or they may connect also to one or more auxiliary bus-bars with a different number of cells in series, feeding into each bus, thus providing two or more potentials at the centre of distribution. It will be found that when only one pressure is maintained at the centre of distribution during the time of maximum load of a large district that the pressure at the ends of the short feeders will be somewhat higher than the standard and they will be overloaded, and at the end of long feeders the pressure will be lower and the feeders underloaded, although the pressure variation at other times may be negligible. Under such conditions the storage battery becomes exceedingly valuable, for by arranging it to operate at two or more potentials, the long feeders may be connected during the time of maximum load to the auxiliary bus or buses and additional current forced over them, utilizing their full capacity and maintaining a uniform feeder end pressure by means of an investment in end cells very slight as compared with the investment in additional feeders and mains required to accomplish the same result.

The direct-current distribution system is very much better adapted to electric elevator work than the alternating-current distribution, and, as far as I am able to learn, there has not yet been developed a commercially successful direct-coupled electric elevator capable of running at varying speeds and operated by alternating currents.

The direct-connected electric elevator is a piece of apparatus which is of the greatest value to the central station companies, since it is practically the key to the isolated plant situation, and with its aid we are enabled in a large percentage of instances to show to the owners of large mercantile establishments and buildings a decided saving in the purchasing from the central station company of electricity for lighting, elevator and general power service as compared with the cost of operating an isolated plant, using hydraulic elevators. The immense advantage to the central station companies, in being able to supply commercially successful electric elevator service economically, may be realized when we consider that there is connected to the systems of the Edison companies in New York, Boston, Brooklyn and Chicago 15,000-hp capacity in direct-connected elevators, representing a gross income of approximately $375,000 annually. At the present time alternating-current distributing systems confine us to the use of continuous running motors belted or geared to the elevator pump or winding equipment; but such an arrangement is not fitted for first-class passenger service and is very uneconomical, and similar equipments using direct-current motors were in use ten years ago, and have long since become obsolete, and have been entirely superseded by the direct-coupled electric elevator which operates for approximately one-half the cost.

The use of low tension constant potential arc lamps connected in multiple to the distribution system has made rapid strides during the past three years, and in New York, Brooklyn, Boston, Chicago and other cities is fast superseding the use of series arc lamps wherever the low tension mains operate, and the day is not far distant when series arc lamps will be employed only in the outlying districts where there is not sufficient business to warrant the extension of the low tension distribution system. The competition effected by the Welsbach gas burner has done much to develop the constant potential arc lamp, and it is safe to say that with incandescent lighting alone the central station companies are rendered helpless against the improved gas burners; but a successful competitor has been found in the use of the 3½-ampere direct-current enclosed arc lamp, and as proof of this we have only to compare the results of the central station companies in the large cities, where these small arc lamps have been employed, with the conditions existing in the small towns, where alternating-current systems of distribution furnish incandescent lighting only. In the latter places the Welsbach light is found to be in general use and is affecting very seriously the earnings of these small central stations, owing to the lack of an alternating-current arc lamp, which would answer the purpose of the small ampere arc lamp used in connection with direct-current systems. Although very much has been done within the last year in the development of the large alternating-current arc lamp, it is still far from being in the state of perfection, and cannot be said to compare practically or economically with the constant potential direct-current enclosed arc lamp.

The use of motor cycles and electric cabs employing storage batteries is becoming more popular every day, and in London and Paris they are used very largely, in Paris an automobile club having been formed by people owning motor cycles. The central station companies using direct current will undoubtedly find a profitable outlet for their product as the motor cycle becomes more popular, and by locating charging stations for the motor cycles along the central station mains the use of the motor cycle will become more extended.

When we consider the many practical advantages inherent to the direct-current system of distribution, which adds so greatly to the commercial success of a central station company, it would seem that the original investment required to establish the plant and system should not be the only question affecting the selection of the system to be adopted.

It is universally conceded by all competent and unprejudiced engineers that the alternating-current system of distribution in a closely settled district, which shall approach in commercial value the direct-current distribution system, shall be one which has for its basis an interconnected system of secondary mains, with transformers of large capacity, and high pressure feeders from the central station to these transformers and generators in the station operated in parallel, as previously described. Therefore the cost of the distribution network in the case of the alternating-current system will not be less than that of the direct-current network, and the cost of transformers, high pressure feeders and alternating-current dynamos should be compared with the cost of low tension feeders and low tension dynamos of the same capacity, these forming the only points of comparison. The investment in each case depends merely upon the advantageous location of the central station in each individual city.

I have shown in the early portion of the paper that, in a large distribution system such as exists in Chicago, 75 per cent. of the total energy supplied to the system is delivered to the business portion of the city covering an area of 1 square mile, the stations supplying this territory being three fifths of a mile from its electrical centre. It is therefore self-evident, since such a large portion of the [illegible] to the desirable location of the central station, that a direct-current distribution system should form the basis of the general system of the company.

It [illegible] operation for alternating-current distribution [illegible] large cities, but rather in the scattered suburban residence districts and small towns where [illegible] remunerative.

The successful central station company of the future will be, as outlined in my paper read before the Association of Edison Illuminating Companies, at its last convention, the one combining intelligently the use of alternating and direct currents, employing direct current in the distribution systems in the thickly settled business and residence districts of a city and alternating current for the distribution systems in the scattered residence districts and surrounding suburbs. The energy will be generated at one or two large condensing stations located where water and fuel may be obtained at the minimum cost and the energy transmitted to the various sub-stations located at the electrical centres of the distribution systems. The choice of low pressure direct current or high pressure alternating current for the transmission to the substations will depend upon their relative distance from the generating stations, rotary transformers or other forms of current rectifiers being employed in the sub-stations which supply the direct-current distribution networks when alternating currents are used for the transmission.

In the discussion of this paper Mr. Ferguson stated in reply to a question that the table of the efficiency of distribution given in his paper was arrived at by taking the ratio between the pressure delivered at the customer's meter and the average station pressure for the year, which is 115 divided by 126.2 volts.* The average drop, he stated, is 11.2 volts or 8.8 per cent.

Mr. Insull, in order to make the matter plainer, stated that his company had a station in the centre of the city in Adams street, where its centre of distribution now is. The company moved 3400 feet from there, so as to have the river on one side of the station and the railway tracks on the other side, to enable it to get free water for condensing and to get coal at the minimum price. It is simply a question of balancing fuel against interest, cost and labor. The reason of the excessive drop here is because of the peculiar local conditions, so it is simply a question of spending money that way in order to save it in another way.

In closing the discussion Mr. Ferguson stated that it was only fair for him to say in the interests of the various Edison central stations that are running throughout the country that the figures which he gave in his paper do not fairly represent the average Edison central station, but are really less favorable than might be shown by the average Edison central station in regard to the question of efficiency alone.

The West Indian Cables.

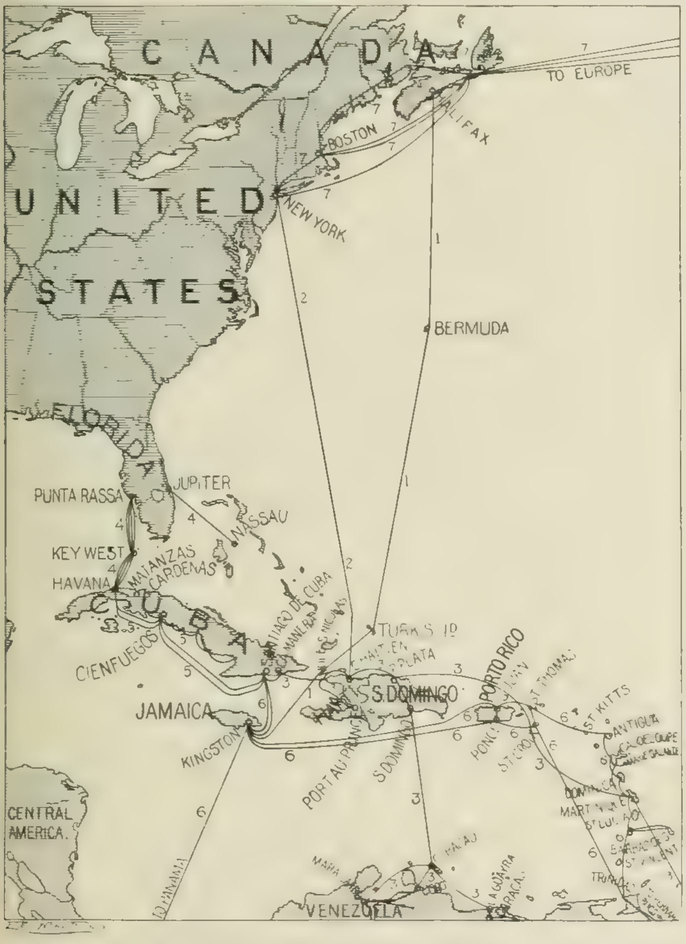
About two weeks ago the cable of the French West Indies Cable Company, between Guantanamo, Cuba, and Mole St. Nicholas, Hayti, was cut by order of the commander of the American squadron now in those waters. The cable was repaired on June 21 by the Cable Company, and communication is now established practically direct between a temporary cable station at Playa del Este and New York, and thence to Washington. By reason of the fact that the American army has landed and established a base of operations on Cuban soil near Guantanamo, and that the territory so occupied is regarded as American soil, the American Government has assumed a censorship over the business going over the repaired cable. These new facilities, the establishment of which was happily timed with the landing of the invading army, will be of immense advantage to the Washington officials.

Since very active war operations will likely soon take place at Santiago and other Spanish West Indian ports, we have prepared an accurate map, showing the location of the various places that are just now figuring so prominently in the campaign. The main object of the map, however, is to show the submarine cable system of the West Indies in a manner so clear and distinct as to make it valuable for reference. In addition to the routes of the various cables, the cables of the different companies are numbered and keyed, so that the lines can be identified. The map was prepared by the Commercial Cable Company, and is accurate. The Western Union Telegraph Company, it will be seen, has four cables from Punta Rassa, Fla., to Havana, touching at Key West. These, however, are under the censorship of the American Government. The cable cut and repaired belongs to the French West Indies Cable Company, and runs from Santiago to Guantanamo, to Mole St. Nicholas and Cape Haytien, Hayti, and Puerto Plata, San Domingo. At the latter point the system branches off in

* [illegible] higher efficiency than the ratio of the watt hours [illegible] customer's meter to the watt hours sent from the switchboard, owing to the fact that the increased drop at high loads is on an increased [illegible]

two directions, an overland line going to San Domingo, thence to Venezuela, under the Caribbean Sea, and a submarine cable running to Martinique, thence to Paramaribo. At Cape Haytien connection is made by the cable of the United States & Hayti Telegraph & Cable Company, which runs direct from Cape Haytien to New York. The landing place of this cable at the New York end is at Coney Island. According to the best information, Captain-General Blanco has only one cable outlet available for communication with Madrid. That is one of the cables of the West India & Panama Cable Company, between Santiago and Kingston, Jamaica. There are two cables between these points, but one of them was recently cut by the Americans.

It is stated that arrangements have been made with the Hayti Cable Company by which messages sent over the Guantanamo line from Playa del Este to Hayti will be transmitted to New York promptly, so that a message can be delivered to the Secretary of War or Secretary of the Navy at Washington within fifteen minutes. The same promptness is assured in sending dispatches in the opposite direction. At Playa del Este the most rigid censorship will be exercised, but the French company will be allowed to transmit commercial messages.



Map of West Indian Cable System.

1—Direct West India Cable Company. 2—United States & Hayti Telegraph & Cable Company. 3—French West Indies Cable Company. 4—Western Union Telegraph Company. 5—Cuba Submarine Telegraph Company. 6—West India & Panama Cable Company. 7—Commercial Cable Company.

Regarding the cable between Guantanamo and Cape Haytien, which touches at Mole St. Nicholas, it is stated that the office at the latter place will likely be cut out and that Government messages will be sent directly from the United States military office at Playa del Este to Cape Haytien, thus saving the time consumed in repeating dispatches at Mole St. Nicholas.

The Possible Light of the Future.

It has been estimated that about 250 times as much light might be obtained per watt than at present, if we knew how to convert it. About ten times as many watts might be obtained from the coal as are at present obtained by means of the steam engine, if we only knew how to do it. By combining both of these possible processes we may some time in the future be able to get 2500 candles with the coal now required for one candle. Besides these prospects there is a further possibility of extracting heat from even cheaper sources than coal.

Mechanical Draft.*

By W. B. Snow.

The substitution of the fan for the chimney as a means of draft production marks a distinct advance in the convenience and economy of steam generation. It is, therefore, fair to assume that a discussion of mechanical draft must be of particular interest to all who are concerned in central station management. Although the advantages of many improvements are to be viewed solely in their direct commercial relation, such is not the case with mechanical draft. Not only does its application insure an evident economic gain, but in both its installation and operation there are certain conveniences which are to be considered as distinct advantages, although it may be almost impossible to determine their definite economic values.

Mechanical draft may, in stationary practice, be applied in either of two ways: First, by forcing the air into a closed ashpit, and maintaining therein a pressure in excess of the atmosphere; and second, by exhausting the air and gases from the flue or uptake and thereby creating a partial vacuum, which causes a constant inward flow of air in the combustion chamber. The former is designated as "forced draft" and the latter as "induced draft." Under certain conditions a combination of the two methods may be found desirable. The natural result of the application of a centrifugal fan in either manner is to render the draft conditions positive at all times. A fan of the disc or propeller type is entirely inadequate for such work.

On the erection of a chimney the first matter to receive consideration is the foundation. This always represents a comparatively large, and in the case of unstable ground, an abnormally excessive proportion of the expense of the entire structure. A fan, on the other hand, is relatively light, requires no expensive foundation, and may in many cases be located upon the top of the boilers. Not only does this vastly reduce the cost of installation, but it furthermore lessens the space required, which is always a definite character in the case of the chimney, but with a fan placed overhead is entirely eliminated.

The portable character of a mechanical draft apparatus renders it not only valuable as an available asset, when it is no longer required in a given location, but makes possible its relocation or arrangement in a manner that is absolutely impossible in the case of a chimney, which must always stand as a monument to a departed industry or an abandoned means of draft production.

The primary duty of the chimney is to create sufficient draft, while its secondary office is to remove the gases and smoke to a proper height for discharge to the atmosphere. The height required for this purpose is almost universally less than that necessary to produce the draft. Obviously a stack of decreased height and cost will serve the purpose with mechanical draft. In fact, a sheet iron pipe extending but a few feet above the top of the boiler house will in most cases fulfil the requirements.

The steel plate construction which is common to most fans employed for producing draft makes it possible to readily design and build them to exactly suit any given conditions. Such a fan may be arranged to be driven by a belt or by a direct-connected engine, as may be desired, may be automatically controlled in its speed to meet the requirements of steam generation, and may be increased in capacity by the simple transmission of more power.

In operation mechanical draft is both positive and flexible. Its positive character renders its action independent of the weather, and its flexibility lends to it that characteristic so lacking in the chimney, the ability to exactly adapt the intensity of the draft, as well as the volume of air, to the existing requirements. How much those two elements of simple convenience mean in the generation of steam for electric traction work can only be realized by one who has experienced the sudden and immense fluctuations incident to such service. The fan is always at its best, can be instantaneously pushed to its utmost and does not have to wait for hotter fire to produce stronger draft. When properly installed, such a fan should be provided with an engine devoted solely to its driving, and the speed of this engine should be so controlled by devices that are readily applied as to increase its speed in proportion as the steam pressure falls. It is thus possible under all ordinary conditions to maintain practically constant steam pressure and to insure immediate response to sudden demands.

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*A paper presented before the Northwestern Electrical Asociation, June, 1898.

Notwithstanding the immense heat losses incident to the use of a chimney, and the discharge of the waste gases at a sufficiently high temperature to create the requisite draft, the engineering public has been comparatively slow in availing itself of the advantages of some form of heat abstractor, by which at least a portion of this loss can be prevented. The reason is evident in the fact that the increased resistance thus introduced and the lower temperature of the escaping gases necessitates a chimney of considerably greater height to produce the same draft. The fan, however, lends itself most admirably to introduction under these conditions. The very factors that operate against the chimney are distinctly advantageous to the fan, if of the induced type, for the lower the temperature of the gases, the smaller the fan and the less the speed to produce the same results.

Another feature of convenience resulting from the employment of mechanical draft is to be found in the ability to burn cheap fuels which are almost invariably of small size and require an intensity of draft which is not readily created by means of a chimney. The economic value of this and the preceding features of convenience will be considered as we proceed.

The "smoke nuisance" is in many of our communities receiving the attention that it properly deserves. In practically all devices which have proved successful in the prevention of smoke, improved draft has been a most important factor and the positiveness and intensity of the draft produced by a fan have assured the success which has attended its application.

We may now turn to the distinctly economic aspects of the installation of mechanical draft, and of necessity these must be considered relatively to those incident to the use of a chimney. Employed solely as a means of creating air movement the chimney is most absurdly inefficient. It may be readily shown that under the ordinary conditions of boiler practice an engine-driven fan will move a given amount of air with the expenditure of about one-seventy-fifth as much power. This immense advantage of the fan over the chimney may be turned to good account by introducing proper devices for transferring the heat of the gases to the feed-water or to the air supplied to the fire, and the gases may, with fan draft, be cooled to a temperature far below that which could be attained with a chimney without too seriously reducing its draft. Tests of nine large boiler plants equipped with economizers and mechanical draft are reported by Roney to have shown on an average a saving of about 14 per cent. In connection with a plant of such size the steam required for the operation of the fan, with an efficient engine, can be kept within 1 per cent. of that generated by the boilers to which it is applied.

Custom and the expense of high chimneys are, doubtless, responsible for the comparatively low combustion rates which prevail in most steam plants. It may be fairly stated that to double the rate of combustion on a given grate area, it is necessary to make the chimney about three times as high, at a cost, perhaps, five times as great. In the case of a fan the same result could be obtained without even so much as doubling the cost. This clearly points to the economy to be secured by properly designing the boilers, increasing the combustion rate and securing a greater output from a given size boiler and for a stated investment. Low combustion and evaporation rates are not essential to high efficiency. Within reasonable limits the higher the rate of combustion, the less is the volume of air required per pound of coal. The fire is of necessity deeper, the draft is stronger, and each individual particle of air has increased opportunity to come in contact with the fuel. With a decreased supply of air the intensity of the fire is increased, its temperature is higher, more heat is radiated to the exposed boiler surfaces and [illegible] ume, move at lower velocity and thus have more time to part with [illegible] & W[illegible] boilers [illegible] pounds per square [illegible]

[illegible]

[illegible] water-tube boilers, two economizers and a chimney 8 feet in diameter by 180 feet high. The latter is located just outside the boiler house wall. If a duplex induced mechanical draft apparatus, each fan capable of operating the entire plant, should be substituted for the chimney, it could be placed immediately above the economizers, and with its attached engine could be rigidly supported by beams resting on the economizer walls. A short stack would serve to discharge the gases above the roof.

The cost of the chimney, with damper regulator and dampers, is $9300; that of fans, engines, draft regulation and short stack, installed complete, would be about $3500, or only 38 per cent. of the draft producing apparatus for which it is substituted. That is, the saving would be $5800.

With the increased draft produced by the fans it would be possible to raise the combustion rate and the steaming capacity, or what is equivalent, the steam capacity might be maintained with a less number of boilers. Suppose one of the eight boilers be omitted from the original design, making the plant 1400 nominal horse-power, a further saving of about $4000 may thus be secured.

If the land be valuable, the reduction of space incident to the employment of mechanical draft may have an appreciable effect. If worth say $2 per square foot, the saving by omission of chimney and one boiler would be about $2000. The total saving in first cost resulting from an expenditure of $3500 for mechanical draft may thus be shown to be $11,800; that is, the saving is nearly three and a half times the expenditure necessary to secure it. Obviously there is a coincident reduction in the fixed charges for interest and taxes.

The power expenditure for operating the fans should be practically inappreciable in any well designed plant in which provision is made to utilize the exhaust steam from the fan engine.

The most direct saving in operating expense which may be secured by the introduction of mechanical draft is that resulting from the utilization of cheaper fuel. Such a plant as previously described would, under good conditions, probably, require at least 8000 tons of high-grade coal per year, operating ten hours per day. If a saving of only 25 cents per ton could be effected it would represent an aggregate of $2000 per year, a pretty good return on an investment of $3500. But in many cases much greater savings may be brought about. A case in point is that of the United States Cotton Company at Central Falls, R. I., where, with a 1000 horse-power boiler plant, the fuel originally employed chimney draft was George's Creek, Cumberland, costing $4 per ton. With forced draft, a mixture of No. 2 buckwheat screenings and Cumberland is now used, costing $2.62 per ton. The saving has been about $125 per week, enough to pay for the special steam fan in about six weeks.

Other direct and indirect advantages of mechanical draft might be presented, but the limits of the paper will not permit. If it were not for its rough and ready character, the chimney would long ago have been discarded, because of its wastefulness. In the search for the highest efficiency such waste can no longer be ignored, and when dollars and cents are concerned crude methods must give way to those of greater refinement. It is for this reason that the most progressive engineers of the present day are not only considering but adopting mechanical draft as a substitute for the chimney.

Efficiency Tests of Bichromate Cells.[*]

Two distinct types of cells were tested, namely, the Fuller type and the Grenet type. The exact style and dimensions of the cells which were tested are shown in Figs. 6 and 7. The heavy conical zinc of the Fuller cell was replaced by a thin zinc plate, as shown in Fig. 6, which exposed practically the same amount of surface as the conical zinc. The balances at our disposal were of insufficient capacity for weighing the heavy conical zinc.

The zinc was in every case thoroughly amalgamated and the period of each test was one hour, starting in each case with fresh solution, which consisted of 1 gram $K_2Cr_2O_7$; 14 grams H_2SO_4, and 8 grams water. The current was kept constant during the run, the terminal E. M. F. of the cell was observed at equal intervals of time, and the zinc plate was weighed before and after the run.

Chemical Efficiency.—The amount of zinc consumed in the proper function of the cell was in each case calculated from the known value of the current, the time, and the electrochemical equivalent of zinc. This is called the useful consumption of zinc, and the ratio of useful consumption to total consumption of zinc is called the chemical efficiency of the cell. The difference between total consumption and useful consumption is called waste zinc. The chemical efficiency approaches 100 per cent. for very large currents, partly because the useful consumption increases and partly because the waste consumption, due to local action, actually decreases, as shown in Figs. 2, 3 and 4.

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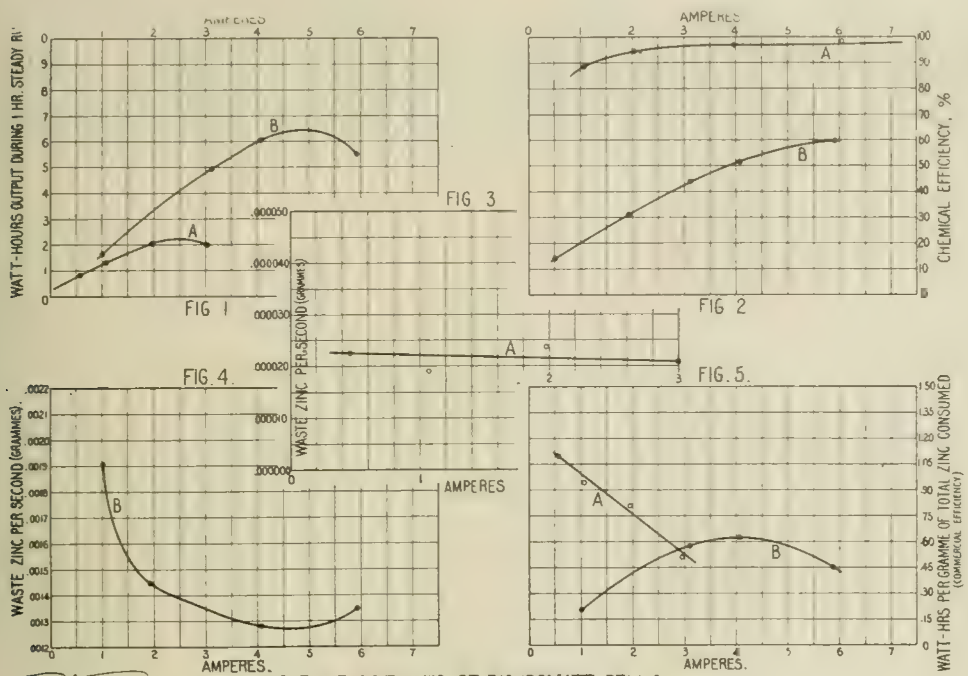
[*] Abstract of Thesis in Electrical Engineering, Lehigh University, '98. Wm. Gratz and H. C. Schwecke.



EFFICIENCY TESTS OF BICHROMATE CELLS

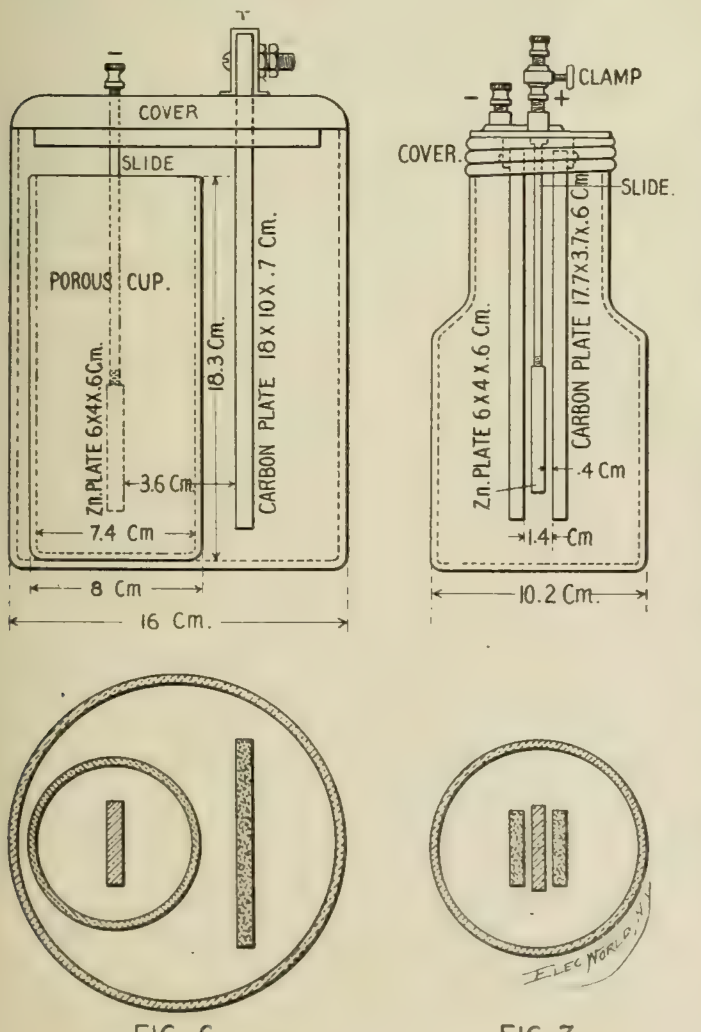


FIG. 6. FIG. 7.

EFFICIENCY TESTS OF BICHROMATE CELLS.

The commercial efficiency is in the watt-hours delivered to the external circuit per gram of zinc consumed (total). Fig. 5 shows that the Fuller cell has its maximum commercial efficiency for a current less than half an ampere, while the Grenet cell gave its maximum commercial efficiency for a current of about four amperes. Fig. 1 shows watt-hours output for various currents. The Fuller cell delivered a maximum of work to the external circuit for a current of about 2½ amperes and the Grenet cell delivered maximum work for a current of about 5 amperes.

The Convention of the Independent Telephone Association.

During the present week (June 30, July 1 and July 2) the Independent Telephone Association of the United States will hold its second annual meeting at the Palmer House, in Chicago. The announcement of the meeting simply states that it will be a "business meeting," and that anyone interested in independent telephony may join as members. Judging from the character of the association and its objects as laid down in its constitution, there will no doubt be plenty of "business" to which the meeting will be called upon to give its attention.

The association was organized in Detroit on June 22 and 23 last year, ninety-nine independent exchanges and twenty-one manufacturing concerns being represented. A constitution was adopted.*

Judge James M. Thomas, President of the Independent Telephone Association of the United States.

The objects of association as set forth in this instrument are: 1, the protection of all independent telephone interests of common concern to the members of the association; 2, the protection of subscribers to telephone apparatus operated by members of this association; 3, the bringing about a reasonable charge for tolls and the rental of telephones, so that the telephone may be within the reach of the masses of people; and, 4, the bringing about a complete system of inter-municipal communication and long-distance trunk lines.

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*See page 8[illegible] of The Electrical World, June [illegible].

DIGEST OF CURRENT ELECTRICAL LITERATURE

AMERICAN AND FOREIGN

By Carl Hering

Dynamos, Motors and Transformers.

STARTING AND REGULATING MOTORS. Menges. "L'Eclairage Elec.," June 5.—An illustrated description of his method as compared with those of Mueller, Fischer-Hinnen, Cutler and Egger, all of which, including the present one, have already been noticed in the "Digest," for most of which, however, the references were to German journals.

CALCULATING THE EFFICIENCY OF TRANSFORMERS. Aliamet. "L'Elec.," June 11.—Knowing the several losses in a transformer for a given charge, the efficiency at that load, as well as at other loads, can be calculated by the well-known formula, which, however, is rather complicated. He describes the simplification of this formula suggested by Johannesen.

CLAMPING COMMUTATOR SEGMENTS.—Lond. "Elec. Eng.," June 3.—Descriptions of methods for clamping and chucking them, before boring.

Lights and Lighting.

LOCOMOTIVE HEADLIGHTS.—"Eng. News," June 16.—A well illustrated description of the Pyle electric headlight, which, after numerous experiments, is in use on more than 200 locomotives. The engineer can see obstacles half a mile distant, and owing to the reflection in the sky and on the clouds, the light can be seen for a distance of 10 miles in a level country and 3 or 4 miles in a rough country; these headlights are now classed as a safety appliance. An objection was raised to the fact that it would be difficult for the engineer to distinguish the different colors of the signal lamps, but experiments have shown that red lights show even more distinctly and that there is no diminution in the brilliancy of green or white lights. The small dynamo, developing 25 amperes at 40 volts, is driven by a direct connected steam turbine, the whole apparatus weighing only 250 pounds; the dynamo also supplies current for incandescent gauge lamps in the cab; the arc light has an intensity of 4000 cp.

Power.

STEAM USING PLANT. Jeckell. Lond. "Elec. Eng.," June 10.—A reprint of a long Municipal Electrical Association paper, with the discussion.

YUBA-MARYSVILLE TRANSMISSION.—"Jour. of Elty," May.—A very long, well illustrated description of this plant. The distance of transmission is 12.5 miles to Marysville and 7.25 to Brown's Valley; there are three two-phase generators of 360 kw each, directly driven by Pelton water wheels; the frequency is 8000 per minute, and the voltage is 1200 or 2400, which is transformed up to 16,700 for transmission; the flume is nearly 8 miles long, and the canal 23 miles. All the engineering data is given in a condensed form.

30,000-VOLT TRANSMISSION.—"Jour. of El'ty," May.—Descriptions of some tests made with the Yuba plant, described above. Some experiments were made with 30,000 volts on the line; when the wires were not more than 2.75 inches apart the arc would jump [illegible] but after changing the distance to 18 inches there was no further trouble; under these conditions the charging current of the line was 2.25 amperes; the drop in voltage was 250, of which [illegible] could be accounted for by resistance, the [illegible] to line inductance and capacity. [illegible] thrown open when the volt[illegible] at the time is not stated). [illegible] not arc, showing that [illegible] no static discharge or [illegible] at these voltages. The experi[illegible] the practicability [illegible]

[illegible] NIAGARA. [illegible] "West. Elec." [illegible]

[illegible] NIAGARA. [illegible]

Traction.

[illegible] OF RAILWAY MOTORS.—Lond. "Elec." [illegible]

done; the question raised about the point on Carus-Wilson's curve, where the acceleration ceased to be uniform, was an important one; Taylor's remarks are explained more fully in a communication to that journal and the Lond. "Elec. Rev." Smith endorsed the American method of rating motors by their force-power as distinguished from their horse-power; the calculations in the paper were based on the assumption of a constant train resistance; while the internal train resistance is approximately constant the external resistance is not so; even the internal resistance varies greatly at the first moment of starting; the calculations are for covering a certain distance in a certain time, but there is another point of value, and that is how to get the work done as quickly as possible with a minimum stress on the machinery, and on this basis he thinks that it would be found that uniform acceleration up to the point at which retardation began was the best law to follow, and that this should be followed by a uniform retardation. Ayrton also favored the American system of rating motors; he called attention to a number of errors and inaccuracies in the paper; he thought one consideration had been ignored, namely, the fact that the train was not going on forever, but that it was going to stop, and the calculations should be made for going from one stopping place to the next in the minimum time; an interesting result arrived at was that by rightly proportioning the air gaps and the velocity ratio results could be obtained approaching very nearly to the greatest possible economy. Grove complained that the paper was full of assumptions, some of which he thought must be wrong. In his reply Carus-Wilson said among other things that as the distance increases the series-parallel control becomes of less advantage; he disagrees with Short on the subject of constant acceleration; while Short made a quicker start by a few seconds, the consumption of energy is much greater than with the ordinary control.

DESIGN OF RAILWAY MOTORS. Carus-Wilson. Lond. "Elec.," June 10.—A brief reply to the recent criticisms in that journal (see "Digest" last week). He did not consider the motor only at rest, but showed also how the conditions of motion may be stated in terms of the force unit; the assumption that the acceleration is to be constant up to full speed was made only with the object of leading on to a case of varying acceleration, and the most important conclusions related to the advantages gained by varying acceleration. The principal obstacles to carrying out the design according to the theory are the limited clearance and weight of the motor.

ELECTRIC CARS ON STEAM RAILROADS.—Lond. "Elec. Eng.," June 3; abstracted from "Moniteur Industriel."—The Northern Railroad of France is about to introduce electric motor cars to supplement its suburban traffic. These cars are to be used on trains traveling a longer distance and will avoid frequent stoppages, as the electric car will be uncoupled at the stopping place, from which it will proceed by itself to the minor stations, leaving the train free from the delays due to stopping at unimportant places. The power for the motor cars will be supplied by accumulators; the total weight of the car is 15,540 kg, the accumulators weighing 4800 kg; trials have shown that a pull of 0.80 per ampere is obtained at the circumference of the wheel. The 50 passenger cars weigh 24,000 kg, of which the accumulators weigh 5500 kg.

MONTMORENCY.—"L'Energie Elec.," June 1.—A long, illustrated description of this line near Paris.

STOCKHOLM. Dahlander. "Elek. Zeit.," June 9.—A brief illustrated description of a suburban line about 7 miles long. The gauge is less than one meter, and the grades up to 4.8 per cent. are quite great; a train carries 150 passengers at a speed of 40 km per hour, thus requiring 120 to 140 horse-power. The conditions involved a number of difficulties, one of which was the arcing at the sliding contact; the trolley wheel is replaced by the contact bar; a battery of accumulators is used to equalize the current. The total weight of the new motor car is 20.5 tons; triple reduction gearing is used, the gearless motors on the first car having been abandoned; there are four motors to the car, each having four poles, only two of which are wound. Some illustrations of the motor and the car are given; the two motors on the same truck are always connected in parallel; when two motor cars are coupled they are connected with a cable containing nine wires, so that both are operated from the same controller.

MOTOR WAGON TRIALS AT LIVERPOOL.—"Eng. News," June [illegible].—A brief account from Lond. "Engineering" and "Engineer" of the recent competition of motor vehicles adapted to heavy loads.

WIRING CARS FOR DECORATIVE LIGHTING. Harding. "St. Ry. Rev.," June [illegible].—An illustrated description of the method used by a Chicago line, by means of which the wiring may be quickly put in place or removed.

ELECTRIC LOCOMOTIVES.—"Eng. News," June 16.—The following table compares the general features of the B. & O., the London Central and the Hoboken Shore Line, electric locomotives:

	London Central.	Balt. & Ohio R. R.	Hoboken. Shore R. R.
Service	**Rapid transit.**	**Heavy freight and passenger.**	**switching.**
Length	30 feet 0 inches	35 feet 0 inches	20 feet 0 inches
Width	7 " 8 "	9 " 0¼ "	8 " 0 "
Height	9 " 4½ "	14 " 3 "	13 " 0 "
Wheel base, rigid	5 " 8 "	6 " 10 "	5 " [illegible] "
" total	20 " 4 "	6 " 10 "	18 " 2 "
Wheels, diameter	3 " 0 "	5 " 2 "	3 " 3 "
Motors, number	4	4	4
" H. P. total.	800	1,280	540
Speed,* miles per hour	27	12 to 30	8
Weight, pounds	84,000	192,000	57,000
Hauled, tons	105	1,200 to 1,900	295

* With load.

Installations, Systems and Appliances.

SINGLE VS. MULTIPLE GENERATING STATIONS. Snell. Lond. "Elec. Rev.," June 10.—A reprint of his short Municipal Electrical Association paper. It is also briefly discussed and criticised editorially. He discusses the question of supplying a district from one or from several generating stations, and favors the latter; when only one station is used it would in most cases be located in the outskirts of the city. As to the limit of the power for one station, he quotes the opinion of Kennedy, expressed several years ago, that the critical limit lies somewhere between 3000 and 5000 horse-power; he appears to agree with this. He thinks the ideal to be aimed at is the direct current system, with its simplicity and the possibility of storage; he considers it unnecessary to build stations outside of a town; the capital cost favors the location directly on the so-called centre of gravity of the system; the lower the pressure adopted, consistent with economy, the safer and more reliable the supply; multiple stations with simple radiating feeders appear to provide the simplest system obtainable; multiple stations are not any more expensive to construct than single stations, and he cites the London companies as examples; the load factor scarcely enters into the argument, as it may even be better for multiple stations than for one distant one; the question of the nuisances are also discussed. In making extensions, therefore, the most natural method is to prospect new areas with high current direct current from sub-stations, so designed that ultimately they may become part of the general network into which the second or other stations will ultimately feed, these taking the place of the temporary substations.

SWITCHBOARD APPARATUS. Blaikie. Lond. "Elec." and "Elec. Rev.," June 10; briefly abstracted in the "Elec. Rev." A reprint of a long Municipal Electrical Association paper. It is of a practical character, giving many hints regarding the construction of switchboards. He claims that the essential characteristics in the design of a board are, that the operator is not in danger, that no arc shall be maintained, that the contacts shall not be burned or injured, and that no heating shall occur at the contacts; the paper does not admit of being abstracted briefly. Among other things he suggests a list of lengths of breaks for various voltages and currents; he suggests the use of a paint which changes color on heating, on contacts which have to carry large currents; copper fuses on the switchboard seem to be recommended. Ammeters, voltmeters, rheostats, switches and synchronizing apparatus are each discussed separately, as is also the general arrangement of the board; he urges standardization of switchboards and seems to favor the American method of unit panels. The discussion is published in the Lond. "Elec. Eng."

MANAGEMENT BY LOCAL AUTHORITIES. Hesford. Lond. "Elec. Rev." and "Elec. Eng.," June 10.—A reprint of a Municipal Electrical Association paper; the discussion is given in the latter journal; some comments of a partially unfavorable nature are given editorially in the Lond. "Elec. Rev." He favors the operation of central stations by municipalities. He urges the cheapening and perfecting of the means of distribution, claiming that the electric light will be popularized when more attention is given to this subject instead of to the improvement of steam engines and boilers; most failures have occurred in the distributing plant as distinguished from the boilers and engines.

ECONOMY IN CENTRAL STATION MANAGEMENT. Summerfield. Lond. "Elec. Eng.," June 3.—A short article pointing out directions in which economy should be exercised. He refers almost exclusively to the steam generating plant.

LEGISLATIVE CONTROL.—Lond. "Elec.," June 10.—A reprint of the report of the committee of both Houses of Parliament concerning the law of electric generating stations and supply business; it is also discussed editorially.

CENTRAL STATION ACCOUNTS.—Lond. "Elec.," June 10.—An analysis of the accounts of the Hammersmith station.

MUNICIPAL ELECTRICAL ASSOCIATION.—Lond. "Elec. Eng.," June 10.—A report of the proceedings of the third annual meeting, together with reprints of the papers, which are noticed in the "Digest" under special headings. Portraits of the president and council are given in a supplement, accompanied by brief biographical sketches. The presidential address by Gibbings is reprinted, and deals chiefly with the work of the association, giving in conclusion some suggestions on the subject of standardization of the plant. A brief account of the proceedings is published in the Lond. "Elec. Rev." The presidential address is also published in Lond. "Lightning," June 9.

SWITCHBOARD. Rosebrugh. "Can. Elec. News," June.—An illustrated description of the switchboard in the laboratory of a school in Toronto.

Wires, Wiring and Conduits.

INSULATION RESISTANCE OF LEAKAGE CURRENTS. Russell. Lond. "Elec.," June 10.—He calls attention to the importance, in the risk of fire, in knowing what power is being expended along the various leakage paths in watts; as leakage takes place along many paths, it is not possible to find the individual leakage path, but it is possible to find what is the maximum possible leakage current, and this he considers the proper object of tests on the wiring of a building; it is the leakage in watts and not the insulation resistance which should be found. The danger to fires depends on the volts, and with the same insulation resistance it is proportional to the square of the voltage; thus the insulation resistance of a 200-volt circuit should be four times that of a 100-volt circuit. He then shows how the leakage watts in a two-wire installation may be calculated from simple measurements of the insulation resistance between each wire and the ground; there may also be a leakage directly from one main to the other, which does not pass through the ground; the resistance should be measured of one main when the other is grounded; the same for the other main; and finally the resistance between the mains which is in parallel to the two other leakage currents in series; the test is first made with the switches turned off, with all the lamps in position, and second, with the switches on and all the lamps out of their sockets; the leakage watts are then equal to the square of the voltages divided by these resistances. In every day practice generally only the insulation resistance of the wiring to earth and that between the two mains are measured, and there is no great objection to this for a two-wire system, but in a three-wire system this method of fixing a maximum value to the leakage current to earth fails; he then discusses with the aid of simple mathematics how the leakage watts in a three-wire installation may be determined; he divides the leakage losses into six, and for a given total leakage the danger to fire would be a minimum when these six values are nearly equal. He then discusses the leakage currents in a three-wire distribution network, and shows how the maximum value of the leakage watts may be determined. The insulation rule is discussed and the inconsistency is shown in that the resistance should be doubled instead of being made four-fold, when the voltage is doubled; the rules which consider leakage currents are more instructive than those which consider insulation resistance; he thinks it will be better to state the maximum watts which it is permissible to waste between the mains themselves and the earth; he suggests that the leakage watts from either main to the earth or from one main to the other should not be greater than the thirty-thousandths part of the maximum watts supplied to the installation. Regarding the distinction between leakage for direct and alternating currents he believes that most electricians will agree that the leakage watts allowable in the two cases ought to be the same for the same power supplied.

MOST ECONOMICAL CROSS-SECTION OF TRANSMISSION CIRCUIT. Bull. "Elek. Zeit.," June 9.—A mathematical article in which he develops a formula based on the well-known Lord Kelvin law, but reduced to a comparatively simple form; one of them gives the loss and the other the cross-section. These are based on an equation for the price of a kw-hour in a secondary circuit, on expressions for the factors in this which depend on the cross-section, and lastly on the finding of the conditions under which the price per kw hour in the secondary circuit becomes a minimum. Such factors as the frequency and the phase shifting are also included. The final formulas appear relatively simple, but cannot be reproduced here without enumerating the numerous factors which have been introduced.

MUNICIPAL OWNERSHIP OF WIRES.—"Eng. News," June 16.—A note stating that according to a recent ordinance the city of Baltimore will build, own and operate subways for electric wires, and that the overhead wires will therefore be removed. An electrical commission is provided for, which is empowered to construct the subways and to compel overhead wires to be taken down; those using the subway must give a bond at the rate of $100 per mile of duct; a sum of $1,000,000 is provided for this work.

Electro-Physics and Magnetism.

COHERERS. Pasquini. "Nuovo Cimento," March; abstracted briefly in Lond. "Elec.," June 10.—A study of the properties of various types of coherers. He concludes that they must have a certain freedom of motion among their particles; the latter should be large rather than small; mixtures of two metals are more sensitive than of a single metal; the change of resistance is greater when in a circuit than when insulated; "the wires have indeed a great deal to do with the disturbance;" even when the coherer is insulated some wire appendages will considerably increase its sensitiveness; a coherer will not re-act if enclosed within a metal case, but a very small opening in the case allows the waves to produce an effect.

PASSAGE OF ELECTRIC WAVES FROM ONE CONDUCTOR TO ANOTHER. Gutton. "L'Eclairage Elec.," June 4.—A reprint of an Academy note.

RETARDATION OF SPARK DISCHARGES. Wesendonck. Wied. Ann.," No. 5; abstracted briefly in the Lond. "Elec.," June

10.—He measured the potential at which the discharge from a gilt needle point begins in hydrogen. He found that the negative discharge potentials in hydrogen lie between 1350 and 1500 volts, and the positive between 1450 and 1500; no amount of retardation appears to make much difference; a very small deposition of mercury on the needle, however, raises the discharge to 2000 volts.

DOUBLE ELECTRIC REFRACTION. Pasquini. "Nuovo Cimento," March; abstracted briefly in the Lond. "Elec.," June 10.—Descriptions of experiments with waves of about 1 cm in length, the substances including a number of minerals.

RE-GENERATING X-RAY TUBES. Graves. Lond. "Elec. Rev.," June 10; abstracted briefly from the "American X-Ray Journal," April.—Dead tubes may be resuscitated by reversal, separate gaps and tin foil on the cathode end of the tube. In tubes of ordinary resistance the direct resistance is about three times the reversed and when the current refuses to pass in the proper direction it can probably be passed in the reverse direction; but if this is impossible then success will usually be attained by introducing a spark gap between the tube and the negative terminal of the generator; a spark gap at the negative pole reduces the resistance, while at the positive pole it increases it; tubes that have been thus resuscitated are far more efficient than new tubes which have not yet become dead.

CATHODE RAY HYPOTHESIS. Villard. Lond. "Elec.," June 10; abstracted briefly from "Comptes Rendus," May 31.—He describes experiments made to prove that cathode rays, the cathode stream, and the so-called canal or Goldstein rays have a reducing action. The oxidized surface of a sheet of copper was reduced by the cathode rays. On the strength of these experiments he advances the hypothesis that hydrogen has exclusively the property of furnishing cathode rays.

MECHANICAL CONCEPTION OF CURRENTS. Weyde. "Elek. Zeit.," June 9.—The first part of an illustrated article describing what he calls the mechanism or mechanical conception of the production of a current from a galvanic cell, based on the conception of whirling ether particles.

ALTERNATING CURRENT WATTS.—Lond. "Elec. Eng.," June 10.—Answers to a request for examples in which there is a wide difference between the true watts expended and the product of the volts and the amperes.

EFFECTS OF PROLONGED HEATING ON MAGNETIC PROPERTIES OF IRON. Roget. Lond. "Elec.," June 3.—A reprint of a Royal Society paper. When transformers are in use their open circuit loss is liable to increase considerably with time, implying a deterioration in regard to hysteresis; this was shown some years ago to be a direct effect of prolonged heating; in the present paper he describes his investigations in this direction with a more extended range of temperature than was used by Mordey and Parshall. The hysteresis was measured with Ewing's tester, and the specimens were all cut from the same sheet of soft Swedish transformer plate; the tests were all made at atmospheric temperature after various periods of prolonged heating at various temperatures. The effects of the heating were always completely removed by re-annealing, so that the same specimens could be used over again. The effects produced by baking differed widely at different temperatures; below 40° C. there was no evidence of any change; between 40 and 135° C. the hysteresis simply increased with time, being rapid at first and then slower; the results are given in curves and tables; from about 135° C. upward a maximum hysteresis value was reached in a comparatively short time, after which there was a marked decrease; for higher temperatures the initial rise is very rapid, the hysteresis doubling in a few hours at 160°, and reaches nearly three times its initial value in a few days; after seven days it began to decrease, and in fifteen days it fell to 2.5 times its original value; a still more notable decrease occurs at higher temperatures; in the neighborhood of 180° the maximum increase seems to be greatest, for at higher temperatures the hysteresis, although rising more rapidly at first, does not reach so high a maximum and begins to fall sooner and faster, tending to a lower state; the peak at which the hysteresis reaches its maximum comes sooner the higher the temperature, and its height becomes reduced when the temperature is high. Experiments were made to see whether the iron took up anything from the atmosphere, but no difference between the iron [illegible] could be found; there is nothing to [illegible] a long time it recovers from [illegible] although the original condition [illegible] some later experiments, which [illegible] probably true for a ring [illegible] and the [illegible] shows that [illegible] by prolonged [illegible] so much altered, [illegible] His experiments are [illegible]

[illegible] MAGNETIZATION. Maurain. "L'Eclairage Elec.," June 4.—It is important to know whether the energy lost [illegible] the cycle, he [illegible] of these [illegible] and the dynamic cycle [illegible] should be compared only [illegible] All other [illegible] dissipated [illegible] but the [illegible] The main results are that the total energy diminishes when the frequency increases, for the most compact cores and it is independent of the frequency for the most subdivided cores. In the latter the effect of the induced currents becomes almost zero, and the energy lost then represents that lost by magnetization alone, which experiments show is independent of the frequency. In conclusion he refers briefly to the retardation of the flux of induction in the field; he found that the retardation in the time is greater as the core is more compact.

PENETRATION OF MAGNETISM. Kirstaedter. "Wied. Ann.," No. 5; abstracted briefly in the Lond. "Elec.," June 10.—Early experiments with iron rods contained in a cylinder of iron showed that the magnetization does not penetrate below a certain depth, that is, that there is a screening action; this has been a subject of much controversy; the present author, therefore, made experiments with iron rings, which have no sensible magnetic dispersion; split, hollow rings of various thicknesses were used. The results showed a residual difference in the cubical magnetization, which is, however, due to disturbances produced by Foucault currents; with a thinner ring just fitting the hollow one, the magnetizations of both were found to be equal to the sum of their separate magnetizations, within 1 per cent.; this argues against a screening action, and is in accordance with Kirchhoff's theory of magnetization.

MAGNETIC SCREENING. Stefanini. "Nuovo Cimento," March; abstracted briefly in the Lond. "Elec.," June 10.—Similar researches to those described in the abstract above (Kirstaedter's paper), but differing in that the rings were built up of several hanks of iron wire; the outer acquired the same specific magnetization as the inner; further tests also showed that there was no magnetic screening.

MAGNETIZING BY MEANS OF LIGHT.—Lond. "Elec. Rev.," June 10.—A brief communication by Charles to the London "Engineer," calling attention to a passage in the British Cyclopedia, published in 1835. It describes an experiment by Morichini in which he concentrates the violet rays from a solar spectrum, by means of a convex lens, on to a steel needle, moving the lens parallel to the needle, so that the focus passed from the middle of one extremity of the needle to the other and always in the same direction, without touching the other half; by continuing this for nearly an hour the needle was found to be "completely" magnetized.

DISCHARGE BY X-RAYS. Child. "Phys. Rev.," May-June.—A long article describing experiments with the fall of potential at the surface of a metal when exposed to the discharging action of X-rays. The results are given in curves and tables, and show the following: That there is a large fall of potential at the surface of the metal when the discharge is caused by X-rays; that this fall is diminished by allowing the rays to strike the plate; that it is diminished to the greatest extent in the case of metals which absorb X-rays most.

SURFACE TENSION. Barnett. "Phys. Rev.," May-June.—A long article describing investigations concerning the surface tension of liquids under the influence of electrostatic induction; he adopted a method in which both electrolytic action and electrostatic disturbances are excluded; he used the method of ripples in its latest form. The results are in accord with the theory of Helmholtz.

Electro-Chemistry and Batteries.

QUANTITATIVE SEPARATION OF CHLORINE, BROMIUM AND IODINE. Speckêter. "Zeit. f. Elektrochemie," June 5.—A reprint of a short paper read before the German Electrochemical Society. He describes the application of a method of separating these halogens by electrolysis at various definite voltages; iodine should separate from chlorine and bromium at voltages below 0.94, while bromium should separate from chlorine slightly below 1.31 volts. To try and separate them in a free state was abandoned, and in the method described he used their combinations with silver; this gave results which are perhaps as good as those obtained by the new chemical methods, but the method has its limits, at least for separating chlorine and bromium. The oxidation of the air must be carefully excluded, the source of current must be a constant one and the concentration of the acid must be kept a certain amount.

ELECTROMOTIVE FORCE AND CHEMICAL EQUILIBRIUM. Bredig. "Zeit. f. Elektrochemie," June 5.—A reprint of a short paper read before the German Electrochemical Society; it is theoretical in nature, showing the proof of the equation through the researches of Knuepffer.

ACCUMULATORS. Gebhard. "Zeit. fuer Elek.," May 29, and June 5.—A reprint of a long paper of a general character on the Tudor accumulator made by his company. He points out the advantages of a large surface on the positive plates, with small depth of active material. Train lighting is briefly discussed; great stress is laid on the proper attendance of an accumulator plant; it appears that in a number of their installations the makers provide the attendant. The paper contains practically no data. He claims that a traction cell is used ten times as much as one in a stationary plant; in a 10-hour discharge the voltage falls only 3 per cent., or with one period of rest [illegible] volt. Theoretically [illegible] grams of the active material should give one ampere hour, or one kg. [illegible] ampere hours, but in practice only 80 are obtained, and this only at very slow discharges; at a three-hour discharge only 40 ampere hours are obtained from the positive plate.

OXIDATION AND REDUCTION OF COMPLEX SALTS. Peters. "Zeit. f. Elektrochemie," June 5.—A reprint of a paper of a theoretical nature read before the German Electrochemical Society, on the part taken by complex salts in the oxidation and reduction chain in connection with Ostwald's theory.

PROGRESS IN ELECTROMETALLURGY IN 1897. Andreoli. "Eng. and Min. Jour.," June 18.—An article summarizing the progress of the various electro-metallurgical processes during the past year.

Units, Measurements and Instruments.

METHOD OF MEASURING POLARIZATION. Heim. "Zeit. f. Elektrochemie," June 5.—A long paper read before the German Electrochemical Society, giving details and results of measurements of a method which consists in measuring the voltage between two parallel plates at a certain current density, and then measuring it again with the same current density when a middle electrode is inserted in the cell, dividing it into two parts; the voltage measured in the first case is equal to that of polarization plus that lost in the resistance, while in the second case it is equal to twice the polarization voltage plus the same voltage lost in the resistance; the second voltage less the first will therefore give directly the E. M. F. of polarization for that particular current density. It is assured in this that the introduction of the middle plate does not alter the internal resistance, and in that case this factor need not be considered; the method, therefore, affords a means of measuring the polarization with a continuous current by measuring simply two voltages and a current; in a short time many measurements could be made for different current densities, being careful only that the temperature is kept constant; if the currents are carried to nearly zero, then, by extending the curve graphically, the value for the decomposition polarization may be obtained. From the same two measurements at the same current, the internal resistance can also be calculated, as it will be equal to the difference between the two voltages divided by the current; this should be done to control the tests, and will show whether the middle electrode fitted the vessel tightly; if it does not, the results will not be accurate, and this seems to be the difficulty in the process. After trying to make the joint watertight he abandoned it and instead passed the plate through deep, narrow grooves in the sides and bottom of the vessel, so that the stray current which leaked around the edge was only an insignificant amount and can be calculated.

WESTERN STANDARD CELL. Cohen. "Zeit. f. Elektrochemie," June 5.—A short paper read before the German Electrochemical Society. According to the researches of Jaeger and Wachsmuth, there is a sudden change in the temperature coefficient at about 15°, due to a certain change in the concentration of the cadmium sulphate. The conclusions of the present author are that the cell should never be used below 15° C.; if it has been subjected to a lower temperature it should before being used be heated for a half hour above 15° C., after which a rest of 1.5 to 2 hours should be given the cell before the tests are made.

PREPAYMENT METERS.—Lond. "Elec. Rev.," June 10.—An illustrated description of the application of Bastian's device to the Thomson wattmeter. This is a prepayment device, which may be attached to any of the well-known types of meters; the coin passed through the slot forms a rigid connection between the needle and the mechanism and a turn of the handle switches on the current; the more coins that are dropped in up to a certain limit, the farther will one pointer be separated from the second, and the longer they will be in coming together again.

ELECTROLYTIC METER FOR ALTERNATING CURRENTS.—Lond. "Elec.," June 10.—A note stating that Bastian has recently succeeded in adapting his electrolytic meter (see "Digest," June 11,) to alternating currents. This he does by placing the meter in one branch of a divided circuit in each of the two branches of which there is a cell with an aluminum electrode; each branch, therefore, allows the passage of a current in one direction only; the meter is in only one of these branches.

ARON METER.—"L'Eclairage Elec.," June 4.—A brief discussion from the German patent.

PHASE METER. Tuma. "Science Abstracts," May.—A brief abstract of the article noticed in the "Digest" January 29.

LOW TEMPERATURE READINGS. Dickson. "Phil. Mag.," June.—A table based on his empirical formula, giving the reduction to normal air temperatures of the platinum temperatures in the low temperature researches of Dewar and Fleming.

PORTABLE TESTING SET FOR INSULATION MEASUREMENTS.—Lond. "Elec. Eng.," June 10.—Illustrated descriptions of the Silvertown, the Muirhead and the Evershed portable testing sets for measuring the insulation resistance of dynamos, cables, etc.

MEASURING STRESS IN IRON AND STEEL. Turner. "L'Eclairage Elec.," June 4; abstracted from the "Iron Age."—A metal wire becomes cool when it is stretched, and this change in temperature may be noticed by means of a thermo-electric couple. He shows that this method may be used to study the stresses in iron and steel constructions, as, for instance, in those of complicated shapes.

MEASURING LIGHT FROM PROJECTORS. Blondel and Rey. "Elek. Zeit.," June 9.—A German translation, with the illustrations, of the article noticed in the "Digest" March 19.

DETERMINING THE PERIOD OF OSCILLATIONS. Webster. "Phys. Rev.," May-June.—An investigation of an experimental determination of the period of electrical oscillations of alternating currents when a charged condenser is discharged through a circuit containing self-induction; the apparatus and methods are described. This investigation was awarded the Elihu Thomson prize.

Telegraphy, Telephony and Signals.

DEVELOPMENT OF TELEPHONY IN GERMANY.—"Elek. Zeit.," June 9.—A long article giving tabular data and other information, including a map showing all the interurban lines. It is accompanied by a brief editorial notice. The date of the statistics is 1897; the number of telephone central stations is 632, an increase of 37 per cent., as compared with the year 1894; the number of subscribers 164,681, an increase of 48 per cent.; the length of lines, 240,127 km, an increase of 77 per cent.; the number of daily communications 1,440,657, an increase of 34 per cent.; the length of interurban lines, 90,512 km, an increase of 86 per cent.; the number of daily interurban communications 191,884, an increase of 48 per cent. As a mean for the whole German Empire there is one subscriber or public station for every 318 inhabitants; the number of connecting circuits is 2,100, and with few exceptions all the stations are connected together; the average length of line for a subscriber is 1,462 km; Berlin contains most subscribers, the number being 36,650, after which comes Hamburg, 13,561, followed by Dresden, Munich, Leipsic and Frankfort between 5000 and 6000; 19 cities have between 1,000 and 5,000 subscribers; 141 between 100 and 1000, and the remaining 466 have less than 100; in Frankfort o. M. there is one subscriber to every 45 inhabitants, in Berlin and Hamburg 46, Stuttgart 49, Dresden 59, Munich 68, and Leipsic 76. The map referred to is the first one of the kind ever published.

CUTTING CABLES.—Lond. "Elec. Rev.," June 10.—Some remarks by Bright in the London "Times." Referring to the recent discussion in that paper, he points out the necessity of a system of cables connecting the entire British Empire by direct and independent means without touching on foreign soil; in the event of a permanent and reliable understanding being arrived at with the United States, that country would not require to be regarded as foreign territory; a further alliance with Japan is also suggested. In another communication by Holland he quotes from the conclusions arrived at at a certain meeting in Brussels in 1879.

LIGHTNING ARRESTER FOR TELEGRAPH CIRCUITS.—"Elek. Zeit.," June 9.—An illustrated description of a device used on one of the railroad telegraphs in Vienna. The usual sawtoothed arresters are used, except that the points are separated about 3 mm, which is about three times the usual amount, thus requiring a higher voltage to discharge across them. Besides these there is a sort of shunt gap consisting of pointed carbon rods which are easily replaced, and the points of which are brought very close together; when carefully adjusted, using a piece of thin paper as a gauge, alternating currents of 50 to 60 volts and continuous currents of 80 to 100 will pass over this gap. There are three blocks, one connected to the incoming line and the other to the outgoing line, the third between them being connected to earth; the points of the three carbons come close together.

SIGNALLING WITHOUT CONNECTING WIRES. Edser. Lond. "Elec. Eng.," June 3.—The beginning of an article in which he intends to give a popular account of the theory which must underlie any system of establishing electrical communications without connecting wires.

HERTZIAN TELEGRAPHY. Guisot. "L'Eclairage Elec.," May 28.—A short article describing the early work of Popoff, a Russian professor at Cronstadt, in this field; it is claimed that he was earlier than any of the others in approaching the practical realization of telegraphing without wires.

SELECTOR. Voisenat. "L'Eclairage Elec.," June 4.—A long, illustrated description of the selector of the Electric Selector and Signal Company of New York, the object of which is to close a local circuit for various purposes, such as starting a motor, lighting or putting out lamps, operating a signal, etc., through one wire.

TELEPHONY. Wehrenalp. "Zeit. fuer Elek.," May 29 and June 5.—The continuation of his long article; he continues the description of underground and overhead lines.

WIRELESS TELEGRAPHS. Keeley. "Can. Elec. News," June.—An article discussing briefly the various methods. He questions the reasonableness of the great expectations from such means of communicating, and shows how much must still be accomplished; he suggests that the alleged Hertz waves may not be such waves at all, and that if this is the case the methods used will undergo some emodification and simplification.

LONG-DISTANCE TELEPHONE LINES.—"Can. Elec. News," June.—A map showing the Bell Telephone Company's long-distance lines in Ontario and Quebec. Another article gives some of the data of the long-distance telegraph line which is to be run from Montreal to Vancouver and is to be a copper wire weighing 300 pounds per mile.

SELECTING TELEPHONES. Clausen. "West. Elec.," June 18.—A short article showing how to select a bridged-circuit telephone.

SELECTION OF TELEPHONES. Dobbs. "Elec. Eng.," June 16.—In this continuation of his long serial on telephone work he discusses the selection of instruments.

Miscellaneous.

ELECTRIC HEATING AND LIGHTING.—"Elettricista," 17, p. 71, noticed briefly in "Science Abstracts," May.—A paper giving some interesting figures regarding the cost of electrical heating and lighting. Fifty liters or 1.76 cubic feet of gas produces 4 cp hours in a fishtail burner, or 20 in an incandescent burner; the same amount of gas with a gas engine and dynamo will produce 16 cp hours; the large calories given out directly are 225 and electrically 45. A kettle taking 550 watts boils one liter (1.76 pints) in twelve minutes, at a cost of 1.32 cents at the rate of 12 cents per unit; a stove will keep a room 22° C. above the outside temperature, supposing the air to be changed once every hour, with a consumption of 65 watthours per cb. meter capacity of the room. An iron plate with an inside temperature of 250 and outside 200° C. in air at 15° C., will radiate 1 kw or 860 calories per hour, with a surface of 0.13 sq. meters.

CANADIAN ELECTRICAL ASSOCIATION.—"Can. Elec. News," June.—The programme of the next meeting, accompanied by portraits and short biographical sketches of the officers and authors of papers. Illustrated descriptions of some of the sights of interest in Montreal are also given.

Cooling Large Transformers by Air Blast and Natural Draft.

To dissipate the heat generated in the cores and coils of transformers of large capacity offers considerably greater difficulty to the designing engineer than is the case with small transformers in which any design, consistent with reasonable efficiency, gives sufficient external surface to allow heat generated to radiate and so prevent undue rise in the temperature. With large transformers, however, the heat generated in the interior has less opportunity to radiate, and to dissipate it effectively without sacrific of proportion or efficiency requires most careful design.

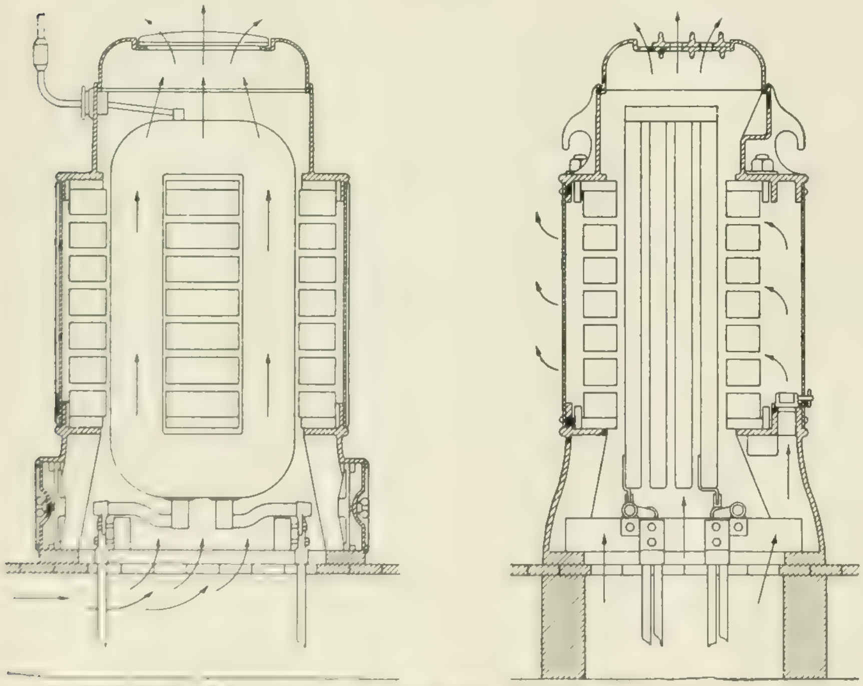
To construct large transformers, say, of 100-kw capacity or larger, placing [illegible] entirely on external radiating surface, neces- [illegible] for economical proportions, and various designs [illegible] made for the circulation of [illegible] through the interior of the transformer. If a duct passing [illegible]

[illegible] ducts, and come into direct contact with the heated surfaces absorbing their heat. Low temperatures are secured without sacrifice of efficiency or increase of cost, and the insulation, being constantly in contact with the current of air, needs no additional protection to guard against deterioration.

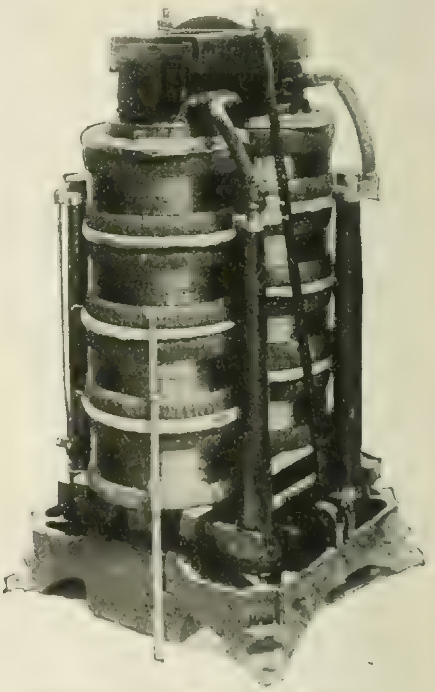
Two methods are employed as standard practice by the General Electric Company in the construction of its large transformers. In the air blast type the current of cool air is forced upward through the core and windings. In the natural draft type the coils and iron are so proportioned and placed that large surfaces are exposed, and the temperature kept within safe limits by the natural circulation of the air.

The air blast type is designed for continuous operation, large output and high potential. In this type, the windings are sub-divided into numerous independent coils, each separately and heavily insulated. With such sub-division the voltage generated in a single section is low even in transformers wound for a voltage of 15,000 to 20,000 volts, and the numerous air ducts between all the coils which this sub-division allows, in addition to the spaces in the iron lamination of the core, limits the rise in temperature to a few degrees only above that of the active cooling air current. The coils are wound with flat copper conductors, cemented together by an insulating compound before the exterior insulation is applied. The method of winding and insulating produces a strong coil, which will successfully resist any tendency of the conductors to vibrate. The primary and secondary coils are assembled in small intermixed groups with air spaces between coils, and between every adjacent primary and secondary section are solid insulating diaphragms, which completely encase the primary winding except at either end of the core, necessarily left open to allow the air to circulate freely. At the end, however, the diaphragms project far beyond the coils, so that a surface insulation of great extent is provided between the primary and secondary. An additional insulation casing is placed around the entire structure of assembled primary and secondary coils, and separates the whole winding from the iron punchings assembled within and around them.

The cooling current of air is obtained from a motor-driven blower, and is forced from below through separate paths at right angles to each other, vertically through the windings and horizontally through the core. The admission of air is controlled by shutters at the top and at the side of the transformer.



Air Circulating in Air Blast Transformer.



Natural Draft Transformer.

The power for the blower seldom exceeds one-quarter of 1 per cent of the total capacity of the transformer, and in most cases is much less, frequently not more than one-tenth of 1 per cent. It is considerably less than that which would be required to pump oil through an oil-cooled transformer of the same capacity.

Air blast transformers are used on 15,000 volts potential or under, and are constructed for higher potential when necessary. The efficiency under full load and partial load, determined under commercial operation conditions, is said to be extremely high. The regulation on both inductive and non-inductive loads, similarly determined, is remarkably close, an important essential when incandescent lamps and motors are operated from the same transformer. Over [illegible] of power in these air blast transformers has been installed, and no record yet exists of a burn-out due to heating or overload.

In the natural draft transformer the dissipation of the heat is obtained by a natural circulation of the air around the coils. The core is formed of two upright legs on which the coils are wound. These are joined together by two yokes, which complete the magnetic circuit. The transformer proper is surrounded by a corrugated iron case, and rests on a substantial base of cast iron. The cool air enters from below and in passing through the transformer absorbs the heat and escapes, finding easy egress through the hood at the top.

Natural draft transformers are built in sizes ranging from [illegible] to [illegible] kilowatts. They require no attention, no blower outfit, and may be located in any convenient place. The standard pressures for which these transformers are wound are [illegible] and [illegible] volts or under secondary. Transformers of higher primary voltages are built to fulfill special requirements.

New Telephone Desk Set.

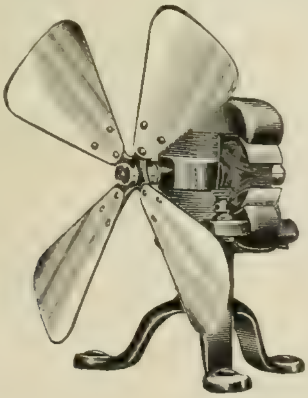
The illustration shown herewith represents the latest type of desk set made by the Ericsson Telephone Company, New York City. In its construction the lightning arrester in the machine itself is done away with and all contacts are carried to the extreme end of the cord. It is equipped with the company's special Ericsson lightning arrester, which has just been brought out. The company guarantees these instruments against injury on any high or low tension currents. This set is wound for bridging or series, and is a new departure of the company as regards this particular type of instrument. The hand micro-telephone used in connection with the set has a double cut-out in the handle, which prevents any conversation being overheard through the telephone. The convenience of this will be generally appreciated.

NEW DESK TELEPHONE.

The company will have an exhibit on the occasion of the annual meeting of the National Independent Telephone Association of America, which will be held at the Palmer House, Chicago, on June 30, July 1 and 2.

New Battery Fan Motor.

The Kent Electric Manufacturing Company, Worcester, Mass., is putting on the market a new battery fan, the motor part of which is of the same type as the "Type C" motor, which it brought out last fall. The simplicity and compactness of this motor give it a very neat appearance. It has but one bearing, 3 inches long. This bearing is a portion of the field magnet frame, at a point where the magnetism is neutral. Thus the shaft can never get out of alignment or bind, and there are no bearings to adjust. Another advantage which will be appreciated by motor users is that there is no bearing on the commutator end where the oil runs onto the commutator, and prevents the brushes from making good electrical contact.



BATTERY FAN MOTOR.

The binding posts are conveniently located at the side of the field coil, and are entirely out of the way. It is constructed with the company's regular drum armature, which it has been putting into its motors for the past two years. This armature insures noiseless running and high efficiency.

This motor is constructed for the most convenient and economical use on battery circuit. It carries a 10-inch fan, and is finished in black enamel with nickel trimmings. The neatness and simplicity of this outfit make it bid fair to become very popular for battery work.

Central Energy or "Express" Telephone Systems in Independent Exchanges.

The independent telephone exchange recently opened at Lockport, Ill., is a most substantially built and most perfectly and conveniently equipped system. The outside construction is metallic throughout, using a large amount of cable on the principal leads and put up in the most substantial manner.

The equipment of the exchange was furnished by the Stromberg-Carlson Telephone Manufacturing Company, Chicago, and is the first public exchange equipped with its central energy system. This system was thoroughly tested in a number of large [illegible] adopted in public exchange work. In general operation it is similar to the old line express system, but is claimed to in no way infringe existing patents. There are no generators at the subscribers' stations. The subscriber signals central office by pressing a push button, which completes a circuit formed by one side of the line, and the ground has a return which throws in the power generator at central office. This current may be either battery or power generator.

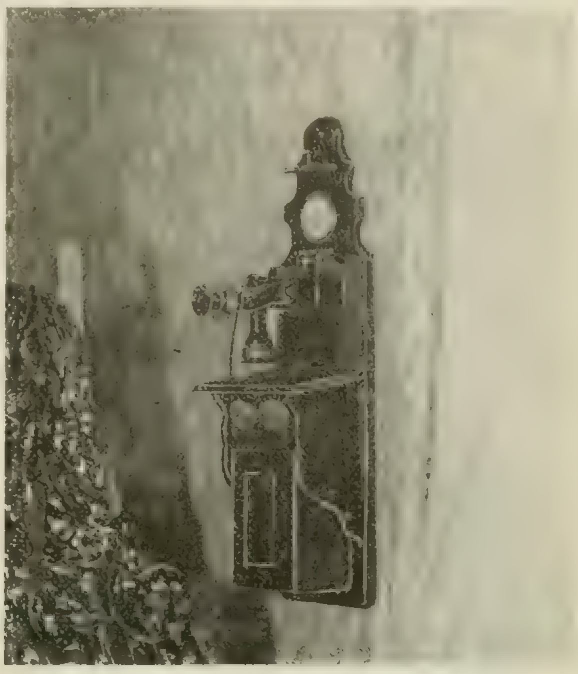


FIG. 1.—SUBSCRIBER'S TELEPHONE.

This system requires the ordinary metallic construction with a ground return for the ringing circuit. The talking is over the metallic circuit and independent of the ringing when connected, and leaves the subscribers entirely free from generator induction.

Fig. 1 shows a central ringing and local talking energy wall telephone.

The receiver of the subscriber's station equipment is claimed to be the most powerful and strongly built instrument of its kind. It is composed of a neatly designed, heavily nickel-plated cast brass adjustable head, in which all parts are firmly fastened. The magnet is of one part of high-grade steel, horseshoe shaped, with its pole ends fastened in one part of the brass head, leaving the yoke end free. With but one end fastened the difference in contraction and expansion between the steel and the rubber shell, in great variations in temperature, will in no way affect its adjustment. In the inside of this part of the adjusting end are clamped a pair of coils to the two pole ends of the magnet. This part is then sealed with an insulating compound to prevent moisture or any foreign material entering. In the other part of the adjusting end is fastened the diaphragm. The magnet being extremely powerful enables the use of a very heavy coke tin diaphragm, the vibration of which produces the sound waves with much greater force than is produced with a weaker diaphragm. The two parts of the adjusting head are provided with a very fine thread, and are screwed together until the diaphragm is in proper relation with the magnet coil, and are then locked with a check ring, and can only be opened with a wrench provided for that purpose. The diaphragm is covered with a hard rubber cap, and the magnets with a shell of the same material, both of which

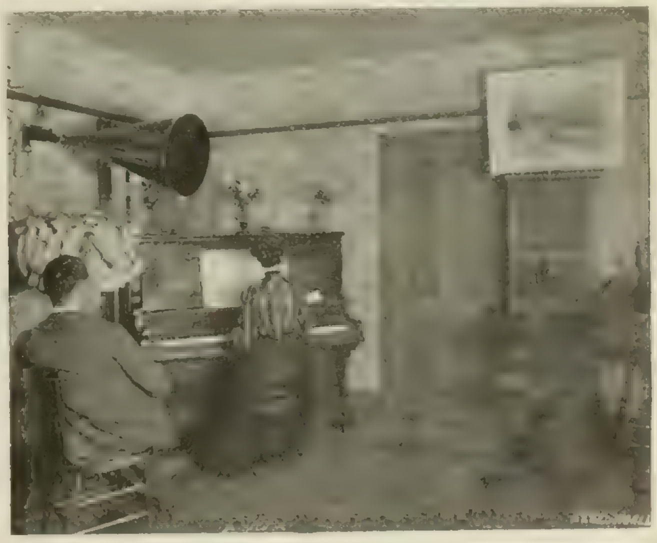


FIG. 2.—THE SWITCHBOARD.

are tightly screwed to the brass head. The cord is fastened inside of the shell on an insulating block between the two parts of the magnet.

The transmitter is of the granular carbon type, with a case of two parts of stamped brass, nickel plated. One part contains the back electrode, which consists of two screens divided by No. 18-wire ring. The electrode is mounted on an adjustable block, which screws into an insulated bushing fastened in the hub of the back part of the case. Around the back electrode is mounted a ring of silk plush, the threads of which enter the screening of the front electrode and form a perfect cup for the carbon. The front screening electrode is permanently riveted on the diaphragm, which is clamped in the case with an auxiliary diaphragm of rubber-covered cloth. This auxiliary diaphragm prevents the entrance of moisture, which causes a buckling of the metal diaphragm and a packing of the carbon. An air space between the two diaphragms serves to soften the sound. The back electrode being an adjustable block enables extremely sensitive adjustment of the transmitter to take up faint sounds at a distance or to have it muffled to take up sounds only when close to the mouthpiece. A large amount of contact formed by the separated screen electrodes makes the battery requirements exceedingly small in this instrument. The receiver being locked and the transmitter riveted prevents inexperienced people from opening and deranging the parts.

The switchboard used in this system is a regular metallic board, and is shown in Fig. 2.

Long Distance Wall Telephone.

Fig. 1 shows a wall telephone which is especially designed to meet the requirements of both general exchange and long distance work. The magneto is provided with binding posts for receiver, battery and induction coil, which

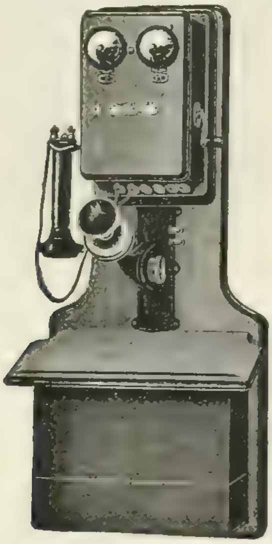


Fig. 1.—Wall Set.

important feature allows the detachment from the back board, without cutting either the battery or transmitter wires. The finish of the generator is exceptional, and the steel used in the same is of the best magnet brand. The [illegible]

construction. As a whole the set is claimed by the manufacturers, Messrs. Schmidt & Bruckner, 209 Greenwich Street, New York, to be one of the best in the market.

Electrically Driven Freight Ramps.

There has recently been devised a comparatively new application of electric power, in connection with an interesting labor-saving and labor-assisting device, known as a traveling freight ramp. This machine is designed for the economical and rapid loading and unloading of freight to and from vessels, and the accompanying illustration is a detailed side view of one of six installed for the Northern Steamship Company, at Buffalo, N. Y. Essentially it is an adjustable gangway, made up of a stationary and a moving part, being pivoted at one end and counterweighted at the other; so that from the horizontal plane in which the sketch shows the machine it may be raised and lowered to have its outboard end meet the ports of vessels of different heights.

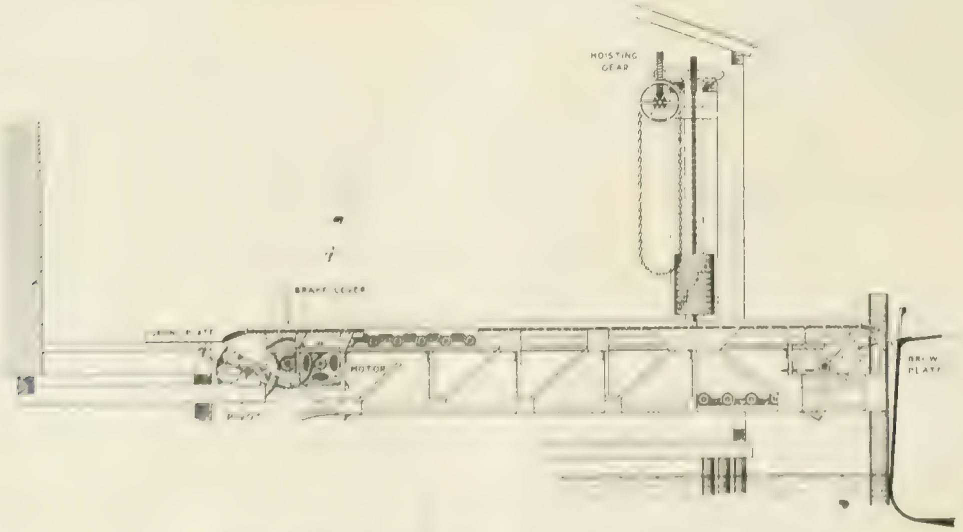
The traveling, or carrying, portion of the ramp consists of an endless apron composed of metal-covered planks attached to two strands of chain running around head and foot wheels, the apron being carried on its upper and lower runs by small wheels traveling on T-rail tracks, as the sketch will make clear. At either side of the foot projects an arm for the reception of one end of the brow plate connecting the ramp with the vessel to be loaded or unloaded. It will be noticed that this arm has a series of recesses; so that in whatever position the ramp may be placed, the brow plate is readily made to form an unbroken path from the vessel to the traveling apron.

The ramps at the Northern Steamship Company's pier are about 25 feet long, the moving portion of each running at the rate of 108 feet per minute, and the direction of travel being reversible, the same machine will carry freight either to or from the vessel. Supposing, for instance, that a vessel is to be unloaded, and that its port is below the level of the wharf, the hand chain shown in the cut is operated to raise the counterweights, and so correspondingly lower the outward end of the ramp, which is locked in the desired position by the worm gearing of the hoisting arrangement. The brow plate is then adjusted, and the men push their loaded trucks on to the moving apron. Instead of requiring the assistance of several others to get the freight up the incline (we will say it is 20 degrees), the wheels of the trucks are allowed to rest in the recesses formed by the metal-covered planks, and thus each man is relieved of his load until he arrives at the warehouse end of the wharf, where he unloads and then returns to the vessel by way of the stationary part of the machine.

Not only is a decided economy in labor effected by the use of this apparatus, but the time required to handle a fixed amount of freight is materially reduced; a valuable consideration, in that the vessel's detention at the pier is of much shorter duration and the pier is accordingly enabled to accommodate a greater number of vessels in a given period.

To operate each of these machines there is used a 5-hp alternating-current motor, which, it will be observed, is located between the upper and lower runs of the traveling apron, an arrangement that puts the motor in an out of the way and easily accessible place and utilizes an otherwise useless space. By means of a friction clutch the traveling portion of the ramp is readily started or stopped, and through the medium of a brake it is prevented from running down hill when the clutch has been thrown out of gear.

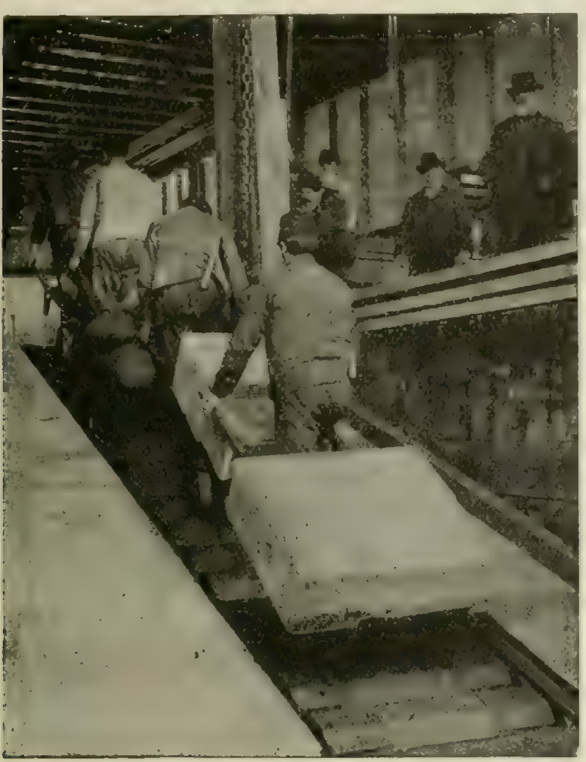
At the Metropolitan Steamship Company's Boston pier four similar machines are in operation. At this point, on account of the salt water waves, the motors are placed overhead, under the roof of the wharf.



Detail View of Electrically Driven Freight Ramp.

The ramp design is one that can readily adapt itself to the conditions found at different harbors. At New Orleans, for instance, where the rise and fall of the river is from 30 to 40 feet, the Southern Pacific Railway Company has installed a number of these machines, each about 100 feet long. Here the ramps are in pairs, one for loading and the other for unloading, the stationary gangways being dispensed with, and are run at a speed of 250 feet per minute. A great deal of the freight (canned goods, barrels of molasses, or [illegible]) is transferred to or from the vessels without using trucks. Where trucks are employed [illegible] one, as a rule, accompanies them on the ramp, the men at the discharging end taking care of them as they arrive, unloading them and returning them on the machine traveling in the opposite direction.

The [illegible] of the ramp [illegible] that the wear and tear upon them is practically nothing, and one company using a large number of these machines reports that they saved their cost in less than a year.



Electrically Driven Freight Ramp.

The Link-Belt Engineering Company, of Philadelphia and New York, and the Link-Belt Machinery Company, of Chicago and New Orleans, made the installations referred to above and reports quite a demand for these freight carriers.

Exhibits at the Philadelphia Electrical Exhibition.

ONE OF THE BEST PROOFS of the advantage of having wide-awake men about an exposition building is the success that is rewarding the efforts of Professor Marks, who is at the head of the Philadelphia Electrical Exposition. No mistake was made when the professor induced Mr. F. R. Upton to remain in Philadelphia, to aid him in entertaining his friends and patrons. It is only just ot say that, due to the efforts of Mr. T. G. Seixas, many have spent pleasant hours wandering here and there, inspecting the numerous appliances and inventions. Mr. T. G. Seixas represents the Edison Electric Light Company of Philadelphia, and the interest he has taken in the Exposition will be felt not only by the Edison Company, but by future electrical exhibit promoters. His writings for the daily press of Philadelphia have interested many, as his explanations of the varied uses of electricity are plain and instructive, as are also his answers to his many friends and questioners.

MR. ALFRED F. MOORE, 200 North Third Street, Philadelphia, Pa., makes an exhibit of office and annunciator wire, fire and weatherproof wire, heavy railway feeder, rubber wire, incandescent lamp cord, switchboard cord, telephone receiver cords and various battery cords, double cotton magnet wire from No. 1 to No. 20, single and double silk magnet wire from No. 20 to No. 40, etc., etc.

THE STANDARD FIREPROOFING COMPANY, 39 Cortlandt Street, New York, and Perth Amboy, N. J., has a very fine exhibit on the main floor of the hall of its vitrified and salt-glazed underground conduits. One of the principal products of the company is the self-centering conduit, 18 inches long, which is claimed to be the best and most up-to-date conduit on the market. It is easy to handle, and can be readily and economically laid, and the joint is said to be the strongest made. These conduits are laid one on top of the other, like brick work, and when laid in a bed of concrete with all joints cemented, it becomes one solid mass of masonry. The company also makes the 18-inch conduits in three or four ducts, with either self-centering joints or plain ends. The salt-glazed conduits are manufactured of fire clay mixed and prepared in machines specially constructed for the company's use. They are properly dried, thoroughly and uniformly burned, heavily glazed inside and out, and are made in any length desired up to 6 feet, in two, three, four and six ducts. They may be perfectly aligned. The outer walls and partitions are nine-sixteenths of an inch thick. The duct or opening is 3¼ inches by 3¼ inches, with rounded corners, and the ends fit exactly. They are provided with openings for use of iron dowel pins. The partitions add to the solidity and strength. A 6-foot six duct conduit laid on supports 5½ feet between bearings will sustain, it is reported, eight tons, and when laid on the smooth bed of concrete, it is claimed that there is no limit to its resistance to crushing. The construction of the multiple ducts affords an economical means for laying, no high-priced labor being required. The interior of the ducts is highly glazed, and the round corners reduce the friction to a minimum, thereby lessening the resistance and saving wear and tear on the cable. These ducts permit of the manholes being placed far apart. They are proof against frost, heat, water and acids. The capacity of the Standard Fireproofing Company to turn out these ducts is said to be practically unlimited. The company states that it can produce 5 miles of conduits per day. Its supply of raw material is inexhaustible, and its machine and kiln output are very large. The exhibit is in charge of Mr. M. J. Harrington, of the Perth Amboy, N. J., office. The company is represented in Philadelphia by Mr. Franklyn A. Lee, whose office is at 403-404 Betz Building.

The Standard Fireproofing Company's Exhibit.

MR. GEORGE M. DE GINTHER, 1037 Walnut Street, Philadelphia, has an exhibit that is of particular interest to those in any way connected with the lighting interests. He shows a full line of holophane glass globes which "lose the glare, but not the light." The perfect diffusion effected by these globes is shown in the accompanying cut of the exhibit, which was made from a photograph taken with many of the lights burning. A particularly attractive feature of this exhibit is a large globe with changing blended colors. The oil lamps seen in the illustration are all fitted with the new self-lighted attachment, which is being handled by Mr. De Ginther. This device was briefly described in the last issue of THE ELECTRICAL WORLD. The self-

Exhibit of George M. De Ginther.

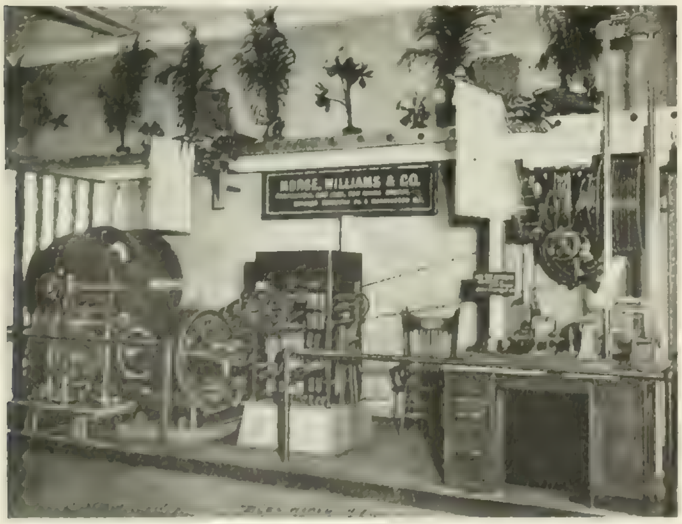
lighting attachment is one of the most popular articles at the exhibition. Mr. De Ginther also shows a full line of the new "Fowler" incandescent lamps, which was described in The Electrical World of June 18. No plaster is used in cementing the bulb to the lamp base. It is stated that this lamp is becoming widely and rapidly known, and bids fair to rival the sales of the largest concerns.

THE HELIOS ELECTRIC COMPANY has two exhibits, one of fifty-four arc lamps lighting the front of the building, which at night illuminate Chestnut Street for blocks, and the other at its tastefully decorated booth in the exhibition hall proper. Here are shown both open and enclosed arc lamps for all purposes; direct current constant potential enclosed arc lamps, burning singly on 110 and 220 volts, for both indoor and outdoor service, and in designs ranging from the neat and durable black japan enamel to the highly ornamental lamps just brought out by the company. These are in every respect equal in appearance to the best French bronzes. The company also displays a number of arc lamps in various finishes for 220 and 550 volt circuits; also a full line of alternating lamps. The exhibit is in every way creditable to the company, and the uniform and steady burning of the lamps has been favorably commented on.

AN INTERESTING EXHIBIT at the Philadelphia Electrical Exhibition is that of Rudolph M. Hunter, Philadelphia's well-known electrical expert. His booth is very luxuriously fitted up, and forms an attractive spot. His exhibit is historical in character and shows the extent of his work in the inventive field on the subject of the application of electricity to the industrial arts. He shows one of his early trolleys, a series multiple controller and models of the electric railway trucks used on street car and train work. He also exhibits a model train one-twentieth full size, having electric motors upon each axle in permanent electrical connection, and controlled by his improved counter E. M. F. system of regulation, which entirely does away with the necessity of complicated circuits, resistances and the series-multiple controller principle. He exhibits also full-sized controllers for this new method of regulation. Some searchlights are also displayed, one of which is on an entirely new principle employing a revolving positive carbon and dispensing entirely with the use of reflectors. It is contended that this lamp, though small, is exceedingly powerful and much cheaper than the present types of searchlights of the same power. His exhibit also contains other forms of searchlights, electric meters, a small working model of a series-multiple controller for showing the operation to the public, electric switches and a large X-ray apparatus. Aside from these exhibits he has a series of volumes of patents, photographs, pictures, publications, etc., showing the comprehensive nature and scope of his past work in the electrical field, not only in the continuous current work, but also in the alternating transformer system. His work in smokeless powder in 1883 is also included.

MESSRS. MORSE, WILLIAMS & CO., 1105 Frankford Avenue, Philadelphia, have an exhibit consisting of a high-duty direct-connected electric elevator for passenger service. This elevator has a capacity of 2700 pounds at a speed of 250 feet per minute, and is connected to one of the firm's type "F" controllers. The controller contains the limit stops, slack-cable, dynamic brake, reversing switch and armature resistance, and can be regulated so that a constant or variable speed can be obtained. A belt elevator with a capacity of from 2000 to 10,000 pounds is also seen running from a 5-hp reversing motor and controller, and is controlled by the firm's handwheel device. A model house elevator and dumb waiter with automatic stops is also shown in operation. A large-sized model of the Hindley worm and wheel, with which all the drum-type elevators of this company are equipped, is also shown.

MESSRS. VALLEE BROTHERS & CO., 625 Arch Street, have an attractive exhibit which occupies two spaces near the electric fountain. The "Victor" in-



Morse, Williams & Co.'s Exhibit.

[illegible]

is also attracting considerable attention. The advantages of this torch are that the point of the blow-pipe flame can be placed exactly where it is needed. Instead of punching down the wick or pulling it up to get it opposite a fixed blow-hole, all that is necessary is to place the blow-hole opposite the centre of the flame. This firm has always enjoyed the reputation of handling nothing but the very best, and it had this in view when it chose the agency for the Diehl ceiling fans. There are 1000 users of this fan in Philadelphia alone. The Paragon direct current desk fan, the Westinghouse alternating desk and the Tuerk alternating ceiling fans are also handled by this firm. Mr. Dale B. Scarborough is in charge of the exhibit, which also includes the Lewis cutout and lightning arresters, Armorite steel conduits, for which this firm is sole agent. It is agent also for the Whitney instruments and the American Electrical Heater Company, Detroit, Mich.

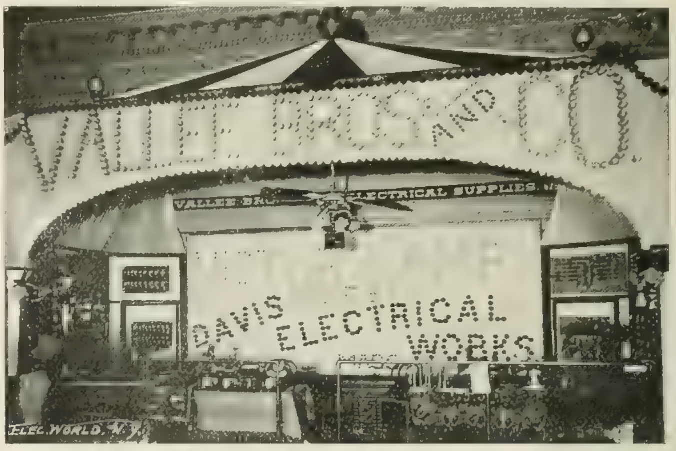
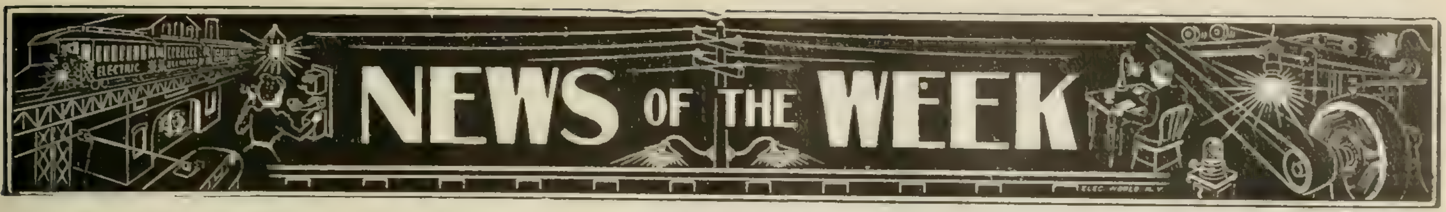


Exhibit of Vallee Brothers & Co.

THE AMERICAN ELECTRIC METER COMPANY, Ninth Street and Montgomery Avenue, Philadelphia, has a very attractive exhibit of nine of its meters in different sizes. There are three 10-ampere, three 20-ampere and three 40-ampere; three-wire meters in circuit, with lamps burning to show the meters in operation on increasing and decreasing the load. There are besides two 10-ampere meters of the three-wire type on stands with the mechanism exposed to view. These meters are provided with a compound pendulum actuated by electricity, which keeps a record of the time, and a solenoid, which measures the amount of current passing. The product of the two factors is given in ampere hours. A pointer moving over a scale shows at each instant the exact amount of current which is passing, and a counter, with five figures in a line, shows the number of ampere hours which have already passed through the instrument. Friction has been practically eliminated in the construction of this instrument, therefore it has great accuracy. It was the aim of Prof. W. D. Marks, the inventor of this meter, to produce an instrument which could be [illegible] and installed by an average workman of an electric station, and one which would not require subsequent calibration or the services of an expert. By the use of this instrument the consumer can tell at any moment just how much current he is using and can read on the counter the number of ampere hours which he has already consumed. The exhibit is very neatly dressed in palms and American colors, and is in charge of Mr. Joseph S. [illegible]

Exhibit of the American Electric Meter Company.



NEWS OF THE WEEK

Financial Intelligence.

BELL TELEPHONE BONDS.—It is stated that the recent issue of $5,000,000 American Bell Telephone Company's 4 per cent. bonds, due July 1, 1908, are nearly half sold.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
9 Murray St., NEW YORK, June 27, 1898.

THE TELEGRAPH OPERATORS of the Police Department of the Borough of Brooklyn will receive a salary of $1850 a year if the action of Justice Maddox of the Supreme Court in Brooklyn is sustained by the Appellate Division, and no further legal complications ensue. The operators' salaries were increased $100 a year on December 15 last, from $1750, but in January the Police Commissioners cut the salaries down to $1500. Justice Maddox granted a peremptory writ of mandamus on June 24 to compel the Board of Estimate and Apportionment to provide funds to pay the operators their salary at the rate of $1850 a year. A stay was granted to the Assistant Corporation Counsel pending an appeal.

JUSTICE BISCHOFF on June 22 dissolved the temporary injunction obtained by Mr. James J. Phelan, a shareholder in the Municipal Electric Light Company, of Brooklyn, to restrain the Edison Electric Illuminating Company, of Brooklyn, from carrying out an agreement made with the majority of stockholders with the Municipal Company. Judge Bischoff held that the contemplated purchase of the Municipal Company by the Edison Electric Illuminating Company is legal. The Edison Company desires to purchase the holdings of the stockholders of the Municipal Company, they depositing with a trustee the shares held by them at an advance of 100 per cent. on the par value of the stock, payable in cash, by the delivery of bonds secured by a second mortgage on the property of the Edison Company.

VOLUNTEER ENGINEERS GET A TASTE OF ARMY LIFE.—The first detachment of the first regiment of United States Volunteer Engineers was transported to Peekskill from this city on Monday last. It was the first experience in "roughing it" for these men, many of them whom had left comfortable homes and some of them large incomes to serve Uncle Sam for $20.40 and $15.60 per month. The detachment consisted of eight officers and forty-six men. The First Regiment is in command of Col. Eugene Griffin, of the General Electric Company. Dr. Louis Duncan is a major in this regiment, and William B. Parsons, the engineer for the Rapid Transit Commission, is a captain. Several electricians are in the ranks. Soon after their arrival at camp the men went to work cleaning house, so to speak. They had to sleep on the tables in the mess room the first night of their camp life, as the tents which were expected did not arrive before the sound of the tattoo.

NO SMOKING ON THE BRIDGE CARS.—The elevated railroads in Brooklyn have for years catered to their tobacco smoking patrons to the extent of running smoking cars on its trains. When the question of running these cars across the bridge came up for consideration the bridge authorities showed a decided opposition to the idea, and issued an order that there should be no smoking in cars while they were on the bridge. The elevated railroad authorities, it is stated, find it easier to run only smokeless trains over the bridge than to attempt to stop the men in smokers from smoking while trains are crossing the river. The same orders were issued to the surface railway companies when they began running their cars over the bridge. Smokers, however, have some hope of being able to bring about some agreement between the railway and the bridge authorities in regard to allowing smoking cars to cross the bridge.

THE RAPID TRANSIT QUESTION.—The Extension Committee of the Manhattan Elevated Railway Company held a meeting on June 21, to consider the amendments to the proposed West Street franchise, suggested by the Rapid Transit Commission in its letter of June 9. The committee practically conceded all that the Rapid Transit Commissioners asked, except upon the matter of compensation. The reply of the Elevated Railway Company to the letter of the Rapid Transit Commission, which reply was signed by George J. Gould, president, was somewhat caustic. Mr. Gould calls attention to the fact that more than four months ago, on February 7 last, he suggested to the Rapid Transit Board, with much deference, that letter-writing should cease and that action should take the place of words. Mr. Gould closes his letter by stating that the counsel of the company is ready to meet the counsel of the commission at any time, with full authority to represent the railway company in the final adjustment of all details of the franchise, other than rentals.

NEW ENGLAND NOTES.

Branch Office of THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., June 24, 1898.

THE ELECTRIC GAS LIGHTING COMPANY, Boston, has recently built a 260-drop return-call annunciator of the Ross style for the Indianapolis District Telegraph Company, to be installed in Hotel English, Indianapolis. This is one of a number of large instruments built by this company this spring for hotels in different parts of the country. The company states that its output of annunciators has been exceedingly large the past few months, necessitating running its factory nights to keep up with the orders.

IT IS STATED on the best authority that the Boston & Maine Railroad Company is developing an entensive electric railway system, and will control about 100 miles of such property. It is understood that its intention is to control existing lines at different points in the East, using them as feeders to the steam road, and build other lines where needed. It is now building a new line from Portsmouth to Dover, N. H., a distance of 8 miles. This line is double tracked, 90-pound T rail being used. The power house is being planned in such a way that it can be quadrupled in capacity when necessary. This indicates that the Boston & Maine people intend to extend the system at some future time.

PHILADELPHIA NOTES.

Branch Office of THE ELECTRICAL WORLD,
929 Chestnut Street.
PHILADELPHIA, Pa., June 25 1898.

MR. E. P. KILLION, of Walker & Kepler, of this city, has been appointed selling agent in Southern Pennsylvania and Southern New Jersey for the products of the Prismatic Electric Sign Company, Williamsport, Pa.

THE WILLIAM T. HAINES COMPANY, 136 South Fourth Street, Philadelphia, Pa., is sending out engraved invitations to be present at its office on any day from 9 A. M. to 5 P. M., and receive a Heintz steam trap on thirty days' free trial. A reception is held after each sale.

BUFFALO AND NIAGARA FALLS NOTES.

BUFFALO, N. Y., June 25, 1898.

THE PLANT of the National Electrolytic Company will begin making chlorate of potash this week. It is the only one of its kind in America, and will have a capacity of 1,500,000 pounds a year. Demand for the article in the manufacture of smokeless powder has raised the price from 6 to 21 cents a pound. All the officers of the company are Buffalonians, with Edward Michael, president.

THE BUFFALO GENERAL ELECTRIC COMPANY is engaged in changing all its transformers and meters from 50 to 100-volt capacity in order to be prepared for doubling the pressure of the current to be received when the new station is ready for use. As the change is not to be made as soon as was hoped it will be the plan of the company to leave nothing undone that can cause delay after the new machinery is in place.

THE NEW TROLLEY LINE from Buffalo to Lockport is progressing fairly well. Contract for a car barn adjoining the Erie station in Lockport, 190x55 feet, has been let, and the transformers are about to be placed in the power house in Tonawanda. They are two of 2500 horse-power. The complications of a legal nature over the Kenmore portion of the road will not delay the opening of the road. This road was found to be bankrupt, as it has no real connections, and a $55,000 mortgage has been foreclosed on it.

TESTS are about completed of the new electric machinery in the power house on the Canadian side of the Niagara. It consists of two three-phase, belt-driven generators of 500 horse-power each. The current is to be 2400 volts alternating. There are also two 20-hp direct current multipolar generators to be used as exciters. A new 1300-hp induction motor is to be placed at once in the electric light station on that side of the river. The Corborundum Company, which is building a factory on the Canadian side, has ordered a 200-hp transformer for reducing the current from 2000 volts to 100 volts.

PITTSBURG NOTES.

PITTSBURG, Pa., June 23, 1898.

MR. WESTINGHOUSE'S GENEROUS OFFER.—Mr. George Westinghouse, Jr., has offered as a gift to the Allegheny University, the entire electrical equipment for the proposed new observatory, consisting of generators, motors, etc.

MESSRS. TATE & JONES, Murtland Building, Pittsburg, Pa., are sending a circular to every street railway president in the United States, announcing that they are in a position to extend to such railways the services of a car trust in financing the purchases of rolling stock. This is a new departure in electric railway financing, and Messrs. Tate & Jones think that it will meeet with favor in this field.

DIVIDENDS DECLARED.—The directors of the Allegheny County Light Company have declared the regular quarterly dividend of 1½ per cent., payable June 30, to stockholders of record June 17. Transfer books will be closed from June 18 to June 30, both inclusive. The Westinghouse Electric & Manufacturing Company has declared a quarterly dividend [illegible] per cent. upon the preferred stock of the company, payable on July 1, to stockholders of record. Transfer books will be closed from June 25 to July 2.

OPEN AIR THEATRE IN SCHENLEY PARK.—In order to stimulate summer travel upon its lines, the Consolidated Traction Company has established an open-air theatre in one of the ravines in Schenley Park. Daily afternoon and evening vaudeville performances are given, to which the admission is absolutely free. A complete change of bill will be made each week, and it seems probable that the increased street car travel at hours when the cars would otherwise run comparatively empty, will amply repay the management for the outlay occasioned by this novel enterprise.

ELECTRIC LIGHT PLANT FOR CITY HALL.—The contract recently awarded by the directors of the Department of Public Works to the Westinghouse Electric & Manufacturing Company, for the City Hall electric light plant, has been approved by Councils. The plant will consist of a 62½-kw, 110-volt multipolar direct current generator, belted direct to a 100-hp Westinghouse gas engine. The City Hall was formerly lighted by electricity supplied by the Allegheny County Light Company. A year or two ago, however, it was decided to reduce the cost of lighting by taking advantage of the fact that one of the gas companies is obliged to furnish to the city, free of charge, 12,000,000 feet of gas annually. A portion of this free gas has therefore been used for lighting the building. It will now be utilized as motive power for the gas engine, and the City Hall employees will have the advantage of superior illumination by electricity, although still using the gas which costs the city nothing.

CHICAGO NOTES.

Branch Office of THE ELECTRICAL WORLD,
936 Monadnock Building,
CHICAGO, Ill., June 24, 1898.

RECENT PROMINENT VISITORS in Chicago included Mr. Charles D. Jenny, of the Jenny Electric Manufacturing Company, Indianapolis; Mr. Herbert H. Brooks, general manager of the American Circular Loom Company, Chelsea, Mass.; Mr. G. G. Luthy, of the Royal Electric Company, Peoria, Ill., and Mr. J. C. Hobart, general manager of the Triumph Electric Company, Cincinnati.

MR. STANLEY S. STOUT, who for some time past has been very prominently identified with telephone litigation in behalf of independent telephone companies, died quite suddenly in this city after a brief illness. Mr. Stout represented the interests of the Western Telephone Construction Company, and his work in bringing about the defeat of the Watson and Roosevelt patents, which cover broadly the automatic hook switch used in all telephones, brought him into great prominence. Mr. Stout had a host of friends, and was a prominent member of the Marquette Club.

THE CUTLER-HAMMER MANUFACTURING COMPANY, which represents the consolidated interests of the old Cutler-Hammer Manufacturing Company and the American Rheostat Company, of Milwaukee, has its offices and works at 70-80 West Jackson Street, this city. The capital stock of the company has been increased to $75,000, and a large proportion of this has been invested in new machinery. With its increased manufacturing facilities and larger capitalization the company will be able to take care of its rapidly increasing business in a prompt and satisfactory manner. The officers of the new company are: F. R. Bacon, president; F. L. Pierce, vice-president; J. G. Hickcox, secretary and treasurer; H. H. Cutler, electrical engineer and general manager.

ST. LOUIS NOTES.

ST. LOUIS, Mo., June 24, 1898.

THE SUBURBAN ELECTRIC RAILWAY COMPANY having failed to reach an understanding with the Union Depot and St. Louis & Cass Avenue Railway Companies, with reference to terms on which it may run over their tracks on the downtown loop, the question will have to be adjusted by com[illegible]

THE CONTROVERSY between the St. Louis, Belleville & Suburban Electric Railway and the Day line has been taken in hand by the East St. Louis City Council. At a meeting of Council this week a resolution was passed to the effect that unless a traffic agreement was made between the Suburban and the City Electric Railway within the next few days the Council would settle the matter. How this would be done was not stated.

THE CHICAGO & ST. LOUIS ELECTRIC RAILWAY.—The Circuit Court refused to grant a mandamus compelling the officers of the Chicago & St. Louis Electric Railway Company to permit George H. Little to see the com[illegible] The company [illegible] organized years ago to build an air line [illegible] between St. Louis & Chicago, and Little alleges that he invested considerable money in the enterprise, and wants to see the books to [illegible]

THE [illegible] ELECTRIC LIGHTING COMPANIES.—The Supervisor of City Lighting [illegible] St. Louis, Edison of Carondelet [illegible] Light & Power Companies, notifying them that they [illegible] requiring them to file with the [illegible] and pay into the city treasury [illegible] January and July of each year. The [illegible] companies above [illegible]

COLORADO NOTES.

[illegible] Colo., June 21, 1898.

[illegible]

operation was not introduced the company would be forced into the hands of a receiver. The company is granted a franchise for a term of twenty years, and it agrees to pay as a consideration the sum of $2500 per annum. The company is given the right to use any motive power except steam, but no plan but the trolley system is under consideration. It is provided that the company shall conform to existing regulations in relation to fenders and vestibules. The company is also required to make provision for carrying bicycles. The adoption of the ordinance by the aldermen by no means ends the matter. The measure will now go to the Board of Supervisors, and then to the Mayor. A great deal of opposition has been made to the measure on the ground that the city is not sufficiently compensated for the franchise, and that certain restrictions should be imposed on the company. It is urged that it should be limited to a certain motive power, that it should be restrained from hauling freight, that it should be required to relinquish its old franchise which the company claims is perpetual before it is given a new right. It is announced that if the company is finally given the right to change its motive power it will expend about $400,000 in the improvement. The Aldermen have also passed a bill giving the Colfax Railway Company the right to build tracks on certain streets in the eastern district of the city. This company owns and operates an electric railway in the town of Montclair, a suburb of Denver. Latterly the road has been practically shut down, as it was a losing venture. It is announced that an arrangement for operating the road has been made with the Denver Consolidated Tramway Company. The new franchise will enable the company to make connections with that company's lines.

PACIFIC COAST NOTES.

SAN FRANCISCO, Cal, June 19, 1898.

THE CENTRAL CALIFORNIA ELECTRIC COMPANY is installing a duplicate of its Newcastle-Sacramento transmission plant. An additional 500-kw two-phase Westinghouse generator is included in the equipment.

LIEUT. W. STUART-SMITH, retired, who until recently was located in this city as a consulting electrical engineer, is now in active service in the steam engineering department at the Navy Yard, Mare Island, Cal.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY supplied a 75-kw direct current generator, to be used for torpedo firing at the mouth of the Columbia River. In all about $15,000 worth of electrical apparatus was installed in that locality.

THE PACIFIC COAST ELECTRIC COMPANY, formerly located at 241 Powell Street, has been consolidated with the California Electrical & Construction Company, E. H. Forst, manager. Mr. Forst will be manager of the combination, which will do business at 1425 Market Street.

THE JOHN M. KLEIN ELECTRICAL WORKS, San Francisco, received the contract for a 50-mile equipment for a signal train to accompany the Philippine expeditionary forces. The principal items were: Four hundred field telegraph lances, to be loaded on lance wagons; 1500 cells of battery, a number of telegraph instruments and single cables to be attached to the lances by rubber and porcelain hooks. The lances are 2 and 1½ inches, round, by 14 feet in length, with sharp butts; to be placed 125 feet apart.

THE WESTERN UNION TELEGRAPH COMPANY now has its Seattle-Victoria, B. C., line in successful operation, via Port Townsend and Port Angeles, Wash. A number of new offices have been established along the new lines. Eight separate cables had to be constructed for this northern extension, the longest being 18 miles in length. The new land lines required the stringing of 125 miles of copper wire. The rate from Victoria to Port Townsend, Wash., has been cut from $1.10 to 25 cents for 10 words. Formerly a message had to be handled by three companies.

THE SOUTHERN CALIFORNIA POWER COMPANY, after an annoying delay, has secured the funds required to complete its 80-mile transmission line to Los Angeles, Cal. The machinery will soon be completed by the General Electric Company. The Edison Electric Company, of Los Angeles, will have entire control of distributing the Southern California Power Company's current at that point. A contract has been let to H. H. French for the construction of a pole line from Crafton station, on the S. P. R. R., to Los Angeles, including connections with the power houses of the Los Angeles Railway Company, the Los Angeles Edison Company, the Pasadena & Los Angeles Railway Company and the Pasadena Electric Light Company. The new transmission system will be in operation this fall.

CANADIAN NOTES.

OTTAWA, Ont., June 25, 1898.

THE AMALGAMATION of the Quebec & Montmorency Railway and the Quebec District Railway is said to have been effected. The motive power of the former road will likely be converted to electricity.

THE NEW COPPER WIRE of the Canadian Pacific Telegraph, in course of construction from coast to coast, was completed between Montreal and Winnipeg last week. The first message over the new wire was sent by Mr. C. R. Hosmer, manager of telegraphs, to Mr. Shaughnessy, vice-president of the company. The new line gives the Canadian Pacific Company greatly increased facilities between the Atlantic Coast and the city of Winnipeg, Man.

THE REPORT of Mr. James Milne, the electrical expert employed by the city of Toronto to make a report on the cost of an electric power supply for street lighting and commercial purposes for Toronto, is against the city erecting a commercial plant. Mr. Milne reports that the data received from users of both electric and steam power is not to be absolutely relied on for the purposes of careful calculations, owing to the different bases upon which the various returns have been prepared. The summary of steam users shows a consumption of 16,802 horse-power, from which may be deducted 10,000 horse-power for the Toronto Electric Railway Company and electric light companies' plants, leaving 6802 horse-power for commercial purposes. Of this amount, he says, nearly 1000 horse-power could be supplied by electric power or gas as cheaply as at present, but for the remaining [illegible] horse-power it is useless trying to [illegible] to change from their present method.

ENGLISH NOTES.

(From Our Own Correspondent.)

LONDON, June 18, 1898.

THE ELECTROPHONE.—The "electrophone," or, as it was formerly called, the "theatrophone," is now being used to a considerable extent in London. The Electrophone Company has an arrangement with the National Telephone Company, by which subscribers to the exchanges of the latter can obtain communication with certain theatres and concert halls during the evenings and Saturday afternoons, and some of the most popular churches on Sunday, when there is not much demand for junction wires for ordinary conversation. Although the rental is fairly high, the service is appreciated very much, especially that to the St. James' Hall and the Queen's Hall, where, with the exception of at the Opera House, the best music is to be heard in London. One evening last week, at an entertainment given by the Electrophone Company, connection was also obtained through the London-Paris line to the Opera House in Paris, and a performance of "Le Prophète" was extremely relished by the guests.

MUNICIPAL ELECTRICAL SUPPLY.—Much dissatisfaction is felt by the companies supplying electricity in London by the fact that Parliament had granted provisional orders under the electric lighting acts to two metropolitan vestries, one in Bermondsey and the other in Marylebone. In the former district the company has had a provisional order for several years, and has not made use of it, but in the latter case, the Metropolitan Company has been working very successfully for a long period. It is feared that all other vestries will follow suit, so that there may be a disastrous competition to supply companies by these local authorities working in the same area, and having to some extent better facilities than a limited company. On the other hand, it appears that the London County Council wishes to be in a position to undertake the supply of electrical energy "in bulk." At a meeting of the County Council, under the local authorities, held yesterday, resolutions were carried to the effect that the conference regarded it as essential to the interests of London as a whole that the present purchase clause in the Electric Lighting Acts should be made to apply to such companies as propose to supply electrical energy in bulk to the whole of London without regard to area. A resolution was also passed that it was desirable that the London County Council should be in a position to undertake—if it so desired or were so requested by the local authority—to supply electrical energy in bulk for the convenience of any particular districts.

MUNICIPAL ELECTRICAL ASSOCIATION.—In this country a great many more municipal concerns own electric lighting stations and tramways than in America, and the third annual convention of the Municipal Electrical Association, which was held in London, from June 8 to June 11, was exceedingly well attended, and a number of very excellent papers were read. On the first day, after the delivery by the president, Mr. A. H. Gibbings (Bradford), of his inaugural address, a paper was read by Councillor Hesford (Southport) on "The Management of Electrical Undertakings by Local Authorities." This paper provoked considerable discussion from those present, who included not only electrical engineers attached to municipal undertakings, but also chairmen of electricity committees and one or two consulting engineers and manufacturers. The paper was followed by a paper by Mr. J. R. Blaikie, chief assistant engineer at Bristol, on "Switchboard Apparatus," and this, as well as the paper on "Steam Using Plant," by Mr. Jeckell (South Shields), was well discussed. During the afternoon visits were made to the City & Waterloo Railway, which is approaching completion, and to the electricity works of the Islington Vestry in London, and in the evening the annual dinner took place. On the second day three papers were down for reading. The first on "The Uniformity of Plant," by Mr. Wordingham, of Manchester, provoked an animated discussion on the question of standardization. In this country electric light plants have not been standardized in the same way as in the States, and some of the facts brought to light showed a very remarkable state of affairs. The declared pressures supplied by central stations in the United Kingdom vary from 50 to 440 volts, and among them are such remarkable numbers as 84-103, 107-114, 102, 113, 230, etc. One station, Mr. Wordingham stated, which normally supplied at 100 volts, supplies at 102 "by a special arrangement with the lunatic asylum." Of the fifty-eight alternate current stations in the United Kingdom there are no fewer than eighteen different frequencies, varying from 40 to 125, and the list given of the various sizes of generating units is also an extremely long one. During the discussion the blame was alternately attributed to the central station engineers, the consulting engineers and the manufacturers. It was incidentally mentioned that incandescent lamps of a useful efficiency can now be obtained from the manufacturers for pressure as high as 250 volts. The paper on "The Appropriation of Profits and Repayments of Loans," by Bailie Maclay, the convener of the Glasgow Electricity Committee, cast interesting light on the way the various municipal concerns distribute the profits derived from their electrical supply, for over here a great number of muncipal electric lighting concerns are working on a profit making basis and are not a burden on the rates as in America. It appears that some stations deem it advisable to put away all their surplus in various depreciation and renewal funds; others lay aside hardly anything for depreciation, and either supply public lighting below cost price or use the profits to relieve the rates. The private consumers seem to be, as a rule, the last to benefit by the success of these municipal electric lighting schemes. After a hasty discussion on a paper entitled "Single vs. Multiple Generating Stations," during which nearly everybody agreed that no hard and fast rule could be laid down as to the critical limit of horse-power at which a single generating station can be said to be more economical than multiple stations, the meeting adjourned for the day. The majority of the members paid a visit to Messrs Willans & Robinson's celebrated engine works at Rugby, and a few visited the Croydon Electricity Works and the lamps works of the General Electric Company at Hammersmith. The meeting on the 10th inst. considered three papers on electric traction, and the discussion on these, although raising many points of interests, would perhaps appear rather tedious to your readers. Visits were made to Messrs. Siemens Brothers & Co.'s works and to the Shoreditch Electricity Works in the afternoon. The last day of the convention was devoted to the consideration of business questions and the election of council of officers and fixing of the place of meeting for the next convention. Visits were made to the Portsmouth and Dover electricity works. The next convention will meet at Bristol, and Mr. Faraday Proctor, who is chief electrical engineer of the electric light works there, is to be the president.

FRENCH NOTES.

(From Our Own Correspondent.)

PARIS, June 9, 1898.

INTERNATIONAL SOCIETY OF ELECTRICIANS.—The regular monthly meeting took place on June 1 at the rooms of the Society of Encouragement. The president, M. R. V. Picou, was in the chair. M. Ducretet began with a paper on telegraphy without wires by means of Branly's coherer, and subsequently M. Gosslin exhibited a number of different forms of potentiometers, which are in actual use. M. Ducretet's experiments consisted in sending long and short signals through a circuit, producing them with successive makes and breaks at a transmitting station and recording them automatically at a receiving station with a Morse receiving apparatus. At the transmitting station was a Ruhmkorff coil capable of giving a spark of about 12 to 15 inches in length, and having a mercury interrupter and a mercury hand key connected with the primary coil. The mercury interrupter was operated by a small electric motor driven from a separate battery. The current in the primary circuit was turned on or off by manipulating the key. To the terminals of the secondary coil was connected an oscillator and also two rods ending in spheres. The latter were immersed in an insulating fluid, and sparks passed between them. To each terminal of the oscillator was also connected a wire, one being grounded and the other being connected to a very tall, insulated rod. It was from this rod that the waves started. The waves were received by a Branly coherer provided with an automatic tapper and connected with a Morse mechanical recording mechanism. The experiments were entirely successful and very interesting.

SOCIETY OF ELECTRICIANS.—At the meeting of May 4 M. R. Picou delivered his inaugural speech; he closed with a eulogy on his predecessor, M. d'Arsonval. M. Laporte read a communication on the results of a study of the photometric standards in use at the Central Electrical Laboratory. He obtained some lamps which had been standardized at the Berlin Electro-Technical Institute, and measured them again for purposes of comparison. His results were as follows:

Berlin......................	108.5 volts	0.338 amperes	10 Hefner
	111 5 "	0.489 "	16 "
Central Laboratory..........	108.5 "	0.338 "	8.7 Carcel
	111 "	0.487 "	14.2 "

The author then gave some information on the standard lamps which he used, especially on the Carcel lamp, following the instructions which he received from M. Condorchon, inspector of gas lighting for the city of Paris, and on the Hefner lamp and the paraffine candle, etc. Using the same lamp X the author compared it with the various standards, and obtained the following values for the brilliancy : X = 0.194 (B) standard laboratory lamp B = 1

X = 0.341 Carcel light.
X = 0.72 Hefner light.
X = 3.13 paraffine candle.

M. Laporte states that 1 Hefner = .092 Carcel and that 1 paraffine candle = 0.109 Carcel. These figures are taken from a series of measurements, all of which agreed within 2 per cent. M. Girault spoke on the commutation in direct current dynamos.

General News.

NEW INCORPORATIONS.

THE KANE'S FALLS ELECTRIC LIGHT COMPANY, of Fort Ann, N. Y., has been incorporated with a capital stock of $25,000.

THE MASSACHUSETTS STREET RAILWAY ASSOCIATION, Boston, Mass., has been incorporated under the laws of Massachusetts, and may conduct employers' liability insurance.

THE ROCKFORD ELECTRIC LIGHT & POWER COMPANY, Rockford, Ill., has been formed with a capital stock of $50,000. The incorporators are F. M. Ellis, W. E. Dewey and C. F. Warner.

THE SOUTH MISSOURI TELEPHONE COMPANY, of Pierce City, Mo., has been incorporated with a capital stock of $20,000. Among those interested are S. J. Armstrong, G. R. Armstrong, Albert Newman and others.

THE WHITE PLAINS LIGHTING COMPANY, White Plains, N. Y., has been formed for a period of fifty years, with a capital stock of $50,000. The directors are Winthrop G. Bushnell, New Haven, Conn.; Joseph H. Hall, Port Chester, N. Y., and John C. Bennett, Brooklyn.

THE GENERAL ELECTRIC AUTOMOBILE COMPANY, Philadelphia, Pa., has been organized under the laws of West Virginia, with an authorized capitalization of $2,500,000. The Board of Directors includes J. A. Brill, W. D. Marks, Rudolph M. Hunter and John H. Noblit.

THE CANADIAN BRYANT ELECTRIC COMPANY has been organized at Bridgeport, Conn., with a capital stock of $5000. Among those interested are C. W. Bryant, L. W. Eaton, J. B. Hubbell, E. W. Marsh, H. S. Hubbell and E. M. Scribner. The company has a factory at Montreal.

THE CROWN INCANDESCENT COMPANY has been incorporated at Camden, N. J., with a capital stock of $100,000. The objects of the new company are to conduct and operate electric light plants and furnish heat and power. The incorporators are John Pechin, Robert Barr, Joseph Green and Louis A. Repetto.

THE TELEGRAPH AND TELEPHONE.

HERMANN, MO.—Hermann is to be connected with the long distance telephone system.

BUTLER, OHIO.—The Farmers' Co-operative Telephone Company is building a telephone line from Butler to Belleville.

EVANSVILLE, IND.—The Cumberland Telephone Company has completed its line from Carmi to Mt. Vernon, Ind. This gives Carmi direct communication with Mt. Vernon and Evansville.

CHILLICOTHE, OHIO.—The Home Telephone Company has recently purchased the private line running from Chillicothe to Londonderry, and now has control of another important territory in the country.

ALVIN, TEX.—The Alvin and Angleton telephone line has been completed, and the two towns are now in telephonic communication. There are two stations on the line, one at Pleasant Bayou and one at Amsterdam.

MADISON, WIS.—The Northwestern Long Distance Telephone Company is building a telephone line connecting Flandreau and Pipestone. The line will be extended to Egan, Colman, Wentworth and Madison, and from there to Woonsocket and thence north.

NEW LONDON, CONN.—The Southern New England Telephone Company has just completed the construction of new lines in Noank, Blackhall and Westbrook, the wires from the two first-named villages running to this place, and Westbrook being connected with Saybrook.

PONTIAC, ILL.—The Livingston County Telephone Company has completed its new exchange building. The poles are erected, the wiring now being put up for the removal of its central office. This new office will be complete in every respect, being equipped throughout with the standard apparatus of the Sterling Company, Chicago.

ROCHELLE, ILL.—The Olga County Telephone Company has obtained the right of way to string wires in Creston. The company will immediately extend its line to that city, and will connect with the DeKalb County Telephone Company's line. The Olga County Telephone Company has recently increased its capital stock from $5000 to $10,000.

EASTHAMPTON, L. I., N. Y.—The New York & New Jersey Telephone Company is engaged in extending its system to include the pay stations of the long distance telephone service in the railroad depots along the Montauk division of the Long Island Railroad. Work of installation is in progress here and at Amagansett, and it is understood that the stations throughout the length of the road are to have the telephone stations added to their equipment.

TRENTON, N. J.—Clarence W. Derby, a convict in the State prison, was pardoned on June 21 by telephone by Governor Voorhees, who was at Sea Girt. The Governor first inquired of the Attorney-General whether his pardon by telephone would be sufficient. The Attorney-General decided that it would. The occasion for this haste was due to the fact that Derby was dying, and it was the desire of his parents to get him home before death intervened.

NASHVILLE, ILL.—The American Long Distance Telephone & Telegraph Company, with headquarters in Chicago, has succeeded in getting the right of way through all the principal counties and cities of Southern Illinois, and now has a force of men at work erecting lines. The main line will extend from St. Louis to Evansville, Ind., and will have direct connection with Chicago and New York. The long distance wires between this city, Mount Vernon and Mascoutah have already been strung.

ATHENS, ALA.—The Town Council has passed an ordinance granting to the American Telephone & Telegraph Company the right to construct and operate telephone and telegraph lines in Athens. The company in return for this privilege has agreed to furnish free of cost to the town the use of its poles for the fire alarm and police wires and to maintain an office for telephone business in this town. This gives Athens a long distance telephone connection and puts her in direct communication with all the trade centres.

ELECTRIC LIGHT AND POWER.

NEW IBERIA, LA.—The electric light plant at this place was totally destroyed by fire recently.

[illegible]—The [illegible] electric light plant has been sold to parties [illegible] enlarge and improve it.

[illegible], OHIO.—[illegible] will have her own electric light plant and the [illegible] Construction & Electrical Company has secured the contract for its [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

installing these lamps was done by the Reading Electrical Construction Company, Limited, under the supervision of Mr. A. V. Arrowsmith.

THE ELECTRIC RAILWAY.

SYRACUSE, N. Y.—The electric road of the Syracuse, Lakeside & Baldwinsville Railroad Company will be completed about July 1.

KANSAS CITY, MO.—The Metropolitan Street Railway Company is surveying the route for a new electric street railway in this city. Work will begin on the same early in July.

PHILADELPHIA, PA.—The Shamokin Street Railway Company has been purchased by Congressman M. H. Kulp, of that city, and Judge C. R. Savidge, of Sunbury. The line will be improved and Indian Park made is terminus.

WHITE PLAINS, N. Y.—According to plans decided upon recently, the Tarrytown, White Plains & Mamaroneck Electric Railroad Company contemplates making important extensions, both easterly along the sound and northerly to the Putnam County line.

PHILADELPHIA, PA.—Work has begun on the electric road to connect Lehigh and Kutztown, Pa., for 1 mile westward from Allentown the road is already complete. The entire line will be completed by September 1, and will be operated by the Allentown & Kutztown Traction Company.

CHESTER, PA.—The officials of the Chester Traction Company and the Mayor of the city of Chester have come to an agreement on the terms of the ordinance granting the company the right of way through the streets of the northwestern section of the city, and the ordinance is now in effect. The work will be begun at once.

CHICAGO, ILL.—The Northern Electric Company is applying to the City Council of Chicago for a franchise for fifty years under the terms of the Allen law, so that it may extend its lines to the city limits. The company offers to pay a license fee of $50 per car for the first five years, and after that an additional fee in a percentage of the receipts, the same to be increased each five years, so that the last fifteen years the rate will be 10 per cent. The length of the line is about 3 miles.

CHICAGO, ILL.—It is stated that all the franchises and rights of the Chicago General Electric Railway Company are now owned by the Chicago City Railway Company. The price paid for the property was $950,000. This trade ends a fight which had been waged in and out of court almost constantly for three years. The fight had been a costly one. Including the purchase price of $950,000, it has cost the city railway Company no less than $3,000,000. Once a 60 per cent. interest in General Electric was offered to the City Company at $40,000, and the City Railway refused to buy, while at another time the City Railway people bid $1,450,000 for the General Electric property, and the owners of the latter refused to sell. The principal benefit accruing to the City Railway from its purchase is the removal of a menace which has been hovering over its property for years, holding down the prices of its securities and darkening its future more or less in the minds of investors.

PERSONAL NOTES.

MR. E. L. BRAYTON, of the Pelton Water Wheel Company, San Francisco, who has been at the company's New York office for some time past, has gone abroad on business for his company.

MR. WILLIAM F. OSBORNE, formerly Eastern representative of the "Western Electrician," and now manager of the "National Provisioner," was married on June 20, to Miss Emma Catharine Gale, of Brooklyn. Mr. Osborne's many friends congratulate him and wish him and his bride a long and happy life.

CAPT. GEORGE O. SQUIER, chief signal officer at Governor's Island, New York Harbor, and a well-known writer on electrical subjects and joint inventor of the synchronograph system of telegraphy, has been ordered to proceed to Chickamauga. Captain Squier has been detailed as chief signal officer of General Wade's corps.

MR. KEMPSTER B. MILLER, who is well known by reason of his work as designer and patent expert for the Western Telephone Construction Company, has accepted a position with the International Correspondence Schools, of Scranton, Pa., where he will have charge of the courses in telephony and telegraphy. Mr. Miller's rise in electrical work has been rapid. Born in Boston in 1870, he graduated from the course in electrical engineering at Cornell University in 1893, after which he worked for a time as draftsman with the Thomson-Houston Company, Lynn, Mass., afterward entering the patent office as assistant examiner, where he remained in the electrical division for about three years, handling largely telephone cases. During the last two years he has been chief electrician and patent expert for the Western Telephone Construction Company, Chicago. Many of the designs and details used by the company are of Mr. Miller's invention.

TRADE AND MISCELLANEOUS PUBLICATIONS.

THE PHOSPHOR BRONZE SMELTING COMPANY, Limited, [illegible] Washington Avenue, Philadelphia, has issued price list No. 13 of its well known [illegible] Brand" phosphor bronze and other alloys, of which this company is [illegible] original manufacturer in the United States and sole maker.

THE HARRISON SAFETY BOILER WORKS, Philadelphia, in a neatly gotten up catalogue, tell all about Cochrane separators for removing liquids or solids from live steam, exhaust steam, compressed air, ammonia gases, etc. A long list of users of these appliances is given, among them being the largest manufacturing concerns in the country. The apparatus itself is described and illustrated in [illegible] form, and tables of dimensions are given. The catalogue contains forty-eight pages and an index.

ELECTRICAL SPECIALTIES, including attachment plugs, branch blocks, socket cutouts, cleats, insulators, cutouts, [illegible], etc., etc., as manufactured [illegible] N. Y., are fully treated and illustrated in catalogue No. 10, just issued by this well known firm. The list included in the catalogue is a very complete one, and everything in the line of china manufacture is included. The firm calls special attention to several specialties recently added to its list. These include attachment plugs, key pony receptacles, bracket rosettes, fusible socket rosettes and all-china junction boxes., This firm has been very successful in making insulators of difficult patterns. It has a plant especially designed for this class of work, and a machine shop fully equipped for die making.

Trade and Industrial Notes.

THE CENTRAL ELECTRIC COMPANY, of Chicago, is carrying in stock an improved type of turnbuckles, both galvanized and plain, which can be furnished hook and eye, double hook, or double eye. These goods are standardized and constructed with a view of great strength being secured.

A NEW TYPE of standard base, 6-cp lamp, is being pushed to the front by the Central Electric Company, Chicago. This lamp is made for standard voltages, is 3½ inches long over all, and about 2 inches in diameter. It is said to be exceedingly economical of current, and will undoubtedly find popular use for signs and other purposes where low candle-powers are desired.

THE DIEHL MANUFACTURING COMPANY, Elizabethport, N. J., in a circular to the trade, announces that it has commenced suit against a Washington firm for infringement of its electric fan patents. The suit is based on four patents, and as soon as these are judicially sustained, the Diehl Company states that it will proceed against all dealers in and users of infringing fans for damages and injunction.

MESSRS. KURZ & ROOT, consulting electrical engineers, Appleton, Wis., on May 16 opened an electrical repair shop in connection with their factory, and are now prepared to make repairs on short notice, such as rewinding armatures, fields and transformers, and repairing and standardizing burned out or defective electrical instruments, etc. Both Messrs. Kurz & Root are young men, and are qualified to render first-class service in their line.

THE BERLIN IRON BRIDGE COMPANY, East Berlin, Conn., is supplying all the structural steel work for the extensive additions to the gas producing plant of the United Gas Improvement Company, Philadelphia. The gas company is erecting a new boiler and engine room, a condenser building, a purifier building, a generator house and a meter house, all of which are of steel fram construction, brick side walls and slate room supported on metal purlins carried by clear, span trusses.

THE STERLING ELECTRIC COMPANY, Chicago, Ill., on account of the rapid increase in its business, finds it necessary to open a Southwestern office in St. Louis. Mr. H. A. Coit, formerly manager of the Missouri Telephone Company and one of the best-known men in the independent telephone field, will have charge of the Sterling Company's business in that territory, and will carry a full line of the company's samples and take charge of its Southwestern business. His office is located in the Laclede Building.

THE M. C. BULLOCK MANUFACTURING COMPANY, Chicago, Ill., reports that its business has been gradually and steadily improving for the past five or six months, and that its total shipments for the month of May aggregated more than the shipments of any month since the financial crash of 1893. The company is doing a large mining business, and several plants of this character are included in the list of recent shipments. Some of its mining apparatus has been shipped recently to Japan and Siberia.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is calling attention to the new Whitney pocket voltmeter, which promises to find a large field of usefulness, particularly among telephone companies, where an accurate voltmeter of low range is desired. This instrument is about the size of an ordinary watch, and can be easily carried in the pocket. It has every advantage of a regular battery gauge, with the additional advantage of being an exact and accurate scale, instead of merely a comparative scale, as the battery gauges have heretofore been made.

THE PRISMATIC ELECTRIC SIGN COMPANY, Williamsport, Pa., reports that in spite of the fact that some people are finding business dull at the present time, it has been unusually busy. Its contracts for electric signs since June 1 have been very large, and shipments have been all over the United States, as the following list shows: Glenwood Springs, Col.; Atlanta, Ga.; Rochester, N. Y.; Pittsburg, Pa.; Little Falls, N. Y.; Washington, D. C.; St. Joseph, Mo.; Sacramento, Cal.; St. Louis, Mo.; Stroudsburg, Pa.; Southampton, N. Y.; Detroit, Mich.; Erie, Pa.; Buffalo, N. Y.; Syracuse, N. Y.; Bushnell, Ill.; Fort Smith, Ark.; New York City, N. Y.

THE MULLINIX ELECTRIC COMPANY, Cincinnati, Ohio, has been recently organized to manufacture a line of electrical specialties. Mr. C. L. Mullinix, general manager of the new company, was formerly a partner in the Ohio Electric Specialty Company, Troy, Ohio, which partnership has been lately dissolved. Mr. Mullinix was the designer of the "Perfection" dynamo brush made by the Ohio Electric Specialty Company. He has improved the brush, and it will be manufactured hereafter under the name of the Mullinix dynamo brush. The new company will also manufacture all the ordinary types of woven wire and leaf copper brushes, and other electrical specialties will be added.

THE ERICSSON TELEPHONE COMPANY, 20 Warren Street, New York City, will be represented at the Chicago Convention of the National Independent Telephone Association on June 30, July 1 and 2. The company has added to its already large line of telephones a complete line of domestic type instruments manufactured by itself, all of which are equipped with the Ericsson Swedish coal-grain microphone; all-metal, bipolar, never-changing receiver and induction coil. A line of these instruments will be exhibited at the Palmer House during the convention, and the company invites all independent telephone men to inspect them. The company is now importing the Ericsson Swedish induction coil on such terms that will meet with the general favor of the independent telephone people.

THE PELTON WATER WHEEL COMPANY has been awarded the contract for the hydraulic work of the new plant of the Central California Electric Power Company, to be installed at Auburn, Cal. This station is to embrace two 43-inch wheels, to run under 200-foot head, at 300 revolutions, and develop 800 horse-power. The wheels will be direct connected to a 500-kw Westinghouse generator, the power to be transmitted to the Newcastle station of this company, 6 miles distant, and to Sacramento over the same pole line. The entire distance from the Auburn station is 34 miles. The interesting features of this plant consist in running two stations so far apart in parallel; also in the double use of the water, it being the same that supplies the Newcastle station, 6 miles lower down. With the rapid fall of many mountain streams, power can thus be multiplied indefinitely and generally within reasonable limit of transmission.

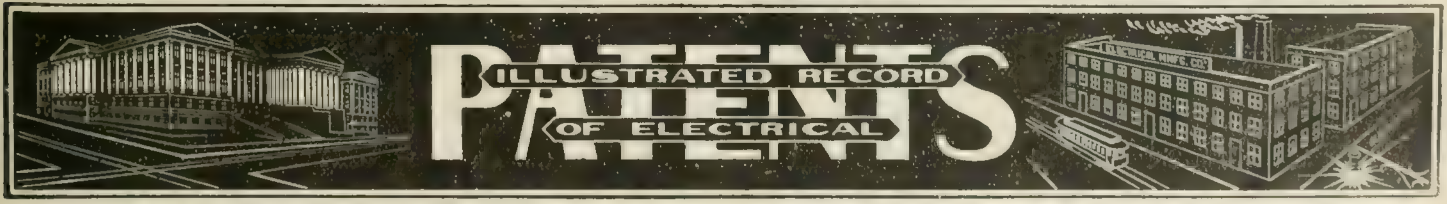
THE AMERICAN WHEELOCK ENGINE COMPANY, Worcester, Mass., is meeting with success in installing the Greene-Wheelock engine. Among the plants now in course of erection or construction in its shops, and those recently installed are the following: Six 1500-hp engines for the Chicago City Railway Company, with rope drives; one 750-hp direct connected engine for the New York Heat, Light & Power Company; three 350-hp direct connected engines for the J. G. White Company, New York, and two 500-hp cross-compound, directed connected engines for the Potomac Electric Power Company, the latter being the second order, the previous order being for two 750-hp direct connected engines. The American Wheelock Company has installed at th Grosvenor-dale Electric Light Plant, Grosvenor-dale, Conn., the high pressure side of a cross-compound engine, putting its cylinder and valve gear onto a Corliss bed and replacing the Corliss cylinders. This is the second Corliss engine in this plant that has been replaced by the American Wheelock Company's cylinder and valve gear.

THE AMERICAN ELECTRIC TELEPHONE COMPANY, Chicago, Ill., has recently received a letter from Mr. M. J. Dillman, vice-president and general manager of the Capital Telephone & Telegraph Company, Sacramento, Cal., in which the writer makes some references to a recent suit which was decided in part against the Capital Company and in favor of the Western Electric Company, of Chicago. Mr. Dillman states that the suit was upon the alleged use by his company of a multiple switchboard, and was instituted on October 16, 1895. The first purchase made by the Capital Company, of the American Electric Telephone Company, was on or about February 15, 1897. The Western Electric Company obtained an injunction, Mr. Dillman states, restraining his company from using the boards in multiple. The American Electric Telephone Company, he says, has never used the boards in that manner and has no desire to do so. The Capital Company made a test of transmitters manufactured by the leading telephone manufacturers in the United States, and after a thorough investigation as to the merits of each instrument, decided to adopt the American Electric Telephone Company's telephones. Mr. Dillman reports that up to the present time he has failed to find anything on the market comparing with the new American Electrric Telephone company's solid back amplifying. transmitter for either long or short distance work under severe conditions.

Business Notices.

THE ILLUSTRATIONS in this issue were made by the Photo-Engraving Company, 9-15 Murray Street, New York City.

NEW WABASH FAST TRAIN EAST. "The Continental Limited," a new fast train on the Wabash, now leaves Chicago daily at 12:02 noon, and arrives at Buffalo at 5 A. M., New York 3:30 P. M and Boston 5:50 P M, next day, with through car service. Ticket office, 97 Adams Street, Chicago



UNITED STATES PATENTS ISSUED JUNE 21, 1898.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

605,850. ELECTRIC MOTOR; F. E. Briner, of St. Louis, Mo. App. filed August 21, 1897. The herein described armature for induction motors, the same comprising a laminated core formed with transverse grooves in its periphery, and induced-current-conducting bars arranged in said grooves, and having their ends bent so as to form a continuous short-circuiting band at each side of the armature, for said induced-current-conducting bars.

605,852. ELECTRIC METER; T. Duncan, of Fort Wayne, Ind. App. filed May 10, 1897. An electric meter provided with a cylindric armature, a shunt field within the armature, and a series field wound about the armature comprising separate horseshoe-shaped cores partially embracing the armature, and series coils wound upon said cores.

605,913. TELEPHONE TRANSMITTER; I. A. Ray, of Boston, Mass. App. filed August 18, 1897. In a telephone transmitter, an outer casing composed of two inseparable parts, back and front, a bridge diametrically of, but within the casing, combined with a screw-threaded boss to receive the arm of the instrument and a screw which unites the bridge with the boss to hold the back and front of the casing together as a unit.

605,915. ELECTRIC CLOCK CONTROLLED SWITCH MECHANISM.

R. W. Rollins, of Hartford, Conn. App. filed Sept. 27, 1897. In an electric clock-controlled switch mechanism, the combination, with a pair of electric circuits, of a clock controlling said circuits and embodying a driving arbor, and two independently regulable circuit-controlling mechanisms, mounted on said arbor and insulated from each other, one for each of said circuits.

605,941. ELECTRIC BLOCK-SIGNAL SYSTEM FOR RAILWAYS; L. C. Werner, of Broad Brook, Conn. App. filed July 22, 1897. In an automatic electric block-signal system, the combination, with a track having a sectional conductor forming insulated blocks, of a vehicle moving along said track; a primary electrical register controlled by a block circuit; and a separately operative secondary electrical register controlled conjointly by the primary register and a block circuit.

605,949. ELECTRIC METER; T. Duncan, of Fort Wayne, Ind. App. filed June 24, 1897. An electric meter provided with a cylindric armature, a series field without the armature, and a shunt field within the armature comprising a cross-shaped core, and shunt coils upon said core.

605,953. CONTROLLING MECHANISM FOR ELECTRIC MOTORS; G. Gibbs, W. S. Johnson and H. Winkenwerde, of Milwaukee, Wis. App. filed May 10, 1897. In controlling mechanism for electric motors the combination with a rheostat, comprising a series of contacts and connected resistances and a movable contact arm, of an emergency switch, means tending to open said switch, a detent for holding the switch normally closed, means for disengaging said detent and releasing said switch, and means for automatically shifting the rheostat arm into starting position when said switch is opened, and for closing the switch when the rheostat arm is returned.

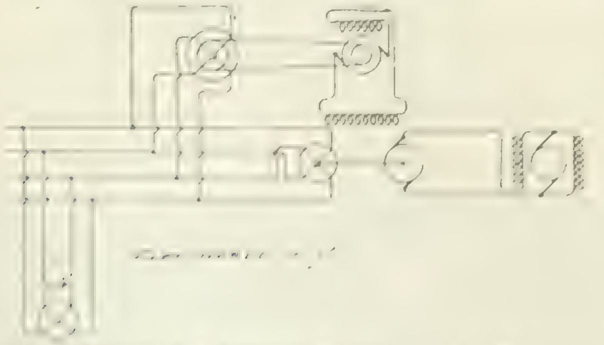
605,970. ELECTROMAGNETIC-SWITCH RAILWAY; A. Norman, of Toronto, Canada. App. filed July 3, 1897. In an electromagnetic-switch railway, a supply conductor, a sectional working conductor, switch boxes containing an L-shaped arm, four spring arms carried by the box and the arm respectively, having a contact with each other in pairs, and two plates and means for moving the plates vertically in an upward direction by the bridging of two of the sections of the working conductor and lowering the same by gravitation.

606,004. THERMAL CIRCUIT CLOSER; L. Emdin and J. A. Dewson, of Reading, Pa. App. filed Nov. 19, 1897. The automatic fire alarm, comprising a base, having a series of plates secured thereto, and in circuit with the alarm system, a spring designed to engage and hold said lever in a normally raised position, said lever being provided with depending arms or members, having lower curved ends designed to engage said plates, and means adapted to limit the movement of said lever under the action of said spring.

606,009. ELECTRIC CONTROLLER; M. W. Hanks, of Madison, Wis. App. filed Dec. 17, 1897. In an electric controller, the combination with a contact cylinder mounted on a rotatable shaft, of a second shaft provided with actuating means, and mechanism, interposed between the actuating means and the contact cylinder, comprising a projecting part on the cylinder shaft, engaging with a spring on the second shaft, whereby the contact cylinder may be instantaneously rotated, in either direction, to its consecutive positions, regardless of the velocity of the actuating means.

606,012. ELECTRIC CURRENT CONTROLLER; J. J. Hogan, of New Haven, Conn. App. filed July 15, 1897. In a current controller, the combination with an operating shaft carrying a resistance coil, of a carriage movable in a plane parallel with the axis of said shaft and carrying a contact finger which engages in said coil, a screw-feeding mechanism and a rack and pinion feeding mechanism, both of which are actuated by said operating shaft, and means for interchangeably connecting said carriage to said feeding mechanisms, whereby either mechanism can be utilized to impart movement to the carriage.

[illegible] SYSTEM OF ELECTRICAL DISTRIBUTION AND REGULATION; B. G. Lamme, of Pittsburg, Pa. App. filed Feb. 10, 1898. A system of distribution comprising a direct-current generator, a rotary transformer receiving current therefrom and supplying alternating currents to translating devices, a generator for exciting the field magnet of said rotary transformer, and means dependent upon changes in the amount of



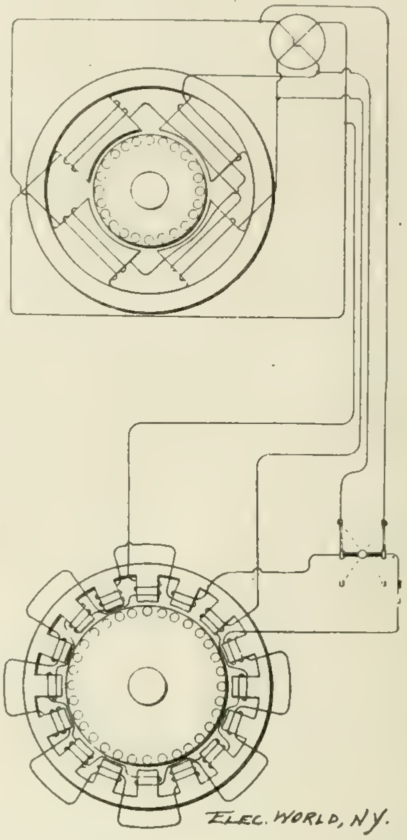
No. [illegible]—System of Electrical Distribution and Regulation.

[illegible]

[illegible]

ternating-current induction motors, one of which comprises two independently movable members, and the other, a stationary and a movable member, of means for mechanically connecting one of the members of the first motor with the movable member of the second, a source of alternating currents, means for electrically connecting the primary member of each motor with said source of currents.

606,076. ELECTRIC ALARM SYSTEM; A. Ovenden, of Akron, Ohio. App. filed Sept. 24, 1897. In an electric-circuit closer, an inclined way, consisting of a plurality of independent super-imposed members, each comprising a conducting rail and a non-conducting rail having a portion of its face composed of conducting material, and a roller-circuit closer.

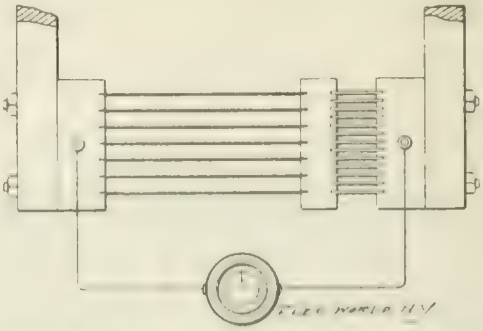


No. 606,056.—Alternating Current Electric Motor.

606,108. ELECTRIC ARC LAMP; F. Wright, of Newburgh, N. Y. App. filed Oct. 7, 1897. An arc lamp, comprising two magazines for containing carbons, tubes extended from the lower ends of said magazines and converging, carbon-locking devices on said tubes, means for automatically operating said locking devices, and stop-fingers on the tubes.

606,127. ELECTRODE FOR ARC LIGHTS; Chas. S. Dolley, of Philadelphia, Pa. App. filed Nov. 21, 1896. An electric arc electrode for use in connection with electric arc lamps, the same consisting of calcium carbide (Ca, C), of size, shape and resistance proportionate to the amount of current used.

606,162. TELEPHONE-EXCHANGE SYSTEM; W. W. Dean, of St. Louis, Mo. App. filed Feb. 6, 1897. In a telephone system, the combination with a telephone line extending from an exchange to a plurality of sub-stations, of a plurality of positively and negatively polarized bells and electromag-



No. 606,171.—Shunt for Electric Circuits.

net connected therewith located at the sub-station, mechanical means controlled by said electromagnet for preventing the actuating of said [illegible], and means at the central office for including said electromagnet in a circuit with direct current with positive or negative sign, and including [illegible] with current of positive or negative sign.

606,171. SHUNT FOR ELECTRIC CIRCUITS; O. B. Shallenberger, of Rochester, Pa. App. filed April [illegible]. A composite shunt, having a portion of [illegible] to changes in the temperature of the surrounding air and [illegible] being connected to act [illegible] in neutralizing the effect of said changes in temperature.

The Electrical World.

VOL. XXXII. NEW YORK, JULY 9, 1898. No. 2.

PUBLISHED EVERY SATURDAY BY

THE W. J. JOHNSTON COMPANY,

9 Murray Street, New York.

Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York.

New England Office, 620 Atlantic Ave., Boston.
Western Office, 936 Monadnock Block, Chicago.
Philadelphia Office, 929 Chestnut Street.

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THE ELECTRICAL WORLD,

9 Murray Street, New York.

VOL. XXXII. NEW YORK, JULY 9, 1898. No. 2.

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THE GENERAL MEETING OF THE AMERICAN INSTITUTE.

The American Institute of Electrical Engineers held its last general meeting at Omaha, Neb., June 27 to the 30th inclusive. The place of meeting was decidedly ill chosen, Omaha being uncomfortably hot at this season of the year and at such a distance from the cities most largely represented in the institute as to require a very disagreeable journey, during the hot season. The only compensating attraction was the existence of a few electrical exhibits at and the illumination of the Trans-Mississippi Exposition.

The result was a very small attendance of only about twenty out-of-town members, which is decidedly unsatisfactory, considering that the membership of the institute numbers about 1100. In meetings such as these the members of the institute become merely contributors to and readers of a periodical entitled "The Proceedings." Conventions are a great advantage, particularly in the discussions they permit, which often are of more value than the papers themselves. If institute conventions are to be held, some effort should certainly be made to increase the attendance.

The suggestion made by Dr. Kennelly in his inaugural address (to be found in another column) that the institute classify and publish the thesis work undertaken in the various colleges throughout the country year by year is a most valuable one. At present each college works more or less independently and in ignorance of the results previously obtained in the same line in other institutions, and but little of the work done comes to the notice of those connected with the electrical industries who might profit by it. The latter may object that such work is done by undertrained recruits and is hence of comparatively little value, but the guidance of instructors unbiased by trade affiliations and comprehending thoroughly the phenomena involved more than overcomes the objection.

THE LOSSES BETWEEN THE STATION METER AND THE CONSUMER'S METER.

In an attempt to fix a proper rate of payment for electric current the approximate cost per kw-hour at the switchboard being known, it is highly desirable to get some idea of the ratio between the power indicated by the consumers' meters and the corresponding power at the station switchboard. In a paper read before the American Institute of Electrical Engineers and abstracted in another column, Mr. W. F. White points out the astonishing loss of 60 or 70 per cent. in customary practice with alternating-current systems and house to house transformers, and attempts to account for it largely by the transformer core losses. There are other causes for a large part of this lamentable discrepancy. Integrating wattmeters with shunt coils are now customarily used for consumer's meters, and, although the loss in the shunt winding may seem at first sight very small, amounting to about 10 watts for a 100-volt meter, it must be remembered that this loss is a constant one, and amounts to about one-quarter kw-hour per meter per day. If the meter measures up about one kw-hour per day (this being a fair average load in private house and small store service) there is a loss right here of 20 per cent.

The meter is also responsible for part of this discrepancy in another way. Every service must be provided with a meter of sufficient size to carry the maximum load. In residence lighting this load may occur once or twice per year at the time of some special festivity. The daily peak of a meter-load curve may rise to one-quarter or one-third of the meter's capacity, the average load being perhaps 5 or 10 per cent. of the same quantity. At these low loads meters almost invariably run slow and the one or two lights left on all night, or occasionally turned on during the day time, often do not start the meter at all. In this way a meter which indicates correctly at full load may really indicate only about 50 per cent. of the power that passes through it in actual service, this being, it is safe to say, a reasonable estimate in residence service.

This means, of course, no real loss of power. It practically amounts to giving the consumer a lower rate than that intended, and can, of course, be corrected by keeping the nominal rates up. It has the unfortunate effect, however, of giving consumers with a low consumption per lamp installed a lower rate than those with a higher consumption per lamp, thus giving exactly the reverse effect of that aimed at in the Wright demand system. It may be well also to point out the fact that both these sources of loss are as serious in direct-current systems where integrating wattmeters are used as in alternating. Unfortunately, the power factor of the meter load cannot be improved as can that of the transformer load by grouping services on one large instrument.

A PROMISING MARKET.

Whatever other results may follow the war now in progress, it seems definitely certain that our trade with certain tropical regions is on the point of being greatly enlarged. Assuming, as seems most likely at this time, that we will occupy the Philippines for an indefinite period and divert to ourselves the trade of those islands, besides introducing upon them many of the appliances of civilization they do not at present enjoy, it seems proper to consider the bearing that this expansion of trade will have upon the electrical industry and what class of manufactures will most likely be demanded there.

Probably the largest demand will be for telephone and telegraph apparatus and supplies and electric light machinery. If the coffee, tobacco, hemp and sugar industries are to be systematized in proper American fashion, there will no doubt be a considerable demand for motor-driven machinery. Among the smaller articles that will find a ready sale will be fans of all kinds. To this day the problem of an efficient mechanical or electrical substitute for the punkah coolie —the man who pulls the string that works the flapping fans that make night endurable in India—has not been solved. The difficulty with the human machine is that it sleeps, under which circumstances its employer wakes. While punkahs do not at present seem to be the fashion in the Philippines, it is unquestionable that the exigencies of one of the hottest climates on the globe require some sort of air-cooling or moving mechanism, and our enterprising fan manufacturers should be on the alert.

The conditions on the vast sugar and tobacco estates in Cuba seem to be especially favorable for the use of a system of electric transmission. Many of these plantations operate railways for the hauling of the cane, etc. and much machinery is used, even now, in the various stages of the sugar industry. Under different conditions [illegible] progressive manner, and that it will be a field for profitable extension of electrical methods. There is not a single line of electric railway in Cuba, though it has four cities of over 50,000 population. There were, before the outbreak of the recent insurrection, about 3000 miles of telegraph lines in the island, and about 1000 miles of railway, a good deal of the latter being narrow gauge road on the sugar

A REMARKABLE INSTANCE OF INCANDESCENT ILLUMINATION.

A most beautiful setting for an attractive illumination has been provided at Omaha by the highly commendable work of the architects and the landscape gardener of the Trans-Mississippi Exposition. The buildings about the Grand Court of the exposition are all purely classical in style, similar to those at the World's Fair in Chicago, but on a somewhat smaller scale, and also much more harmonious, there being no architectural incongruities whatever. No building is allowed to be out of proportion, or especially prominent, thus dwarfing the general effect. The scene is a very beautiful one by day in spite even of the dazzling effect of the sunlight on the white structures, but by night with the soft artificial illumination it is one that cannot be described but must be seen to be appreciated.

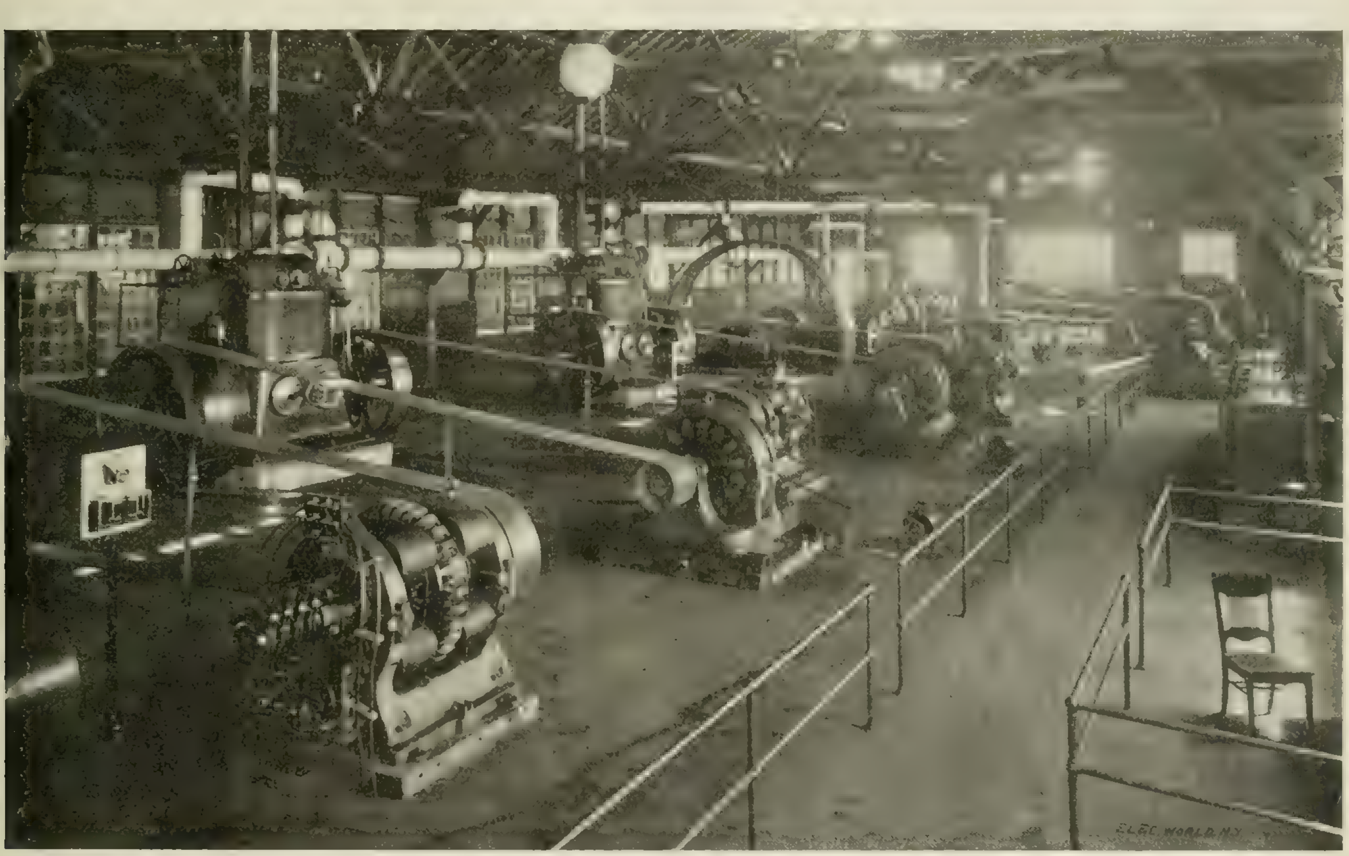
The lighting is undoubtedly quite a triumph of the incandescent electric lamp. The great court, some 2500 feet in length by 400 feet in width, the lagoon in its centre and the buildings surrounding it, are apparently quite brilliantly illuminated without the use of a single arc lamp. The rigid exclusion of the latter is probably the main cause of the success of the lighting system. Some twenty odd thousand 8 and 16-cp lamps are used, the former, as a rule, outlining the principal architectural lines of the buildings fronting the court, and the latter mounted in clusters on the tops of decorative columns. The result is an illumination highly diffused, widely distributed and with no points of intense brilliancy, the highest intrinsic brilliancy being that of the 3.1-watt filaments. Advantage is thus taken of the optical principle that the retina adjusts itself to the points of greatest intrinsic brilliancy in the field of view, opening wider and allowing more light to enter the eye if the brilliancy of these maxima is reduced.

To take the fullest advantage of this principle in general illumination the intrinsic brilliancy of the whole field of view should be the same, and the Grand Court of the Omaha Exposition probably realizes this effect more nearly than any other large area ever illuminated artificially. The pure white untinted staff of the buildings and of the decorative columns and colonnades gives a diffused reflection of the incandescent lighting with a brilliancy not nearly so much below that of the lamps themselves as though arc lamps had been used. The effect is a most delightfully pleasing one, the soft glow of the myriads of lights resembling somewhat moonlight, except for its greater diffusion and the consequent absence of shadows. The comparatively yellow light of the incandescent also reflects from the water in the lagoon, giving a beautiful shimmer over the whole surface, an effect not obtainable with arc lamps. The lighting of such an enormous area with incandescent lamps, especially with the limited funds available in this case, was a bold undertaking, but the result is highly successful.

This piece of lighting illustrates anew the advantages of diffusion in artificial illumination. The optical effect of the naked arc in blotting out a background has long been recognized, especially by those riding or driving in streets thus illuminated, the difficulty of seeing anything beyond such an arc being well known. The decision as to the means of illumination in any given case should not be based solely on the maximum number of candle power per kilowatt, a far more effective illumination being perhaps obtainable with a smaller aggregate candle power, especially in cases where there is no occasion for lighting of any considerable intensity, as there is in reading rooms and art galleries, and where the eye may be coaxed or deceived, so to speak, into adjusting itself to a comparatively faint illumination.

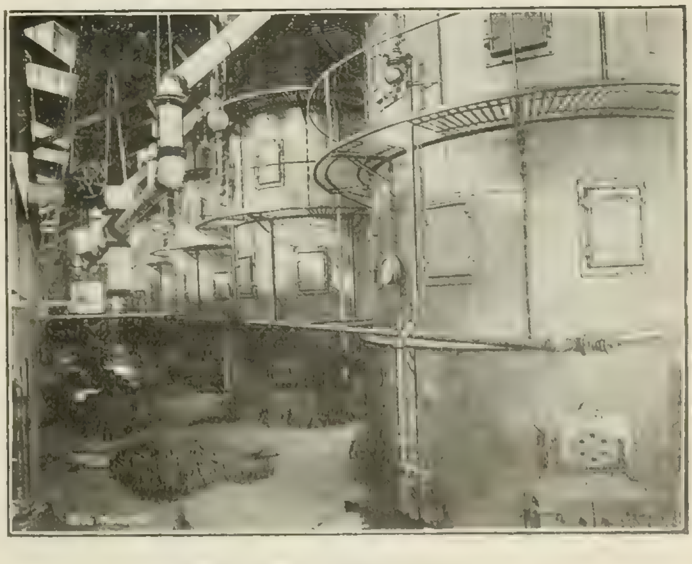
The Lighting of the Trans-Mississippi Exposition.*

BESIDE the electrical exhibits, descriptions of which may be found in another column, the Trans-Mississippi Exposition is of interest because of its extensive electrical illumination. The power plant supplying all the current used in the exposition is removed a distance from the Grand Court, and is very evidently of a temporary character. The building consists of two wooden structures side by side, with modern wooden floors, wooden roofs and corrugated iron sheathing, each crowned by a monitor. Six steel stacks rise in a straight row from the monitor of the boiler room to a height of 140 feet, giving the plant a characteristic appearance. The boiler room contains six Morrin "Climax" boilers, four of which are capable of evaporating 22,500 pounds of water per hour each, and two 15,000 pounds each. This boiler plant was taken from the Nashville exposition. It is interesting from the fact that about 3600 horsepower is located on a floor space about 25 x 100 feet.



Main Engine Room of Power Plant.

These boilers feed a group of seven engines in the engine room belted to generators of various types, but all made by the General Electric Company. For a more full description of these engines and generators see The Electrical World of April 30, 1898. It is unfortunate that at this time it was considered necessary to adopt a style of central station abandoned in all high-grade work some years ago, but the temporary character, hasty construction and the necessity of taking what can be had for show purposes in such work rendered this necessary. The current is distributed on series arc, single-phase alternating and 500-volt direct-current circuits. All the dynamos are run independently. The lines run overhead throughout the grounds except in the immediate neighborhood of the grand court. Here they run underground, and it is interesting to notice that they are carried in cables made by the Safety Insulated Wire and Cable Company, originally used at the World's Fair, in Chicago, later at Atlanta and at Nashville, and now doing duty in a fourth exposition.



Power Plant Boiler Room.

The lighting of the grand court is entirely effected by incandescent lamps, some twenty odd thousand 8 and 16-cp lamps being used in rows on the prominent architectural lines of the buildings facing the court or in groups on columns near the water front. The court is some 2500 feet long by 400 feet wide, and it is astonishing what a satisfactory illumination has been obtained with the lamps used. The result is due to the almost perfect diffusion and the consequent uniformity of the illumination.

Rising from the balustrade on the water's edge about the whole lagoon are standards simply made up of 2-inch iron piping painted white, with pedestals and crowns carrying circlets of 12 or 16-cp incandescent lights. Back further from the water front between the lagoon and the buildings are fluted Corinthian columns about 10 feet high, also carrying crowns of incandescent lights. It is surprising what an illusion as to the height of the buildings is effected by these lights. While by day the buildings look rather low in comparison with the great size of the court, at night these lights, comparatively near the ground, make the buildings stand up to a far greater apparent height, and of course correspondingly increase the apparent distance and size of the background.

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*Illustrated by Supplemental Inset Sheet.

The electric fountain, which is designated by the name "Nautilus," stands at one end of the lagoon in front of the Government Building. A figure of Neptune stands on a column in the centre of the fountain, which consists simply of a large number of jets forming sprays, the whole being some 100 feet in length by about half that distance in width. These sprays are illuminated by incandescent lights rising just above the surface of the water, socket end down, and surrounded by ordinary opalescent shades, giving the effect of water lilies. Further illumination is also effected by searchlights improvised on the surrounding colonnades, the more perfect searchlights ordered having been appropriated by the Government. This simple fountain does not, of course, give the variety of effects that can be obtained from those illuminated from below with arc lights and colored screens, but is remarkably pleasing, considering its simplicity and low first cost.

The lighting effects were all under the supervision of Mr. Luther Stieringer, the installation of the entire electrical equipment being in the hands of the superintendent of the Bureau of Power and Light, Mr. Henry Rustin. Almost all of the special construction work, including all the electrical work on the fountain, was designed and carried out on the grounds, under Mr. Rustin's superintendence.

The General Meeting of the American Institute of Electrical Engineers.

The fifteenth general meeting of the American Institute of Electrical Engineers was held in Omaha, Neb., June 27, 28, 29 and 30. The attendance was very small, owing to the distance from the large centres of population. The members arrived from the East early Monday morning, June 27, the first meeting being called to order by President A. E. Kennelly, in the Omaha "Bee" Building, at 10 A. M.

The association was welcomed to the city by a representative of the City Government, by G. W. Wattles, president of the Trans-Mississippi Exposition Company, and by Mr. Edward Rosewater, manager of the Department of Publicity of the Exposition. Invitations were read, inviting the members of the association to various points of interest in and about Omaha, after which Dr. Kennelly read the inaugural address, which may be found in another column. On motion of Professor Goldsborough, a committee of five was appointed to report on the advisability of the institute's undertaking the classification and publication of college thesis work proposed in the president's address. The members of the committee were as follows: Prof. W. E. Goldsborough, Prof. R. B. Owens, Dr. H. T. Eddy, Mr. B. J. Arnold, and the president, ex-officio.

In the discussion of the address the much debated subject of the standardization of machinery came up, Mr. Steinmetz speaking strongly against specialization and citing the rapid progress of several lines of work in America compared with that in Europe, such, for example, as electric railway work, as due to the comparatively greater standardization in this country. He spoke also of the apparent increase of specialization, particularly in generators, due to the coupling of the latter to the prime movers in place of belting, and stated that the prime mover, as a rule, was chosen first and a special generator was called for to suit. Standard speeds, voltage, frequencies and sizes are badly needed, the first cost of such standard machines being much less than those of special machines, and repairs and replacement being far easier and cheaper. As an instance of the serious effects of an apparently minor specification, the call on the part of the consulting engineer for an insulation test of three times normal voltage instead of twice the normal voltage might necessitate the construction of the machine on entirely different lines, owing to the lack of room for the extra installation thereby called for, increasing the cost perhaps 50 or 100 per cent.

Mr. B. J. Arnold stated that in his consulting engineering work he found the greatest need of standardization was in the matter of speeds of engines and generators. He attempted to get up a set of specifications on which competitive bids could be obtained. It was found that the various engine builders differed in their standard speeds, as did the various generator builders, and it was only possible to obtain a set of competitive bids which as a rule meant a specially built engine and generator, no matter who got the contract.

Following this discussion a paper was read by Mr. C. P. Steinmetz entitled "The Dielectric Strength of Air," giving most valuable data and discussion of the breaking-down strength of air gaps under various conditions, with alternating voltages up to 150,000 volts. Tests were made between parallel cylinders of different diameters, between sharp points and between spheres of different sizes, and complete sets of curves were given, illustrating the relation between the voltage and the breaking-down strength. This relation for distances greater than 6½ inches is, as a rule, linear, varying from 40,000 volts for that distance to 14½ inches at 140,000 volts, these figures being taken with a smooth core alternator and pointed terminals. One interesting point in the paper was the fact that the relation is so definite that Mr. Steinmetz proposed the use of a spark gap as a voltmeter for high-potential differences. Another peculiar point brought out was the fact that the insertion of a thin conductor between the terminals increases the breaking-down strength of the gap in spite of the slight reduction of the actual thickness of the insulating medium. Thus with a 10-inch disc midway between one-quarter-inch spheres at about 9 inches distance, 126,000 volts are required to strike across, while with the disc withdrawn 100,000 volts will strike; or, in other words, with a voltage between 100,000 and 126,000 volts, under these conditions, a disruptive discharge will take place between the spheres unless the electric conductor is placed between them. In some cases the voltage is higher than that necessary for a single stroke through air around the edge of the disc. No difference is found between the action of similarly-shaped waves at different frequencies, but differences in the wave forms make considerable differences in the striking distance.

The next paper read was that on "Two-Wire Distributing Systems and Lamps at 220-240 Volts," by John W. Howell.

In the discussion of this paper, Prof. George D. Shepardson brought out the points that high-voltage systems should be planned with an ample reserve of generating machinery for the following reasons: First, that high-voltage lamps are of low economy, generally 4 watts per candle-power initial, and, on account of the difficulty of geting a sufficiently high resistance, are generally of large candle power, starting at 18 or 20 and running up to perhaps 22 candle power, making a double increment of the load. The dynamos must, therefore, not only be 25 per cent. larger because of the inefficiency of the lamp, but about 20 per cent. more on account of the increased candle power of the lamps. Professor Shepardson thought that the disparity between the 110 and 220-volt lamps was likely to remain since any improvement in the one would effect a similar improvement in the other. One reason for the comparative perfection of the 220-volt Professor Shepardson thought to be the very difficulty in manufacturing, since only the best manufacturers could solve the problem at all, while any one could make a 110-volt lamp, and many poor lamps of this voltage are consequently on the market. The illumination of 220-volt lamps is, as a rule, steadier than that from 110-volt, since, with the same voltage regulation, the candle power varies much less in lamps of the lower economy.

In further discussion Mr. H. H. Humphrey, the consulting engineer of the Imperial plant of St. Louis, stated that the rate of improvement of the 220-volt lamp was much faster than that of the lower voltages, and that the difference between the two would in his estimation soon vanish. While one year ago it was difficult to get any guananty or even promises from the lamp manufacturers, his company has lately ordered 10,000 lamps with guaranties nearly as good as can be obtained for 3.5 watt 110-volt lamps. The guaranteed life was just as high, but the drop in candle power was allowed to be a little greater.

A paper by Mr. Charles F. Burgess on "A Capillary Electrometer for Electrical Measurements" was then read. This paper described an instrument making use of the change of surface tension of two liquids in contact in a capillary tube and the consequent movement of the meniscus upon the application of a potential difference to the two liquids. Such an instrument is useful in the place of a sensitive galvanometer, being comparatively portable, simple, rapid in its indications, of low first cost and free from the effects of mechanical vibration and varying magnetic fields. The instrument described responds to a difference of potential of 0.001 of a volt, and with proper attention to construction and the use of a suitable miscroscope its sensibility may be increased tenfold or even more. It is a polarized instrument, the movement of the meniscus being reversed by a reversal of the polarity, and it is useful for almost any delicate applications of the zero method, particularly those modifications of the Wheatstone bridge method for the measurement of resistance, inductance and capacity. The meniscus moves with great rapidity, and it has been shown that alternating curves of a frequency of 120 cycles per second may be obtained by a photographic record of the excursions of the meniscus.

After the reading of this paper the meeting adjourned until the next morning.

An afternoon excursion was made to the Omaha & State Smelting Works and to the shops of the Union Pacific Railroad. In the evening the delegates attended a complimentary initiation by the Knights of Ak Sar Ben, and also rode out to the exposition to view the illumination.

PROCEEDINGS OF TUESDAY, JUNE 28.

After the meeting was called to order a paper on "A Modern Electric Central Station" was read by the author, George A. Damon. An abstract of this paper will be found in another column of this issue.

In answer to Prof. F. B. Crocker's criticism of the reduction of the necessary reserve capacity by the Arnold coupling system, Mr. B. J. Arnold explained that there is no such reduction in generators, but that the engines are so made that they can run at 100 per cent. overload by using live steam in both high and low-pressure cylinders, and the necessity of an engine reserve is thus done away with. This effect could not, of course, be obtained with ordinary direct-coupled units, as the generator would not stand the overload.

In answer to a criticism by Mr. Steinmetz on the difficulty of aligning such a long shaft, Mr. Arnold said that each shaft or quill is supported in but two bearings, and only when they are coupled together is there any likelihood of difficulty, and then but little, as the coupling arrangements give some radial flexibility.

In answer to a question concerning the procedure in case of a hot bearing in the middle of the line, Mr. Arnold stated that the boxes are readily removable without disturbing the shaft and that they are all water jacketed.

Following this discussion the preliminary report of the Committee on Standardization was read by title and discussed. Mr. Steinmetz spoke of the difficulties found in nomenclature, the old terms, direct and alternating-current generators, being non-applicable in many cases, and the adjectives commutating, rectifying, synchronous and induction being used instead.

The difficulties of determining the proper division of the losses between windage, bearing friction, brush friction, etc., led to the practical necessity of charging all of them against the prime mover in the case of direct-coupled machines. The advantage of the resistance method of measuring rise of temperature over the thermometer method was stated to be on account of the abnormal condition likely to exist at the point where the thermometer is situated and the better general average thereby obtained by the resistance method. The resistance method, as a rule, gives higher indications than the other.

As to the question of insulation specifications it was pointed out that these are, as a rule, too high, and that insulation against voltage is also insulation against heat, thereby reducing the capacity of the machine. Disruptive lightning discharges are so much higher in pressure than machine voltages that the difference between their effects on insulation that will stand three times the normal voltage and one that will stand one and one-half times is slight. In regard to standard frequencies, of which the committee proposed four—namely, 25, 40, 60 and 120 cycles—Mr. Charles F. Scott thought it better to adopt but three—namely, 30, 60 and 120 cycles.

After the thanks of the association was expressed for the committee's valuable work, the meeting adjourned.

The afternoon and evening were spent at the Trans-Mississippi Exposition.

PROCEEDINGS OF WEDNESDAY, JUNE 29.

The first paper read was that of Mr. Ernst J. Berg on "Transmission and Distribution of Power for Railway Service," an abstract of which will appear in these columns at a later date.

Following this Mr. Albert H. Armstrong read his paper on "Some Phases of the Rapid Transit Problem," giving a detailed discussion of the power necessary for the transmission of a given weight over a given distance at various rates of acceleration and retardation. It was shown clearly that for short runs the following conclusions may be drawn:

First. The rate of acceleration determines the energy consumption for a given run, and since this energy consumption decreases with increased rate of acceleration, the train should be brought up to speed as quickly as possible and allowed to coast to secure the minimum energy input.

Second. The maximum current input during the acceleration increases with the rate of acceleration, and hence limits the rate at which a train can be accelerated with a given feeder loss or feeder investment.

Third. In order to reduce the average energy consumption and also the maximum current input to a minimum for a given run, a due amount of acceleration should take place on the motor curve after starting resistance is cut out, hence a motor should be carefully proportioned for the work it has to do.

Fourth. A normal amount of coasting should be permitted after power is shut off, partly to provide a margin to allow for errors of judgment of the motorman, but largely because this is the most efficient method of accelerating a train. On no account should the maximum speed be continued by supplying the motors with just sufficient current to overcome train friction, as this method of accelerating is extremely wasteful and inefficient.

It was pointed out that only from 15 to 20 per cent. of a fully loaded train consists of a paying load, and with an average load this percentage is reduced to 10 or less. In rapid-transit work at least ten times the energy required to overcome friction alone must be expended in the acceleration of the train, only to appear as heat in the brake shoes when bringing the train to rest. Hence, the actual efficiency of our modern methods of transporting passengers is reduced to less than 1 per cent. of the total energy delivered to the train. One possible method of improving this condition in many cases is the use of a profile so arranged as to accelerate and retard the trains by gravity on leaving and approaching stations, respectively. A complete discussion of the effects of the application of this system was given in the paper.

In the discussion of the paper the great savings that can be effected by training the motormen to a proper use of the controller were brought out.

After the discussion Dr. George L. Miller was introduced to the convention and spoke on the subject of a power production and transmission plant designed for the supply of electric power to Omaha from the water of the Platte River. An available head of 138 feet was stated to be obtainable at a point 6 miles from Omaha, with sufficient water to give 20,000 horse-power continuously, this requiring a canal which had already been laid out.

A paper on "The Commutated Curve of a Composite Wound Alternator," by Prof. D. C. Jackson, was then read by title. This paper gave the results of tests upon a 50-kw 125 cycle alternator, the commutated current in the series field coils being plotted under various loads. The curves showed that the commutated curves have practically the same form as the original waves of current in the armature (with alternate loops inverted) except in regions occupying about 25° on either side of the zero points of the original waves. Within these regions the commutated waves do not come to zero and they take a characteristic toothed shape, as is to be expected from the effect of the self-induction of the field windings when they are short circuited by the brushes on the commutator. The curves were taken by means of the balance or potentiometer method, using the capillary electrometer described in the paper by Mr. Burgess, noticed above.

In the absence of the author a paper by Mr. Arthur V. Abbott, on the "Evolution of the Line Signal," was read by the secretary. An abstract of this paper will be published in these columns later.

Prof. George D. Shepardson then read his paper on "Some Telephone Disturbances from Electrical Generators," describing a study of the effects of commutated currents (particularly street railway currents) on common return telephone lines. The paper pointed out that the effect was often due to plain leakage, as considerable difference of potential between the telephone system and the ground can often be detected. The disturbances are largely due to the waves set up by the imperfections of commutation, and they can in the case of lighting circuits be partially damped out by large self-inductive coils in the feeders. In railway circuits, however, such self-induction would be required in every car as well.

After the reading of this paper a resolution of thanks to the local Committee on Arrangements was voted, the obituary notice of Dr. Charles E. Emery was ordered printed in the transactions, and the meeting adjourned.

In the afternoon the delegates visited the extensive packing houses in South Omaha, and in the evening a trolley ride to Council Bluffs was largely attended.

The Present Status of Electrical Engineering.*

BY DR. A. E. KENNELLY.

While mechanical engineering may be said to have an antiquity coeval with civilization, its latest offshoot, electrical engineering, only came into existence with the advent of the electric telegraph some sixty years ago. For the greater part of this time, electrical development was confined to the telegraphic industry, but with the extended introduction of the arc and incandescent lamps, the utilization of the magnetic properties of iron and steel made rapid progress in dynamo construction, so that the magnetic properties of steel now play almost as important a part in the advance of civilization as do their mechanical properties.

By far the greater proportion of electric development has come within the past decade and a half. Looking back from the Trans-Mississippi Exposition at Omaha of to-day, to the International Electrical Exhibition of Philadelphia in 1884, the birth-place of the American Institute of Electrical Engineers, it is doubtful whether, outside of telegraphy and telephony, there was at that time in the United States a total investment of $1,000,000 in electrical applications. The words ammeter and voltmeter were just commencing to be generally recognized, and of electric traction there was none. At the present time the capitalization in electrical applications in the United States is estimated at about $1,900,000,000.

In 1884 a 50-kw dynamo was considered a large machine, while a 100-kw Edison steam dynamo was justly called a "jumbo." At the present time the largest size of generator built or building is of 4600-kw capacity. The price of dynamos in 1882 was about 20 cents per watt of output, while dynamos of similar running speed in comparatively small sizes, without switchboards, now cost about 2 cents per watt. The great reduction in price represents the aggregated result of the very large amount of labor devoted to this branch of engineering in the last fifteen years.

It is interesting to notice that the efficiencies of continuous current dynamos have not made any marked nominal advance since the birth of the institute, though their output per unit of mass has considerably increased. Thus the 50-kw dynamo tested at the Philadelphia exhibition is stated to have had an efficiency of approximately 92 per cent., and this would be considered a satisfactory performance in that size of machine to-day. But, whereas, the output then was only 6 watts per pound of net weight, the output of a machine of similar rating and speed to-day would be about 10 watts per pound. In other words, the efficiencies of the best dynamos of 1884 were already so good that it has not paid, at existing costs of power, to markedly improve them, and such improvements in material and design as have since been effected have enabled manufacturers to increase the rating or yield, and, therefore, the cheapness of the machines. It seems probable, moreover, that this will continue to be the direction of future progress. We scarcely can desire more efficient machines than the best we have now, but we shall always desire cheaper and more powerful machines, and shall welcome any improvements which lead to them.

Another evidence of the development in dynamo machinery is its improved appearance. Formerly the only claim possessed by such apparatus was utility. More recently grace, the expression of unconscious power, has supervened, and the modern dynamo is often pleasing to look upon as well as useful to operate.

The cost of generating a kw-hour of electric energy from steam for electric lighting appears to have been at least 7.5 cents at the bus bars in 1884. At the present time the cost of delivering a kw-hour to large street railway systems from steam is only about 1 cent, and the power house operating costs are reported in some cases as low as half a cent. In municipal electric lighting systems [illegible] stations and hampered by relatively heavy distributing expenses, the retail price of the [illegible] according to the locality and quantity consumed. Niagara power is now sold to consumers in Buffalo at rates varying, according to the amount delivered, from [illegible] cent to slightly less than two-thirds of a cent per kw-hour delivered.

The price of a 16-cp incandescent lamp sixteen years ago was about $1. Now it is about 18 cents. The best lamps at that time [illegible] mean horizontal [illegible] per [illegible] watts power [illegible] and under commercial conditions about 0.20. The highest pressure for which they could then be obtained was about 110 volts. At the present time lamps are obtainable, giving normally 0.4 mean horizontal British candles per watt, while under commercial conditions the average lamp normally develops about 0.25 candles per watt. They can also be obtained (at 0.25 candles per watt) for pressures up to 240 volts, and are frequently installed on 220-volt mains.

Arc lamps were already so far advanced in 1884 that comparatively little improvement in their effectiveness has taken place, the gain having been made in economy of operation. Thus, the carbons which cost at that time about 6 cents apiece now cost about 2 cents apiece. The inclosed arc lamp has of recent years become popular, owing to its diffused light and a carbon life of from 100 to 150 hours.

It has been estimated that about $600,000,000 have been invested up to the present time in electric lighting stations and plants in the United States.

The best storage cells tested at the Philadelphia exhibition of 1884 gave a yield, under laboratory conditions, of 3.4 watt-hours per pound of electrodes with an energy efficiency of 69 per cent. when discharged at the mean current density of 12 amperes per square foot of negative plate surface; while the deterioration was comparatively rapid. At the present time storage cells are in use giving, under laboratory conditions, a yield of from 5 to 6 watt-hours per pound of charged cell, with an energy efficiency of about 85 per cent., when discharged at a current density of 4.8 amperes per square foot of negative plate surface. There are now storage batteries installed in the United States to the aggregate capacity of about 56,000 kilowatt-hours. The largest installation has 166 cells, weighs 500 short tons and has an eight-hour discharge capacity of 22,400 ampere-hours, or 3136-kw hours at 140 volts pressure.*

A very great development has taken place in the direction of electric traction, by virtue of which the horse car, once so well-nigh ubiquitous in city streets, has almost entirely disappeared, while electric locomotives of 1500 horse-power have even made their appearance on steam railroad tracks. The introduction of soft cast steel has been very advantageous to the electric motor, enabling its output to be increased from 5 watts per pound of net weight in 1884 to about 14 watts per pound in street-car motors at the present time. It is estimated that there are to-day in the United States about 14,000 miles of electric railroad, with a nominal capital of about $1,000,000,000, and employing about 170,000 men.

The electric transmission of the power of falling water is a branch of engineering that has come into service since 1884, and is making rapid strides, owing to the recent successful employment of high voltages and multiphase alternating currents. It has been estimated that about 150,000 kilowatts of this class of machinery is installed in the North American continent, commercially transmitting power to various distances up to 85 miles, at various pressures up to 30,000 volts.

The alternating-current induction motor has become very popular in recent years, mainly owing to its powerful starting torque and its freedom from commutator and brushes. A burned-out armature, the perpetual source of dread in motor operations of days gone by, is practically unknown in this type of machine, even when put to severe service. Indeed its depreciation under fair conditions appears to be as low as in any class of rotating machinery.

The alternating-current transformer has been correspondingly improved, developing in large sizes an efficiency of about 98.5 per cent. and an output, when cooled by external power, of about 100 watts per pound of weight.

The principal engineering value of electricity to-day lies in its adaptation to the transmission of power through mills or cities, or from some locality where power is cheap to others where it is dear. A steel rope, by its bodily motion, can transmit, with appreciable friction and depreciation, some hundreds of kilowatts to a distance of some thousands of feet. A bare quiescent copper rope, half an inch in diameter, and supported on poles, can, by maintaining an effective potential of 10,000 volts, by the motion of electric waves over its surface, transmit, say, 2500 kilowatts, with an energy loss of two-thirds per cent. per mile, and with practically no depreciation except that of the poles and supports.

The use of high pressures has thus become more frequent during the last few years. Alternating-current generators are now made to supply 10,000 volts at their terminals, and insulation testing sets have been made for producing alternating pressures up to 100,000 volts effective.

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* The presidential address presented at the annual meeting of the American Institute of Electrical Engineers, Omaha, June, 1898.

* See The Electrical World, June 11, 1898, pages [illegible] and [illegible].

The application of electric power to domestic use and household comforts, irrespective of illumination, has made steady progress. In the large cities the fan-motor day load of summer is in the aggregate a perceptible quantity, while electric ranges and heaters on a small scale have found favor through their convenience.

In telegraphy, comparatively little change has recently taken place, beyond the substitution of the dynamo or dynamotor for the voltaic battery, and of copper line wire with some 5 ohms per mile for iron wire with some 13 ohms per mile. About 1,000,000 miles of telegraph wire are now strung on some 200,000 miles of pole line in the United States, connecting about 25,000 offices, and working an invested capital of about $150,000,000.

In the United States, the uniformity of the closed circuit Morse system, simplex, duplex or quadruplex, is only varied by an occasional Wheatstone set. This crystallization of methods is not due to any lack of invention, or capability of improvement in signaling speed, but rather to the apparently settled belief that the present systems are the most economical under existing conditions of traffic. In long submarine telegraphy, the pressure of increasing traffic has made itself more distinctly felt, and automatic curbsenders, have, to some extent, been introduced, but the physical difficulties in the way of attaining high speeds have, as yet, been obviated only in part by an increased expenditure in copper and gutta-percha, to obtain a diminished conductor resistance per mile. Wireless telegraphy has entered its experimental stage, and bids fair to enter practical service in the future, at least within a limited range. Its public use thus far in the United States seems to have been limited to blowing up at stated intervals, in the recent New York Exhibition, miniature models of the "Maine," at a distance of some 25 metres from the oscillator.

In telephony the most notable improvement in recent years has been the general substitution of metallic circuits for ground return circuits, with great advantage to the convenience and effectiveness of the traffic. At the present time conversation is carried on commercially up to a distance of 1800 miles, and quite frequently at distances of 1500 miles. There are at the present time in the United States about 1,000,000 telephones connected with the telephone service of the country, employing a capitalization of about $100,000,000, 400,000 stations and about 900,000 miles of wire. Every day about 17,000 employees make on the average more than 3,000,000 of connections. About 300,000 miles, or nearly one-third of the total length of telephone wires, have, within the last few years, been made up into aerial and subterranean cables within city limits, owing to the reduction of the electrostatic capacity effected in such cabled wires to less than one-twelfth of a microfarad per mile.

A considerable development has occurred in electro-thermic and electrolytic processes. More than 4000 kilowatts of Niagara power are now employed in such processes. Among electro-chemical processes are the electrolytic refining of copper to the extent of about 150,000 tons annually, the production of aluminum, the production of sodium and alkalis and the treatment of ores. Among electro-thermic processes are the production of the carbides of silicon and calcium in steadily increasing quantities.

In electrotechnical theory considerable advance has been made of recent years, particularly in the study of alternating currents. Accompanying the expansion of knowledge in the various branches there is a tendency among them to combine and unite into one general theory. Thus, while the low-tension electricity of dynamo origin was once regarded as something so dissimilar to high tension electricity as to require separate treatment and classification, to-day the high tensions derived from alternators through step-up transformers so far invade the territory of so-called frictional electricity that a dividing line between the two classes can no longer be maintained. Similarly telephony and telegraphy are coming to be regarded as sub-classes of alternating current power transmission, while electricity and magnetism cannot properly be studied apart.

Although a large amount of electrical work is done in physical laboratories in the United States, a comparatively small amount of the results of this work becomes available to the science or art of electrical engineering. Each year sees more than 100 students engaged in experimental thesis work after a laborious training and perparation for several years in the technical college. Many of these men have the time and facilities to do the best experimental work of their lives under the guidance of their instructors. Some of the men display aptitude and interest in some special line of research in which they would be best left untrammeled, but in most cases the experimental work under co-operative guidance could accomplish a great deal for the knowledge and progress of our branch of applied science. There are numerous questions concerning the various electromagnetic properties of matter and of the ether that are of great and growing importance, and there are numerous scientific subjects of immediate practical importance that it is necessary to measure and observe, so that by uniting the available experimental resources of the various colleges in this country under a common leadership, in sympathy with the college instructors, the results which now largely fill thesis books lying on neglected shelves might be incorporated into permanent results for the general advancement of our profession. The plan would involve practically no expenditure beyond the voluntary efforts of those upon whom the duty devolved of formulating and dividing the subjects of research, and classifying or comparing the results attained. Such a system of co-operation among the students through their instructors would economize a large amount of the most skilled technical labor, and accelerate progress in all branches of inquiry, application and industry. No better work could be undertaken by our institute than the fostering of such an organization.

The technical progress of a profession like ours is shown by the precision of which it is capable. A loose nomenclature begets looseness of observation and description and is inconsistent with a high degree of development in a science that quickens the footsteps of every human industry. The tendency of our machinery and definitions to become standardized is apparent in the impulse which has led the American Institute of Electrical Engineers to appoint a committee on standardization, the preliminary report of which is to-day laid before this institute for consideration.

In connection with standardization it is important to observe that there has been of recent years a tendency to depart from the regular standards of dynamo machinery built by the manufacturers, in favor of special machinery of independent design. To a limited extent this is, of course, necessary, under the pressure of changing methods and conditions, but there is reason to believe that much more special machinery is built than necessity can warrant. Not only is the special machinery thus ordered or specified considerably more costly than standard machinery, but the tendency, by interfering with the natural shop methods of standardizing and cheapening protection, prevents regular consumers from purchasing standard machinery at as low rates as would otherwise be possible. When we consider that the industrial radius of application of electricity mainly depends upon the first cost of the apparatus it employs, it needs no homily to drive home the conviction that the unnecessary introduction of special machinery is a puncture in the tire of progress.

Our institute may well take pride in the share which it has taken in the electric progress of the fourteen years which have elapsed since its inception. It now numbers 1100 members. Its purpose is to aid all who seek to acquaint themselves with this branch of science and art, and to set the stepping stones of progress in the sands of time for the advance of the industrial applications of electricity.

The Coming Meeting of the American Association for the Advancement of Science.

The preliminary announcement of the fiftieth anniversary meeting of the American Association for the Advancement of Science, in Boston, August 22-27, 1898, has been made. A meeting of the council will be held on Saturday, August 20, at the Rogers Building of the Massachusetts Institute of Technology, and the meetings of the various sections of the association will be held in the immediate vicinity. Many foreign scientists have been invited and foreign educational institutions are asked to send delegates to the meetings. A number of affiliated societies will meet in Boston during the same week. The headquarters of the council will be at the Copley Square Hotel. Further details of the arrangements can be obtained from the local secretary, Prof. H. W. Tyler, Massachusetts Institute of Technology, Boston, Mass.

A Modern Electric Central Station.*

BY GEORGE A. DAMON.

The plant of the Imperial Electric Light, Heat and Power Company, of St. Louis, Mo., is interesting at this time, as it is a good example of the present tendency in electric power station practice.

The designers of this installation were not burdened at the outset with the complication of an old system of distribution, nor were they confronted with the necessity of adapting their new station to the use of the generating machinery already on hand. Everything was to be modern, and the engineers in charge of the work were free to adopt the plans which seemed best suited to the existing conditions. The territory to be supplied with electrical energy was a down-town district, and the load to be expected included arc and incandescent lighting, with more than the ordinary amount of motor work for elevators and light manufacturing establishments.

The system which has been adopted as the one best fulfilling all the conditions in this particular case involves the use of the 220-volt incandescent lamp; the location of the station as near as possible to the centre of distribution; the operation of generators capable of delivering direct current at a potential of 500 volts, a special arrangement of the generating units, and the installation of a storage battery in the plant to act as an accumulator, and also in parallel with the generators as an equalizer. The generators are run at a potential enough greater than 440 volts to overcome the line loss, and the motor circuits are at present operated at this potential. The storage battery across the outside mains allows 220-volt incandescent lighting on the three-wire system.

The greatly reduced investment required for copper distributing feeders for a 220-volt system from that required by the usual direct-current 110-volt system, the enlargement, therefore, of the territory which could be supplied, as well as the quality of light and the possibility of operating 220-volt motors on the same circuits, and thus making it possible to connect in many motors already in use in the city, were the main advantages which led to the adoption of the 220-volt lamp. The comparative lower efficiency and higher first cost of the lamp as compared with the 110-volt type was recognized, but these points are yielding to development, and it is thought that the difference between the two lamps in respect to efficiency and price is sure to become much less as the demand for the new lamp increases.

Local conditions made the location of the plant a much simpler problem than is usually the case. To have secured free water for condensation purposes would have removed the plant much too far from the centre of distribution. The difference between drayage charges on the coal delivered to the station on its present site, and the cost of bridge tolls and switching charges which would have been necessary if the coal had been delivered directly from the cars, is only 15 cents per ton in favor of the latter plan, and this is not enough to justify the extra expense in feeders which would have been required to secure the location of the plant on a railroad switch. No doubt, therefore, was entertained in regard to the advisability, in this particular case, of carrying the fuel of the plant in wagons from the railroad to the station at the centre of supply, rather than transmitting the product of the plant over copper conductors the same distance.

The advantages of supplying all classes of service from one type of generator, thus simplifying the distribution circuits as well as the arrangement of the station, and at the same time increasing the economy of the plant by reducing the amount of both fuel and labor required, were not forgotten. At periods of light loads it is possible to furnish the entire output for incandescent lamps, arc lights and motors from one generator, when, during the hours of minimum demand, the load may be carried by the generator.

Fig. 1 shows a cross section of the station and indicates the general compact arrangement of the plant equipment which was made necessary on account of the cost of real estate in the vicinity of the site. The engine room and the boiler rooms are upon the ground level, which arrangement insures plenty of light, good ventilation, and convenience in operation. The engine room basement is used for the storage batteries, while in the boiler room basement is located the coal-storage bin, the ash-handling apparatus, the piping, pumps, hot well and condenser. A second floor is added to the building for the offices of the company, for the storage of supplies and for a machine and repair shop.

The furnaces of the boiler are of the down-draft type, thus securing the advantage of skillful hand firing, and at the same time avoiding the cooling of the gases, by the frequent opening of the furnace door. The water-cooled grates furnish some additional heating surface to the boiler and the general arrangement insures a better combustion of fuel than is ordinarily obtained. This results in reducing the amount of ash and preventing the production of smoke, which is an absolutely essential feature with a city installation. Considerations of availability and cost limit the fuel supply to coal from southern Illinois mines, which produce a bituminous slack containing about 11,000 B. T. U. per pound. As the wagons deliver the coal directly on the boiler room floor, automatic coal-handling machinery was not thought to be a good investment.

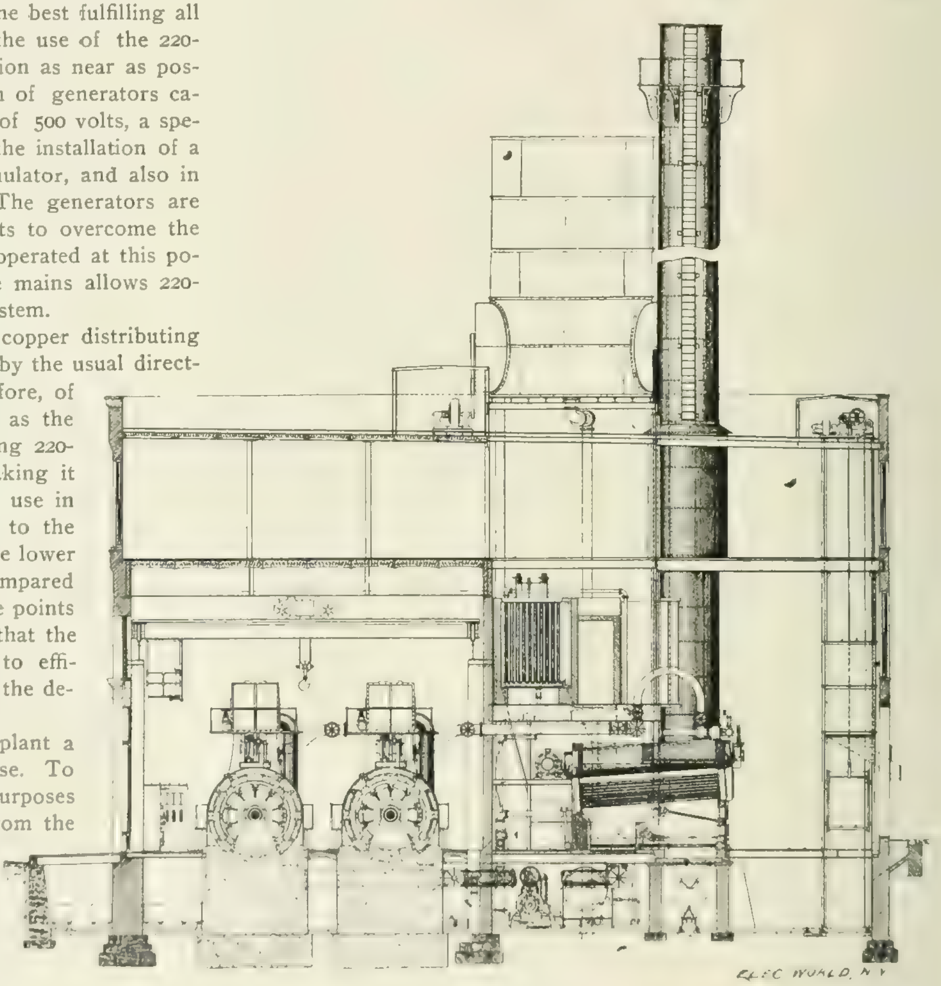

FIG. 1.

Horizontal water-tube boilers were adopted on account of their quick steaming properties, the comparatively small amount of floor space occupied by large capacities, their economy of fuel, and their safety under high steam pressures, the pressure adopted for this plant being 175 pounds. In determining the size of the boilers due allowance was made for the fact that they were to be operated in conjunction with economizers, and their capacity was reduced accordingly. The question of economizers was thoroughly considered, and they were adopted only after careful estimates had been made, which demonstrated that the probable saving of fuel effected by their use would be sufficient to cover the usual allowance for depreciation, insurance, etc., and yet leave a very good margin for interest on the investment. As no steam-driven auxiliaries are to be used in the plant, there will consequently be no other feed water heater besides the economizer. The economizer for each battery of two 375 hp boilers consists of 320 pipes, and the heavy weight is carried on special iron framework, which places the economizer at the back of and above the boilers, as shown in the figure. The flue passages and stack connections are so arranged and fitted with dampers that the flue gases can pass either directly to the stack through the economizer to the stack, or through the mechanical draft fan in series.

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* [illegible]

The engines are compound condensing, and are the only steam-using parts of the entire station equipment, all auxiliary apparatus being operated by means of electric motors. The steam from the engines exhausts into a surface condenser placed in the basement below the boiler room, from which the water is pumped into the hot well and through the economizers back into the boilers.

The condensing water is taken from the bottom of a cooling tower located upon the roof at an elevation of 50 feet above the condensing apparatus. After this water passes through the condenser it is forced back to the top of the cooling tower by means of centrifugal circulating pumps. The water circuit is arranged so that the weight of the descending column is used to balance the weight of the ascending column of water. The work actually required of the circulating pump, therefore, is represented by the amount of power required to raise the water through the height of the tower, or about 30 feet, and the net result is the same as if the tower had been located on the ground level.

The plans for the completed station contemplate a total capacity of 5000 kw. There are at present, however, installed in the station, but two engines, one of 750-hp and the other of 1500-hp capacity. These engines are of the cross-compound marine type, of massive design, and run at a speed of 150 r. p. m. They are expected to develop an indicated horse-power hour on less than 14 pounds of water. Each engine is designed, however, to stand a continuous overload of 100 per cent. This will be developed by means of admitting high-pressure steam directly into the low-pressure cylinder. The conditions under which it is expected to operate the engines in this manner will be referred to later. The cylinders are placed side by side, each piston acting upon a separate crank. Between the cylinders is located the receiver, which is provided with copper reheating coils. The high-pressure cylinder is steam-jacketed on the barrel, and both cylinders have steam jackets on the heads. Both receivers and cylinders are protected with a non-conducting covering over which there is a steel jacket held in place by bands. Each engine is provided with a heavy fly wheel located in the centre of the frame between the cylinders. The speed is regulated by a shaft governor operating an eccentric connected to the cut-off valves of the high-pressure cylinder, and in addition to this governor each engine is provided with an additional automatic safety device, designed for the protection of the engine in case the speed should be abnormally increased for any reason. The engines also have a speed-controlling attachment by means of which they may be brought to the same rate of speed under frictional load as under full load.

The engines are directly connected to three 500-kw generators and two 50-kw boosters. These dynamos are of the multipolar type, with ironclad bar-wound armatures. Provision is made for sliding the field casting parallel with the shaft a sufficient distance to allow the field coils to be removed and the armatures reached for repairs.

The engines and generators are connected by means of the "Arnold System." This system of power station design is well known, but its application to this particular station will be of interest. The general idea of the system is to improve upon the usual direct-connected unit principle by mounting each generator in such a manner that it can be operated by more than one engine. Three engines are to be used on one shaft, the capacity of the centre engine being 1500 horse-power and double that of either end engine. Each of the four large generators is rated at 500 kw, while each of the two small dynamos, located between the larger machines, is a low-voltage booster of 50-kw capacity. The central engine, therefore, has a capacity sufficient to operate two of the generators when running at its most economical load, while either end engine is proportioned to supply but one generator with power under normal working conditions. The use of the boosters in this plant is incidental, and occurs at periods of light loads only, so that no additional engine capacity over that demanded by the main generators is required for their operation.

Each generator armature is mounted on a hollow shaft or quill, which is carried in independent bearings. The booster armature is attached to the solid shaft. This shaft is made of forged steel and is extended at both ends through the hollow generator quills, but without touching them, so that it is supported in its own bearings between the two quills. It is by means of this shaft that any engine can reach the generators not contiguous to it, but under all normal operating conditions this shaft does not turn, so that this system of connecting involves no more friction and requires no more lubrication than the ordinary arrangement. The coupling on the end of the shaft permits of three combinations: The engine may be directly connected with the quill of the adjacent generator, allowing the interior shaft to remain idle, or the solid shaft may be attached to either the engine flange or to the generator quill. The latter two combinations allow the transfer of power peculiar to this system.

The coupling or clutch is of particular interest, as it is said to be the first magnetic clutch applied upon a large scale to power station work. Fig. 2 shows a cross-section detail of this clutch. One part, *B*, is bolted to the engine flange, *N*. A corresponding part, *D*, is bolted to the generator quill, *H*, and this part carries an annular armature, *A*. Radial arms, *F*, keyed to the solid shaft, *G*, carry an interior armature, *C*. Each coupling is provided with five circular coils of magnet wire, *O*, *P*, *Q*, *R* and *S*. These coils are electrically connected to contact rings, *J*, *K* and *L*, carried on insulating bushings bolted to the hubs of the clutch. The parts of the clutch containing the coils are made of cast steel of high permeability, so that when a current is sent around any coil the surrounding metal becomes a magnet and the armature facing the coil is immediately magnetically attracted. The two surfaces of the clutch parts being held in contact by a pressure of at least 80 pounds per square inch, it becomes possible to transmit power from one to the other. Thus to connect engine shaft *N* to generator quill *H*, a current is sent through coil *O* in that part of the clutch *B* attached to the engine shaft. Armature *A*, which is attached by means of strong studs to that part of the wheel, *D*, which is securely bolted to the generator quill, is immediately attracted and, overcoming the small resistance of the spring, *I*, the two parts become firmly attached to each other, making it possible to run the generator from the engine. If it is desired to revolve the interior shaft by means of the engine, the current is sent through coils *P* and *Q* in parallel, attracting armature *C*, while if the solid shaft is being turned by the other engine and it is desired to connect the shaft to the generator quill, then the coils *R* and *S* are energized and the armature *C* is attracted in the other direction. The circuits to these coils are all controlled by means of switches on the main switchboard. These switches are so arranged that when the circuit of any coil is broken the discharge of the extra current is taken up through a carbon resistance, and the insulation of the coil is therefore protected from puncture. When the current in any coil is discontinued, spiral springs overcome the residual magnetism and bring the armature back to its original position.

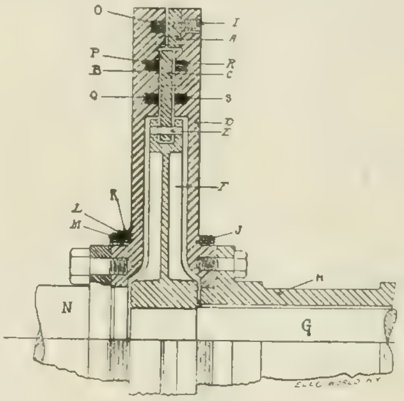

Fig. 2.

If both parts of the clutch which are to be attached are stationary, the connection becomes an easy matter, but if one part is revolving it becomes necessary to put the other part in motion before the current is sent through the coils. This is accomplished by starting the dynamos as motors and bringing them up to speed before closing the magnet coil switch. For this purpose regular starting boxes have been installed, one for the boosters and the other for the generators, so that any machine may be thrown into or out of service directly from the switchboard.

The result of the whole arrangement is that a number of combinations between the engines and the generators becomes possible. Under all normal running conditions, the centre engine will run its two adjacent generators, and the outside engines will operate the end generators. Each booster may be run, when necessary, from either of the two engines. The entire line of machinery may be connected together, so that all the engines and generators operate in unison as one large unit, the speeding attachment on the engines making it possible to operate them satisfactorily in this manner.

In case of accident to any generator that particular machine may be stopped without stopping its corresponding engine, and the electrical load will be immediately taken up by the other generators, but without overloading the engines. In case of accident to any engine the ability of the other engines to carry an overload of 100 per cent. may be taken advantage of, if necessary, without overloading any of the generators. Thus the centre engine is capable of carrying all four of the generators fully loaded, while either of the [illegible] engines can operate two of the generators, if necessary, in case of a break-down of the larger engine.

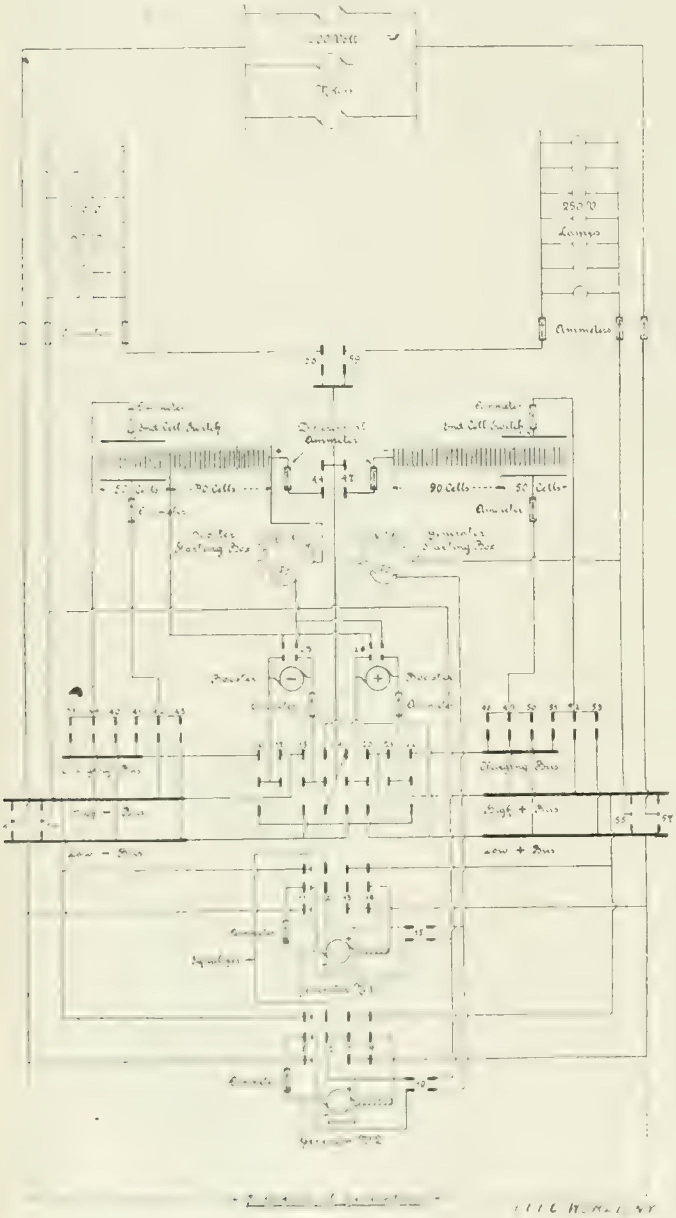

FIG. 3

The flexibility and reliability of the system may be compared to that of a belted plant, and this has been secured without the use of an unsightly arrangement of belts or the complicated system of levers and pivots necessarily connected with mechanical clutches.

All the variable speed motors operating the auxiliary equipment of the plant are designed to run at two voltages, the maximum being 440 volts, and the other voltage being one-half the maximum. [illegible] speed regulation is obtained by changing the field excitation [illegible]. The use of armature resistance is thus entirely obviated. A switchboard containing the [illegible] apparatus for the pumps and fan motors has been placed conveniently in the boiler room, and another auxiliary board has been placed in the engine room to control the circulating pump and cooling-tower motors as well as the circuit [illegible]. The use of economically controlled electric motors for running the pumps, fans and other auxiliaries of the plant is expected to result in a considerable saving of fuel.

The storage battery is located in the basement, and has a capacity of 2000 ampere hours at the normal rate of discharge, but is capable of standing a discharge at the rate of 500 kw for one hour. The station, therefore, as it now stands, can carry a maximum of 2000 kw, three-quarters of which can be taken care of by the generators, the remaining quarter being supplied by the battery. The battery consists of 280 cells, 100 of which are end or regulating cells, by means of which the potential may be regulated, the voltage depending, of course, upon the number of cells in circuit.

Fig. 3 shows a diagram of the electrical connections of the station. The generators are compound wound, but are so designed that they will give a potential of 500 volts with shunt excitation only, as it is desirable when operating with storage batteries to run the generators as shunt dynamos. As extra switch has been added, therefore to each generator panel which is used to cut out the series winding and connect the equalizer lead directly to the positive bus bar. Referring to the diagram: When switches 6 and 8 are closed and 7 and 9 are open, the generator is running as a straight shunt machine, while with 6 and 9 closed, but with 8 open, the dynamo is connected to the omnibus bars as a compound generator, and may be thrown in multiple with the other dynamos of the plant by closing equalizing switch 7.

When starting up a dynamo the shunt fields are excited directly from the omnibus bars through a special field switch. When the generator is taken out of service this field switch is automatically opened, leaving the field coils connected as in a shunt machine, and thus avoiding the discharge of the coils.

The switchboard is a double potential board, so that the feeders extending to the outlying districts of the territory may be supplied with current at a higher potential than the shorter feeders. All switches on the generator and feeder panels are arranged so that when thrown up they connect with the high potential omnibus bars, and when thrown down they connect with the low potential bars. All positive switches are placed on the right of the panels.

The battery is connected in two independent parts and is provided at each of the two outside ends with two end-cell switches. These end-cell switches may be connected through suitable knife switches to either the "high" or the "low" omnibus bars or to a charging bar. Combinations of switches numbered on the diagram from 16 to 22, allow the boosters to be connected between either bar and the charging bar. The boosters in the plant are used to charge the batteries when it is desired to give the batteries a heavier charge than they would ordinarily receive when working in parallel across the mains at the regular voltage. Without in any way interfering with the performance of the battery as an equalizer across the system, the boosters can be placed in series with the batteries, and thus any amount of current can be forced through the cells. The condition for this operation occurs at periods of light demand upon the station, which is the time the battery can be most economically charged. The voltage of the boosters ranges from 0 to 130 volts. The two boosters may be placed in series and can thus be substituted for either leg of the battery, allowing the replaced half of the battery to either accumulate an extra charge in case the two sides of the system have become so badly unbalanced as to have discharged one side of the battery excessively, or that part of the battery may be entirely cut out for repairs. In fact, the boosters may take the place of the entire battery if necessary, acting as an equalizer across one leg of the system, giving or taking current, as occasion requires.

The switchboard consists of eleven panels of black enameled, polished slate. The three generator panels are each provided with the usual complement of switches, a rheostat, a cutting-in galvanometer, a circuit-breaker, an ammeter, and a voltmeter. One booster panel and two battery panels are necessary for the manipulation of the battery auxiliary. The battery panel is provided with hand wheels, which control the end-cell switches, so that the potential of the battery can be changed from the front of the board. It is also possible to operate each end-cell switch by means of a small motor directly attached to the switch spindle. This motor is controlled by a push button on the front of the battery board, and an indicator shows how many cells are in service at any time. Low-reading voltmeters and voltmeter switches allow the potential of the end cells to be ascertained conveniently from the front of the board. A meter panel contains four station wattmeters, which register the total output of the plant. Three feeder panels are at present employed to distribute the current, and these panels each contain a feeder [illegible] and corresponding ammeters. A regulating voltmeter panel is located at the end, and at right angles to the rest of the board in a position where it can be easily seen by the switchboard attendant.

Alternating Current Transformers—From the Station Manager's Viewpoint.*

BY W. F. WHITE.

In the early days of alternating central station development many a sale of central station equipment was lost to direct current competitors by the facts, figures and fancies which the salesman of direct current apparatus was able to advance concerning the wastefulness of energy, the expense of maintenance, and the danger to life which purchasers must accept as inseparably wedded to any transformer system.

Notwithstanding that the danger to life was unfortunately made much of, and the facts grossly misrepresented, still the correctness of many of those arguments, in the light of present knowledge, stands up remarkably well under the scrutiny of qualitative analysis. And it is even more remarkable, in view of the natural tendency to exaggerate induced by zeal to make sales, how little, if any, were the facts of these evils overdrawn or magnified. Quantitative analysis in fact proves that most figures then given to show the amount of transformer "leakages" were understated. On the part of salesmen this was undoubtedly more a mistake of the head than of the heart, for while some few of them knew the results of some isolated tests of some particular size of one type of manufacture of transformer, no one, whether salesman, engineer and designer, or manufacturer, had any knowledge or conception of the cumulative effect of transformer losses on the station output.

As long ago as 1892 the writer, in making a careful examination into the operations of one of the then largest alternating stations in this country, made the discovery that with a net meter rate to consumers of about 20 cents per 1000 watt hours, the income per kw-hour output at the switchboard was only about 6 cents, showing an average loss from station switchboard to consumers' meter of about 70 per cent.

Current was supplied, in accordance with the then existing universal practice, through one or more transformers for each customer. In two or three cases, for large installations, as many as eighteen or twenty transformers were erected for a single customer, no transformer of more than seventy-five lights capacity being used, the transformer primaries connected in multiple, but the secondaries feeding entirely distinct and separate circuits.

Of each 1000 watt-hours output at the switchboard, it was estimated that approximately 300 watt-hours were delivered through the customers' secondary meter, 600 watt-hours were accounted for by transformer core losses, leaving 100 watt-hours to be accounted for by transmission and other losses.

Very few plants exist, giving continuous service, using separate transformers for individual customers, and charging from 12 to 20 cents per 1000 watt hours, secondary meter measurement, whose income per kw-hour output at the switchboard exceeds from 4 cents to 7 cents. In other words, the transmission, transformation and distribution losses are commonly as much as 200 per cent. of the customers' demand, as shown by the customers' meters. This does not mean operating expenses three times as great as if all these losses were eliminated, but it does mean that large expenditures are made for fuel and feed water for the keeping warm of numerous transformers operating about twenty hours per day with open secondaries. And great numbers of small transformers also mean great variations of secondary voltage, large bills for lamp renewals, unsatisfactory service, and a reduced number of lamps which can be served at any instant from a given generator capacity. To show the benefits to be derived by using a secondary net work, fed by large transformers working in multiple, but located one at each feeding point or local centre of distribution, as compared with the use of small transformers, one or more to a customer, the writer presents some results accomplished by an existing plant in remodeling its transformer system in accordance with these ideas.

January 1, 1895, this plant was serving 16,702 incandescent lamps (16 candle power equivalent) through 547 transformers of 22,190 lamps rated capacity, each transformer averaging 40.6 lamps capacity and serving 30.6 lamps. The transformer load, with open secondaries, was, as nearly as could be determined, about 80 amperes at 1000 volts. In view of the fact that the maximum load never exceeded 50 per cent. of the lamp capacity connected, it was evident that a very considerable reduction could be made both in the number of transformers connected and in their aggregate capacity, by the use of a secondary network. The theoretical limit was a transformer capacity equal to the maximum load, which would lower the capacity connected from 22,190 lamps to about 7000 lamps, a reduction of about 64 per cent. This limit was evidently impossible of attainment because of the large number of isolated installations, especially in the residence districts, requiring individual transformers, which of necessity must generally be of capacity equal to several times the average load.

To replace one circuit of seventy-one transformers a 3-wire secondary network was erected, supplying all customers, and fed by five 400-light transformers, located at as many feeding points or local centres of distribution. Each transformer was provided with primary and secondary switches, by means of which each night all transformers were thrown into service from dusk until midnight, at which latter hour four transformers were cut absolutely out of circuit. On a yearly average, five transformers were in circuit about six hours per day, and one transformer the remaining eighteen hours per day. The combined core losses of the five were about 1250 watts, and for the hours in service aggregated about 4,380,000 watt-hours per year. Some results of the above changes on this one circuit therefore were as follows:

Number of Transformers.	Lights Capacity.	Total Core Losses—Watts.	Total Annual Core Losses—Watt Hours.	Equivalent Tons Coal.
71	4,482	10,402	91,121,520	446.7
5	2,000	1,250	4,380,000	21.5
Saving.	2,482	9,152	86,741,520	425.2

A reduction of over 95 per cent. in core losses and a saving for one year in cost of fuel alone of $815.40 were effected for this one circuit. This example was an extreme, because the lighting was concentrated; and because in most residence and outlying business districts few changes in the number and capacity of transformers could be made.

Some results for the plant as a whole may therefore be fairly indicative of what other average plants operating under similar conditions may accomplish in the same direction, and were as follows:

Time.	Lamps Connected.	Transformers Connected.	Total Capacity.	Average Lights Capacity.	Average Lights Served.
Jan 1, 1895...	16,702	547	22,190	40.6	30.6
" 1, 1896....	19,282	201	13,865	69.	90.1
" 1, 1897....	20,262	152	13,498	88.8	133.3
" 1, 1898 ...	23,043	141	14,946	106.	167.7

Year.	Income.	Switchboard Output, K. W. Hours.	Income per K. W. Hour Output.	Increase of Income per K. W. Hour Output.
1894............	$59,012.71	928,400	$.0635	....
1895............	54,231.67	791,752	.0684	7.7 per cent.
1896............	51,415.20	551,064	.0933	46.9 per cent.
1897	56,317.42	508,070	.1108	74.5 per cent.

Year.	Actual K. W. Hours Output.	Estimated K. W. Hours Output—Basis 1894. Conditions.	Estimated K. W. Hours Saved by Change.	Estimated Saving in Coal—1894 Basis.	
				Tons.	Cost.
1894......	928,400	......	......	......	......
1895........	791,752	854,042	62,290	[illegible]	[illegible]
1896........	551,064	809,689	258,625	1,267.8	2,641.42
1897.......	508,070	886,888	378,818	1,856.9	4,015.43

In core losses alone, the savings already effected have more than paid all costs of the entire change of lamps, meters and transformers (for because of a simultaneous change from 52 volts to 106 volts, secondary, all lamps and meters also had to be changed), and of the erection of secondary network; and the annual saving of $6000 is equal to 6 per cent. interest on $100,000, secured without one dollar invested.

To be certain that the saving of fuel was in proportion to the reduction in kw-hours output, as estimated, the plant efficiency under the changed conditions must be known. It is therefore pleasing to note that, using coal from the same mine most of the time, the watt-hours output per pound of coal actually increased for 1896 by 3.8 per cent., and for 1897 by 5.9 per cent. over 1895, so that the saving in fuel was at least not less than in proportion to the saving in kw-hours output.

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*A paper presented at the General Meeting of the American Institute of Electrical Engineers, Omaha, June, 1898. Abstracted.

Some incidental advantages of the change may be mentioned.

First. Under the old plan, the 6941 lights added would have required about 9200 lights additional transformer capacity, of forty lights average size, of $1 per light average cost, giving an investment saving of $9,200.

Second. The transformer load, with open secondaries, of 80 amperes, was reduced, by the fall of 1897, to about 30 amperes, notwithstanding an increase of about 25 per cent. in the number of lights connected. A saving of 50 amperes at 1000 volts represents a capacity to serve, without additional station or line equipment, approximately 1000 16-cp equivalents, all burning at one time, or fully 2000 16-cp equivalents connected.

Third Formerly as many as a dozen transformers were frequently burned out in a single thunderstorm. Ten per cent. of the transformers connected would be a conservative estimate of the number burned out each year from various causes. Of the new transformers during the past three years only one has failed from any cause, and that one was defective, and burned out under light load almost immediately upon being put in service. Transformer repair costs are therefore practically eliminated.

Fourth. Incandescent lamp renewals have been greatly reduced. Using lamps from the same factory, of the same efficiency, and bought at the same price per lamp, the cost (estimated) of renewals per kw-hour consumed by the lamps has been reduced from $.0081 in 1895 to $.0057 in 1897, a reduction of 29.6 per cent. This saving represents the advantage of regulating the secondary voltage by pressure wires connected to the secondary network, as compared with the former method of regulating the primary voltage by station transformers.

Fifth. The principal remaining incidental advantage is the uniformity of voltage, bringing uniformity in quality of service and the consequent satisfaction of customers, the value of which cannot be estimated in dollars or percentages. These are some actual results, and such as any plant operating under similar conditions can achieve at small expense, if the changes are well planned, and the replaced apparatus sold to the best advantage.

Two-Wire Distributing Systems and Lamps at 200-240 Volts.*

BY JOHN W. HOWELL.

Distributing systems, operating at 200 to 240 volts, with simple 2-wire circuits, first attracted attention about four or five years ago. These early plants used two 110-volt lamps in series, and were installed as a means of competing in cost of installation with 3-wire plants without resorting to the alternating-current system, with its disadvantages where motors are operated.

The growth of these plants was slow until the demand created by them led to the production of the 220-volt lamp, and practical experience had shown the weaknesses of these lamps and led the makers to overcome the difficulties met in their manufacture.

What these weaknesses were can be judged by the following extracts from previously published articles:

"The consensus of opinion at the present day of the average types of high-voltage lamps undoubtedly points to the fact that a large percentage is expected to short-circuit as soon as they are put up, and I have heard several engineers say that they expect about one in twelve to go in this way."

"There is no doubt whatever that almost all the present day 200-volt lamps are only suitable for burning in a vertical position. As soon as any other position is adopted defects become prominent. The long, thin filament soon drops onto the bulb and cracks it. Also electrostatic attractions, owing to higher voltage, cannot be resisted by the long, thin filament, and this is an additional cause of the filament approaching the bulb.

"The effect of electrostatic attractions on long, thin filaments is very noticeable with lamps burning in a horizontal position."

These are extracts from a paper read by Mr. G. Binswanger Byng before the British Institution of Electrical Engineers on February 24, 1898.

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these lamps to be just as reliable in service as are 110-volt lamps. The development of the lamp has taken considerable time, and the growth of the 220-volt 2-wire system, in spite of the shortcoming of the early lamp, is due to compensating advantages in other elements of the system.

Cheapness of installation of the 220-volt 2-wire system, when compared with the 110-volt 3-wire system, arises from the use of a single large dynamo where the 3-wire system requires two, each having half the capacity, with the accompanying duplication of regulating apparatus, indicators, ammeters, etc. There is also a saving of the entire cost of the neutral conductor of the 3-wire system, which conductor in street mains (as distinguished from feeders) and in house wiring should be as large as the outside wires.

Three-wire plants in cities, whose business warrants the employment of the skill necessary to operate the system to best advantage, successfully use 110-volt 3.1 watts per candle lamps, and get very excellent results from them. The 220-volt 2-wire system cannot be considered a competitor of the 3-wire system under these conditions, since the best 220-volt lamp on the market to-day is a 4 watts per candle lamp. But it is my opinion that in smaller installations, whose conditions call for a 3.5 watts per candle lamp when a 110-volt 3-wire system is used, the advantages of the 2-wire 220-volt system are sufficient to offset the disadvantages of a 4 as compared with a 3.5 watts per candle lamp. Under normal conditions the performance of the present 4 watts per candle 220-volt lamp as regards life and maintenance of candle power is about 25 per cent. poorer than the present 3.5 watts per candle 110-volt lamp, but it is my opinion that the greater irregularities in pressure ordinarily found in the 3-wire plants we are now considering, as compared with the 2-wire plants operated under similar conditions, fully counteract, by their injurious effect upon the lamps, the advantage in life and candle power which the 110-volt 3.5 watts per candle lamp has under normal conditions over the 220-volt 4 watts per candle lamp.

In considering the relative advantages of the two systems, in the case of moderate-sized plants above referred to, we must charge against the saving effected in a 2-wire plant, by its single equipment and omission of the neutral conductor, the increased capacity of machinery and conductors made necessary by a 4 watts per candle as compared with a 3.5 watts per candle lamp.

Considering the copper required by a 220-volt 2-wire system using four W. P. C. lamps as our unit, the copper required by the two outside conductors of a 110-volt 3-wire system using 3.5 W. P. C. lamps will be .875. The amount to be added to this for the neutral conductor will vary somewhat with location of the station with reference to the points of consumption. If we assume that one-half the copper is installed for feeders and one-half for the distributing mains, and that the neutral wire is one-third the size of the outside wire in feeders and the same size in mains, then the total copper in the neutral conductors of feeders and mains will be 29 per cent. of the amount used in the 2-wire 220-volt system, and the total copper used in the 110-volt 3-wire system will be 16 per cent. greater than the copper used in the 220-volt 2-wire system. This comparison of the costs of copper does not consider the cost of wiring customers' premises, which is usually borne by the customer; it is, however, an advantage to the 220-volt system that this wiring will require at least 20 per cent. more copper for the 3-wire 110-volt system than for the 220-volt 2-wire system.

The 4 W. P. C. as compared with the 3.5 W. P. C. lamp would require for the 220-volt 2-wire system one-seventh greater capacity of boilers, engines and dynamos than would be required for the 3-wire 110-volt system.

The duplication of apparatus required for the 3-wire system will only partly offset this increased cost in the 2-wire 220-volt system, but the cost of this duplication of apparatus, together with the increased cost of copper required, will in many cases make the cost of installation of the 3-wire system at least equal to that of the 220—240-volt 2-wire system, leaving the simplicity of operation of the 2-wire system to be balanced against the increased cost of fuel required to operate 4 W. P. C., as compared with 3.5 W. P. C. lamps.

During the time the plant is operated considerably below its rated capacity, which will probably cover even the maximum load during the first year of the plant's existence, and all but three or four hours per day at all times, I think the increased fuel consumption due to 4 W. P. C. lamps will not be appreciable because of the poor efficiency of boilers and engines with light loads, and the total in

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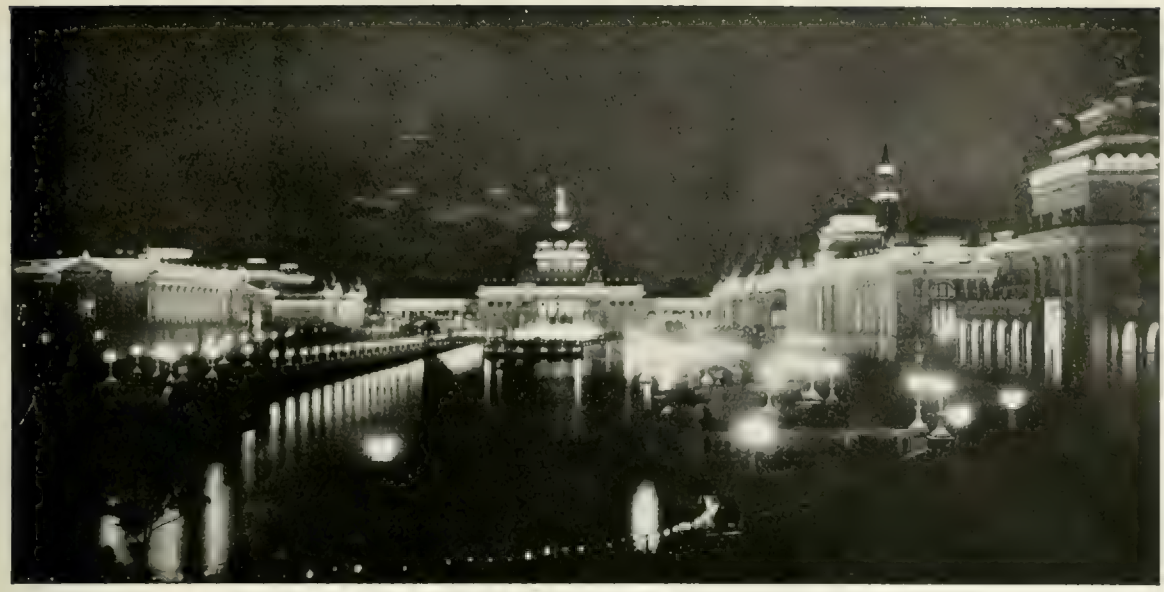
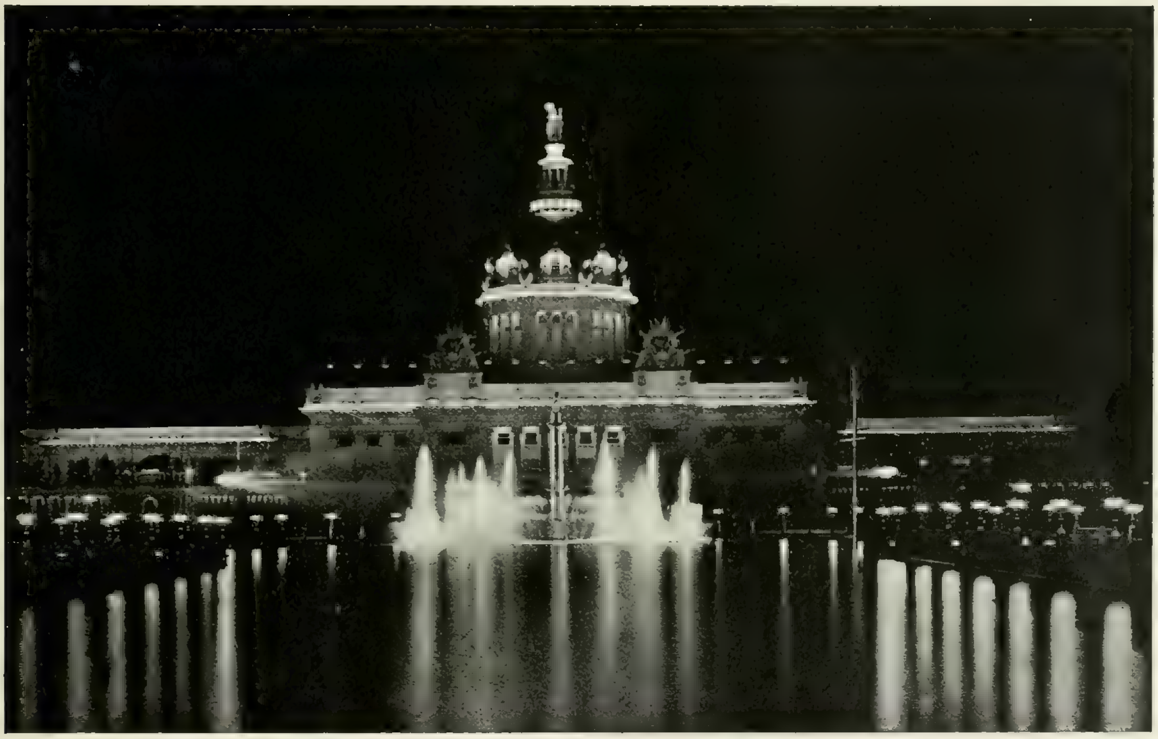


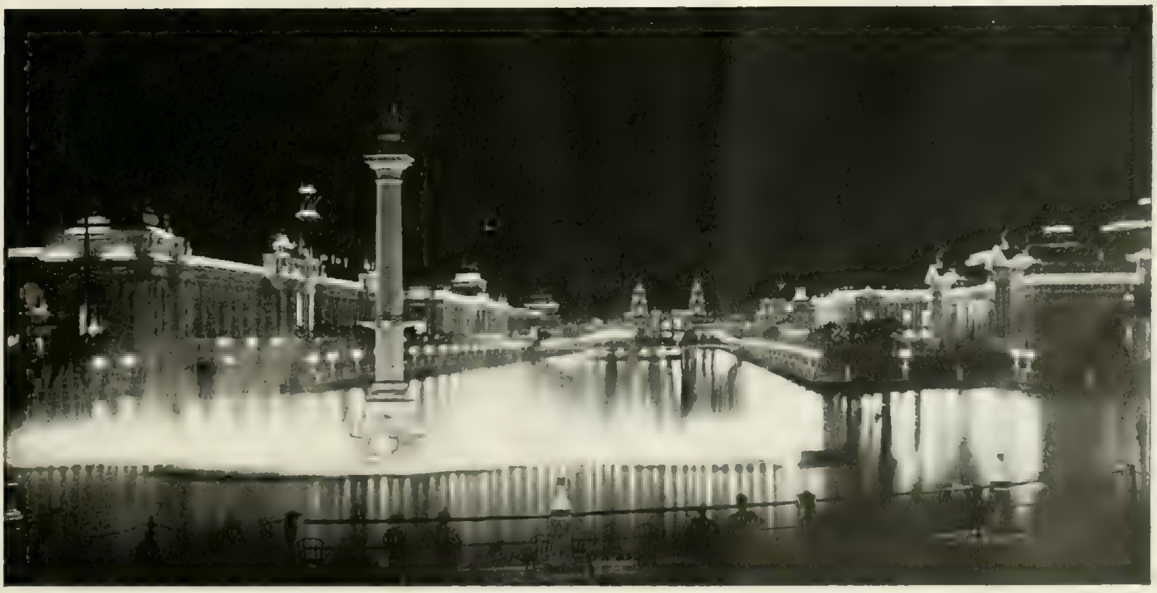
Views
of the Night
Illumination of the
Grand Court at the
Trans-Mississippi &
International
Exposition,
Omaha.

GRAND COURT LOOKING TOWARD THE GOVERNMENT BUILDING.



GOVERNMENT BUILDING AND FOUNTAIN.

Supplement to
THE
ELECTRICAL
WORLD,
July 9, 1898.



ILLUMINATION OF THE GRAND COURT, WITH FOUNTAIN IN FOREGROUND.

creased consumption of coal during the year will, I believe, be a small consideration under most circumstances, and in my opinion not enough to balance the simplicity of operation above noted.

A few months ago I made a trip through some of our central states, visiting a number of 220-volt plants to get a knowledge of the practical workings of the systems from the persons actually operating them, hoping to get from their experience information concerning existing conditions which would be of value in the lamp factory.

Naturally my first questions to the man who operated the plant concerned the lamps; were they generally satisfactory? Were they long-lived? Did they ever explode? I was greatly pleased with the answers I received. The lamps were reported to be almost universally satisfactory. They were very long-lived, in fact, too long-lived, for better service would be rendered if the lamps were renewed when they began to get dull, and not allowed to remain in service after they ceased to give a first-class light.

These 4 W. P. C. 220-volt lamps may be used for 600 hours and still give a good light, but I think this is about the limit of their useful life. If not taken in they will keep on burning for a long time and will give an average life of over double that figure before breaking.

The reports concerning exploding were equally satisfactory. For the past year or more, exploding lamps had been practically unknown; previous to that time, however, this had been one of the most serious objections to the system.

All these plants have been installed with switches, cut-outs, and other appliances made for 110-volt installations, and it is remarkable how little trouble has been caused by them.

Electric Utilization of Water Powers.*

BY L. D. W. MAGIE.

The harnessing of water powers is not an easy task, but requires a great deal of thought, scheming, trying and fitting by the engineer. The records of the stream have to be looked up and studied into, with reference to high and low water, during a period covering many years, and due provision made for getting rid of the maximum flood of every season.

Probably one of the most important things to study, especially in localities subject to severe winters, is the question of frazile or anchor ice. This is a condition which has caused hundreds of thousands of dollars to be spent, either from the lack of knowledge or want of forethought; in some cases the conditions have been such as to make it almost impossible to successfully cope with them, without expending such sums of money as to practically ruin the enterprise. To overcome it successfully the only way seems to be to provide a large pond of still water, extending to as great a distance as possible, even several miles, if attainable.

The pioneer work in electrical transmission was done with direct-current system, and too much credit cannot be given for achievements attained. However, although in a few instances the distance transmitted by the direct-current system has been up to 12 miles, yet, on the whole, for commercial reasons it has not been desirable to transmit power by direct current to a distance of over 2 miles, and even the advisability of this is looked upon to-day doubtfully.

The amount of copper required for the transmission of power is directly proportionate to the amount of power to be transmitted, and also directly proportionate to the square of the distance for a given efficiency. This may be stated commercially by the amount of copper required for transmitting, say, 100 horse-power for both 1 and 10 miles, the loss in transmission to be 8 per cent. and the voltage to be 500 volts.

For each leg of a 1-mile circuit there would be required two No. 0000 wires, or four No. 0000 wires, each 1 mile long, weighing 15,312 pounds, which, at 15 cents per pound, would cost $2,300. For each leg of the 10-mile line there would be required twenty No. 0000 wires or forty No. 0000 wires, each 10 miles long, weighing 1,531,200 pounds, which, at 15 cents per pound, would cost $230,000; or the power would cost, at 10 per cent. interest and depreciation on copper alone, $2.30 per horse-power annum in the first instance, and $230 per horse-power annum in the second case.

If, however, the voltage be raised to 5000 volts, and be used for transmitting 100 horse-power for 10 miles, the condition would be entirely different, for instead of forty No. 0000 wires, each 10 miles long, there would be required for each leg but one No. 4 or two No. 4 wires each 10 miles long, weighing 15,300 pounds, which, at 15 cents per pound, would cost $2,300, or the same as transmitting the same amount of energy only 1 mile at 500 volts.

The primary or fundamental question is to ascertain the point at which transmission of water powers will be a source of profit to the investor. The cost of electrically transmitted power is represented by the interest on the capital invested; the depreciation; the maintenance; the operating expenses, and numerous other small contingencies, and besides, in some cases, the amount of money that has to be expended for water and land privileges. The sum of these accounts per year, divided by the amount of horse-power actually sold, will be the actual cost per horse-power for the case in question.

Probably the greatest competitor to electric power is steam power. In a few instances power derived from gas or petroleum engines may also compete. The cost of producing steam power in any given locality is a fair criterion by which to determine how much electric power should cost. The cost of power produced from other sources can usually be disregarded.

The cost at which steam power can be produced in a given locality being ascertained, it can be determined what cost per horse-power may be expended on the construction of an electrical transmission plant to make it profitable to the investor, provided, again, a sufficient market can be obtained for power.

When electrically transmitted power does not cost more than $100 to $140 per horse-power installed, the investment is apt to be a profitable one, providing, of course, it is properly managed.

The first item of expense is amount required for water privileges. In some cases this is rather an unimportant consideration, while in others it is the chief expenditure, for it may involve the buying of thousands of acres of land surrounding the stream, because the necessary dams may cause to be submerged a great deal of valuable land, or large tracts have to be bought for building storage reservoirs, or the right of way for pipe lines, etc., have to be secured. When land is cheap these considerations are often not objectionable, but where good farming land, or land valuable for other reasons, has to be thrown to waste, the question is often a perplexing one.

The cost of the dam, power house and hydraulic machinery is, as a rule, dependent almost entirely on the characteristics of the stream being utilized. Entering into the question is the amount of water in the stream, both under normal as well as abnormal conditions at various seasons of the year; also the head or fall, and whether it is dependent on natural conditions or requires the building of large dams. Generally speaking, other things remaining equal, generating plants, comprising the power house, hydraulic and electric machinery, as a whole cost less as the head increases, until certain limits have been reached. When the head is low, as ranging from 4 to 10 feet, it requires a comparatively large wheel for a relatively small amount of power, and then slow speeds can only be attained. Where large units are desirable a number of these wheels must be coupled together in order to get the required power. The speed required can be raised or lowered to a certain extent, depending on the size of the wheel. If higher speeds at low heads be desired for large units, many wheels must be operated together, requiring not only a great deal of room, and consequently larger power house, but considerable line shafting, gears, couplings, etc., which not only increase the initial cost, but increase expenditure of operation and maintenance of the plant, as well as introducing another source of inefficiency. With higher heads a larger amount of power can be obtained from fewer and smaller wheels, with higher speeds, and, therefore, cheaper generating apparatus.

The cost of generating apparatus for a given capacity, other things remaining equal, is almost directly proportional to the speed at which it runs, and for this reason it is always desirable to refrain from too low speeds wherever possible. A good engineer will hardly warrant the expenditure of, say, $15,000 for a 300-kw generator to run at a speed of say 75 to 100 r.p.m., when a machine just as good in every respect, and sometimes better (because it is a standard size), can be bought in belted units for $5000.

The next item of considerable expense is the transmission line. The poles, with their appurtenances, exclusive of wire, will cost between $250 to $500 per mile, varying according to circumstances. Rights of way for the placing of poles may often be expensive. The transmission wire must be considered separately.

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*Abstract of a paper read before the Eighth Convention of the Canadian Electrical Association, Montreal, Que., June 28, 1898.

The cost of the transmission wire is often the most important part, but is always different with each case, dependent as it is upon the amount of power to be transmitted, the transmitting voltage, distance, and the allowable loss. As a whole, it is always best to keep the transmitting voltage as low as possible and still keep within commercial conditions. Many people are carried away with the idea that if they could only use high voltages the cost of transmitting would be reduced to a minimum. It must be borne in mind that with the use of the higher voltages the cost of insulators increases, the electrical apparatus necessarily costs more, and, moreover, the risks are greater throughout the system, and consequently necessitates more skilled attendants to look after the plant. All of these items have to be carefully considered before looking into the possible saving of copper on the line. For mechanical reasons, a wire smaller than No. 6 B. & S. should not be used for line work. More cautious engineers will say it should not be smaller than No. 4 B. & S. It is foolish to attempt to use voltages which allow the use of smaller than No. 6 wire. Where a shut-down would mean heavy damages, it might be even advisable to use a wire not smaller than a No. 2 B. & S. If these facts are always borne in mind, the question of voltage will oftentimes adjust itself, and the use of very high voltages will not be found necessary, unless the transmission be for especially long distances, and the amount of power particularly large.

The Convention of the Independent Telephone Association.

The Independent Telephone Association of the United States met in its second annual convention at the Palmer House, Chicago, Ill., on Thursday, June 30, at 4 o'clock P. M., and continued in session Thursday, Friday, and Saturday. The attendance was excellent. Representatives from independent exchanges and toll line systems were present from fourteen States. Great interest was manifested, and the reports from all sections of the country showed a vigorous growth and extension of the independent telephone movement throughout the United States.

The programme which was announced was carried out. A committee consisting of H. D. Critchfield, Ohio; S. P. Scherin, Indiana; H. K. Cole, Kentucky, was appointed to propose changes in the constitution adopted at Detroit last year. This committee submitted the following report, which, after discussion, was unanimously adopted: The committee to which were referred the proposed changes in the constitution beg leave to submit the following report: We recommend, first, that section 2 of article 3 be amended to read as follows: "Sec. 2. The payment from time to time of such further assessments as the association, through its proper committee, may levy, shall not exceed per year 10 cents for each telephone in use by any exchange or toll line company, and 10 cents per mile of toll lines carrying wire or wires over which paid messages are transmitted." The committee further recommended that section 3, article 3, be amended to read as follows: "Sec. 3. Any corporation, partnership, or individual engaged in the manufacture of telephones, switchboards, etc., may become a member of the association on the payment of the membership fee of $10 and annual dues to the sum of $100. The membership fee shall be paid but once, the annual dues of the first year to accompany the membership fee and to be paid annually thereafter on notification by the secretary. Any corporation, partnership, or individual engaged in [illegible] the construction, operation or maintenance of an independent telephone exchange or toll line system, except corporation, partnership or individual engaged in the manufacture and sale of switchboards, telephones, etc., may [illegible] $10 and [illegible] and at the time provided for the payment by manufacturers of telephones and [illegible]

[illegible] three vice-presidents, a secretary, two assistant secretaries, a treasurer [illegible] whom shall be the president and secretary, together with three [illegible] It [illegible]

[illegible]

entitled to one vote for each 500 telephones or less, or each 500 miles of toll lines or less, in actual use, and one additional vote for the major fraction of 500 telephones or miles of toll line in use, and no more, on the election of officers or on any question which may be voted upon by the association, provided, however, that each person, firm or corporation admitted to membership under section 3, of article 3, of the constitution shall be entitled to one vote."

The committee recommended that article 5 of the constitution be amended to read as follows: "The association shall elect an executive committee, to consist of one member from each State, the State, through its delegates, to suggest the name of the member of the committee to represent the State. Should the State be without representation, the convention shall select a member from such State, who shall sit until the vacancy be properly filled under this article. The executive committee shall, with the consent of the advisory board, select sub-committees as it deems expedient, and fully empower these sub-committees to carry out the objects for which they are created."

The committee recommended that section 3 of article 7 be amended to read as follows: "The secretary and treasurer shall keep the minutes, collect the moneys, give receipt for the same, shall pay properly executed orders and drafts provided for by the constitution, and other orders signed by the president under the direction of the advisory board. He shall also keep an accurate account of the receipts and disbursements of money, make a report thereof at the annual meeting, and to the executive committee or the advisory board whenever called upon. He shall issue by mail the official calls and perform the other duties required by the association. He shall receive a salary not to exceed four hundred dollars ($400.00) per year, fixed by the executive committee. He shall have an allowance for expenses, to be paid after approval by the advisory board on the presentation of vouchers. His salary shall be paid at the end of the quarter, by a draft upon the treasurer. He shall give a bond in the sum the executive committee may require, the security to be approved by the advisory board."

The committee further recommended that section 5 of article 7 be stricken out, and that the offices of secretary and treasurer be vested in one person; also that section 1 of article 7 be amended by the words and figures "$1200 per year."

These important changes met with the unanimous approval of the members present. After the adoption of the report of the revisional committee the association proceeded to the election of officers. The following were elected for the ensuing year: President, James M. Thomas, Chillicothe, Ohio; first vice-president, H. C. Young, Columbia, Pa.; second vice-president, S. T. Slade, Oskaloosa, Ia.; third vice-president, J. B. Ware, Grand Rapids, Mich.; secretary and treasurer, W. J. Vesey, Fort Wayne, Ind.; first assistant secretary, George W. Beers, Fort Wayne, Ind.; second assistant secretary, D. C. Dow, Cobleskill, N. Y.; advisory board, James M. Thomas, Chillicothe, Ohio; W. J. Vesey, Fort Wayne, Ind.; H. B. Critchfield, Mount Vernon, Ohio; Hugh Dougherty, Bluffton, Ind.; E. B. Fisher, Grand Rapids, Mich.

After the new officers had assumed their respective duties, the following resolution was offered: Whereas, express companies have in many cities all over the country, presumably at the instigation of the Bell telephone monopoly, issued orders directing the taking from their several offices of telephones not furnished free of charge, and whereas we regard this act as a direct assault upon the independent interests of the whole country, therefore, be it resolved, that the Independent Telephone Association of the United States in annual convention assembled, believing that a just compensation for service and the right to enter into fair competition in every line of business is an inalienable right of American citizens, denounces the action of the express companies as an outrage upon the common rights of citizenship, advises that local independent companies resent each in its own way, appealing to patrons and fellow-citizens to aid their efforts by sending as many light shipments by mail or fast freight as possible, and especially recommends that independent companies order exchange and line supplies to be shipped in like manner. This resolution, after a full discussion and careful consideration, was adopted without a dissenting vote. After transacting miscellaneous business and general discussion, the association adjourned to meet in June, 1899, at a time and place to be fixed hereafter by the executive committee, unless sooner called to convention by the president. All differences growing out of the Detroit convention were settled. Many new members were added and ample financial support was pledged.

Convention of the Canadian Electrical Association.

The eighth annual convention of the Canadian Electrical Association was held at the Windsor Hotel, Montreal, June 28, 29 and 30. There was a large attendance of delegates.

The first session opened on the morning of June 28, and the first business was the reading and approval of the minutes of the last annual meeting.

Mayor Prefontaine, of Montreal, was then introduced and addressed the meeting. In the name of the citizens of Montreal he heartily welcomed the members to the city.

President John Yule then read his annual address. After giving a hearty welcome to the eighth convention of the association, he dwelt upon the objects of the association and the good that had resulted from membership in it. He reviewed the electrical developments in Canada during the last four years which mark the interval of time since the association last met in Montreal. He referred to the abundant water powers of the Dominion which were available as a substitute for coal, with which mineral the Dominion of Canada, at least so far as Ontario and Quebec were concerned, was not abundantly provided. The only point at which satisfactory progress cannot be reported, he stated, is at Niagara Falls, where, unfortunately, the tying up of the greatest water power in the Dominion by an alien corporation has prevented its development for the benefit of the people of Ontario. He trusted that this state of affairs would be removed before another year. In the field of electric lighting a reasonably satisfactory condition of affairs existed. A large majority of the plants now in operation is equipped with reasonably modern and efficient machinery, and the rates at which current is supplied are, it is safe to say, taken on the average, the lowest in the world.

After the close of the president's address, Mr. J. J. Wright, on behalf of the Committee on Meters, reported that inasmuch as no special business had been brought before the committee during the past year, it had not been convened. The president appointed Messrs. Reesor, Smith and Hunt as members of a committee to convene standing committees.

Mr. A. A. Wright then read a paper entitled, "How to Overcome Some of the Difficulties Encountered by Central Station Men."

Mr. Wright treated the subject from the standpoint of one who has to deal with customers living in a town of moderate size. In the matter of dealing with the corporate fathers regarding contracts for arc lights for streets, he suggested leaving municipal politics entirely alone. As to commercial lights contracts could be made with customers on a yearly basis, with the same renewing clause that there is in the contract with the town, but with this difference, that the payment in this case be made weekly. He advised never, under any circumstances, to do free wiring. He thought that meters should be placed where they could be readily and accurately read. He related some of his experiences with people who doubted the veracity of meters, and the tactics adopted to handle such cases. Mr. Wright supplemented his paper with the advice to central station men that where they did not have contracts with a town to try to form a joint stock company, and not endeavor to run the concern alone. He also suggested getting the most influential men in the town as members of the company, and in that way a leverage on the Council could be had that could not be otherwise possibly obtained. It would also prevent other companies from coming in, and would assist managers in many ways. He also suggested that it is as well to try to let the lighting contract with the town be the weak arm of strength and devote more time to the commercial aspect than to the other. Then, if the desired legislation could not be obtained, the central station men would be in a position to stand the shock better. Later on in the discussion, Mr. Wright stated that he found that giving notice where an account was not paid promptly was very effective. His company had a system of first, second and third notices, and if the bills are not paid after the third notice the customer is disconnected. This generally resulted in the delinquent paying the bill and asking for reconnection. In answer to a question Mr. Wright stated that his company (in Renfrew, Ont.) supplied incandescent lights almost entirely by meter. A rental of 25 cents a month for all sizes of meters is charged. The smallest meter in service is 7½ amperes, both two and three wire.

Mr. Reesor stated that in Grimsby the bills for incandescent lighting and commercial lighting were collected monthly, and his company had a rate of discount of 33⅓ per cent. if the bills due on the first are paid before the 10th. This inducement worked fairly well. Customers came to the office to pay, and the company was trying to have all its collections made at the office instead of sending out collectors. There are a few delinquents, but the company was trying to weed them out and educate them to a better system.

Mr. Dion, of Ottawa, related his experience with 5-cp lamps. His company supplied the lamps free to meter customers. The company had confined itself to 10 and 16-candle-power, but a few years ago the customers found out that lamps of 5 candle-power were made, and asked for them to be used as night lamps. It finally decided to let every customer have a 5 candle-power lamp, supplying only one, and when that burned out to exchange it for a new one. It was found that this popularized electric lighting, and prevented the use of coal oil lamps. These night lamps, while not registering on the meter, are a small expense to the company, as the load is small at the time that they are used, and it was found to be advantageous to allow them to be used in this way. He stated that about one-eighth of his company's business is a flat rate one. The company supplied the lamps in the first installation, but renewals are paid for. On the meter system lamps were supplied free, both for installations and renewals. The company has house to house inspections for the purpose of renewing lamps. It found that customers on the meter system allowed their lamps to get very old and black until they hardly give any light, and then complained to their friends without coming to the office, so that the company had no means of remedying the difficulty. The house to house inspection was a solution of the problem. The men gave attention to sockets, etc., and although an expense, the company found that the satisfaction thus given to customers more than reimbursed it.

Mr. Ellis, of Barrie, gave an account of the method of making collections adopted by his company. The accounts are sent out every six weeks. The company employs a form with a coupon on the end to the effect that the bill is payable at the bank fifteen days after date of issue, and if not paid at the bank discount will not be given, and if tendered at the bank after the fifteenth day the coupon will not be accepted. This has been found to work very successfully. The bank is paid $50 a year for doing this work. The company charges 17½ cents per kilowatt, net, and if the bill is over $12 in six weeks, it gives a discount of 20 per cent. The gross rate is 25 cents per kilowatt.

Adjournment was then taken until 2 P. M.

At the afternoon sesssion a paper by Mr. Louis Dewitt Magie, entitled "Electrical Utilization of Water Powers," was read. There was considerable debate over the question of deferring the discussion of this paper until the next annual meeting of the association, because the members had not had an opportunity to study the subject. It was finally decided, however, to go on with the discussion at this meeting. Mr. Magie, in explanation, stated that he did not attempt to fight the steam man, and, in fact, tried to give him good leeway, but merely took up the electrical part of the subject. If it were desired to fight the steam man, it would be better to get up another paper. An abstract of this paper is printed on another page.

Mr. Thompson questioned the wisdom of putting in 20,000, 30,000 or 40,000-hp plants, and then only be able to find customers for one-tenth or less of the output. Too many people imagine, he thought, that because the waterfall turns the waterwheel, the power costs nothing. He illustrated this by telling a story of a small town where they obtained lights at a few cents a week, and power that did not cost anything because it was water power. A few years later the dam of the water power broke down, the operation of the plant was discontinued, and the people in the town returned to coal oil, as it was stated that it cost too much to run the water power. He thought that an immense amount of money had been sunk in getting power in advance of the demand. In a city like Montreal, he thought it advantageous both to the company and to the city because, with the shipping facilities in Montreal and the large country to draw from, a large number of manufacturing concerns will be induced to come to Montreal and establish their business so as to get cheap power. But that does not apply in every case.

Mr. W. F. Bonner then read a paper on "The Unconscious Ownership of an Important Key." In the discussion of this paper Mr. Hill thought that the suburban railway managers were losing sight of the large field of steady utilization of their power, by not canvassing the farmer. He used an electric road at Grimsby as an illustration. It runs through a most fertile country, tenanted almost entirely by large fruit growers and farmers, each of which has a certain amount of power in use almost every hour of the day. They have the grinding of the ensilage product, and a thresher, and pumping and churning, and everything of this nature is going on which requires a certain amount of power all the time, and yet, strange to say, none of these suburban roads seems to be willing to do anything in the way of allowing the farmer to take any power from their circuits. He stated that it had been figured that the farmers on large grain fields in Manitoba could, with the straw that they burn up in heaps every fall, do, by electric power, all the work on the farm that now requires from 100 to 150 teams. By centralizing the power in one spot, drawing the straw after the season was over and keeping it in spots, to be used from time to time, the farmers could have sufficient power to do the farm work and do away with this large number of teams, to say nothing of the men who look after them.

Mr. Wright, Jr., of Montreal, stated that on the Montreal Belt Line farmers are supplied with power, and the company has more demand for it than it can supply. The only difficulty has been with the insurance people, who object to the "grounding."

On Wednesday afternoon the members of the association visited the Bell Telephone Company's building, the power house of the Montreal Street Railway Company and the works of the Lachine Rapids Hydraulic and Land Company. They were taken around the works of the latter company and shown its most interesting features. Considerable surprise was expressed at the extent and magnitude of the equipment. After a thorough inspection of the plant and vicinity, luncheon was partaken of, through the courtesy of the Lachine Company.

ELEC. WORLD, N.Y.

W. H. Browne, President.

At the meeting on the morning of June 30 the election of officers took place, and resulted in the selection of Mr. William H. Browne as president; Mr. H. P. Dwight, first vice-president, and Mr. A. A. Dion, second vice-president. Mr. C. H. Mortimer was re-elected secretary and treasurer.

After the adjournment of the meeting the members paid a very interesting visit to McGill University, after which they were taken to the works of the Royal Electric Company, visiting first the lighting station and then the factory. The members and their friends to the number of about 250 were then conveyed by special train to the power house of the Chambly Manufacturing Company, at Richelieu, where an opportunity was given to witness the hydraulic development at that point.

The entire success of the work, in addition to its interest from a mechanical and electrical standpoint, was directly attributable to the untiring energies and the acknowledged executive ability of General Manager William H. Browne. At the conclusion of the inspection of the power house and its surroundings the members sat down to a delightful luncheon, which was thoroughly appreciated. A number of addresses of welcome were made, and in response to a toast to the success of the entire undertaking, Mr. Browne made a fitting reply.

Mr. Dion, on behalf of the association, extended the hearty thanks of the members for the many courtesies extended by the Royal and Chambly Companies.

The annual banquet of the association was held at the Windsor Hotel on June 29, upward of 100 persons being present. It was a thorough success in every respect and the after-dinner speeches were short, bright and enjoyable. The toast, "Electrical Montreal," was responded to by Mayor Prefontaine, who gave some interesting figures regarding electrical progress in the city. He referred to the pioneer electrical company in the city—the Royal Electric Company. It started in 1894 with a dynamo of 12 arc-lights capacity, a dozen employees, a small workshop and a capital of less than $10,000. To-day the same company is serving from its two generating station electrical current for about 1500 arc lights and 75,000 incandescent lights. Its works now cover an area of about 40,000 square feet, and about 500 persons are employed, while its invested capital is upward of $2,500,000. In July, 1886, the streets of Montreal were first illuminated by electricity by 133 lights; now there are about 1500. In 1881 the first incandescent lights were supplied and in 1892 the first electric motor was installed. He referred to the Chambly Manufacturing Company and the misgivings which prevailed in the minds of many regarding the success of the scheme. He also spoke of the Lachine hydraulic works, which were a credit to Montreal. The development of the Montreal Park & Island Electric Railway and the telephone service were also touched upon by the speaker.

Mr. W. H. Browne, the newly elected president, responded to the toast, "Electrical Research."

The Importance of Proper Methods of Illumination.*

BY F. A. BOWMAN.

It should be distinctly borne in mind, especially by the smaller companies, that to do a growing and really successful business something more is necessary than to merely induce your customer to put in so many lamps and then to get as much pay as you can from him for them. It is now clearly demonstrated beyond a peradventure that the margin of profit is as narrow in the central station business as in any other, if not a great deal narrower, and that even when there is no competition from gas or a rival company the closest economy and best management are necessary to yield a profit to the shareholders and provide for future contingencies. In view of this the manager should realize that he must educate his clientele and give them the best satisfaction in every way. Too many managers are satisfied when they have succeeded in persuading a customer to take a certain number of lights. If in addition they are giving full pressure at the lamps and a reliable service they consider that their duty to both the company and the public is done. Now, this is a wrong principle. Attention should be paid to the purpose for which the light is required. Take for example a shop. The purpose for which it is to be used, its size, the height of ceiling, finish of the walls, kinds of goods to be displayed and sold, arrangement of counters and show cases—all must be noted and considered. It is useless to attempt to light a modern drug store and a ready-made clothing store in the same way, and expect equally satisfactory results in both cases. The manager should be looked upon as an authority on methods of lighting, and if he gives the matter a reasonable amount of attention he very soon will be. He must remember that he is a dealer in light, and to be a successful one must know all about it—how it is best used and what are the latest fashions in it. Education of his customers is a very material part of the work of every successful manager in the electrical business, and is one of the principal reasons why the business cannot be properly carried on by some one who has a number of other interests to look after as well. The manager must study this question of proper illumination so as to master the main principles necessary to a clear understanding of it. He must study his customers so as to know what their tastes and requirements are. He must carefully watch the advertisements in the technical journals and the catalogues that are so plentifully distributed, and many of which contain accurate and valuable information, and then correspond with the advertisers to see if the articles that strike him as suited to some of his customers can be brought within their reach. Then he must canvass carefully and patiently, and if he fails one year must try again the next, because by that time he will know better how to work, his customers' ideas will have advanced somewhat, possibly prices will have dropped a little.

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* Abstract of paper read at the eighth convention of the Canadian Electrical Association, Montreal, Que., June [illegible]

Electric Light and Power Plant in the Land, Title and Trust Building, Philadelphia.

WITHIN the past month an important electric plant has been completed by the Chicago Edison Company for what is now the tallest office building in Philadelphia. This plant, situated as it is within one block of the City Hall, is noticeable not only on account of the prominence of the building, but for some unique features which, to a certain extent, distinguish it from plants heretofore installed in the modern office building.

The plant consists of two Westinghouse compound-automatic engines, with cylinders 11 inches and 19 inches diameter by 11 inches stroke, direct coupled by means of the Arnold quill-drive system to two 45-kw Siemens & Halske generators. By this arrangement either engine can run either one or both dynamos, a liberal reserve capacity having been allowed for the engines (the arrangement of dynamos and engines is indicated in Fig. 1).

To further guard against any possibility of a breakdown a storage battery plant is provided, consisting of sixty-five cells of the standard "15 F" type, manufactured by the Electric Storage Battery Company. In addition to acting as a reserve the battery serves the double purpose of providing economically the current for the night load when the dynamos are shut down, and also of acting as a pressure regulator during the daytime under sudden fluctuations.

An examination of the diagram will show that the battery is so connected that the circuit for charging is independent of the discharging circuit, the 50-ampere end cell switch being used for the charging circuit, and the 400-ampere end cell switch for the discharging circuit. All feeders are provided with automatic circuit breaker switches, and are connected through a multiple point switch with Weston illuminated dial ammeters. The instruments and switches are finished in nickel. The building is wired for 3000 16-cp lamps and 125 horse-power in motors, with ten sets of feeders controlled by independent switches at the switchboard. All wires are run in iron armored conduit. Special cast-iron outlet boxes are provided at all light and switch outlets.

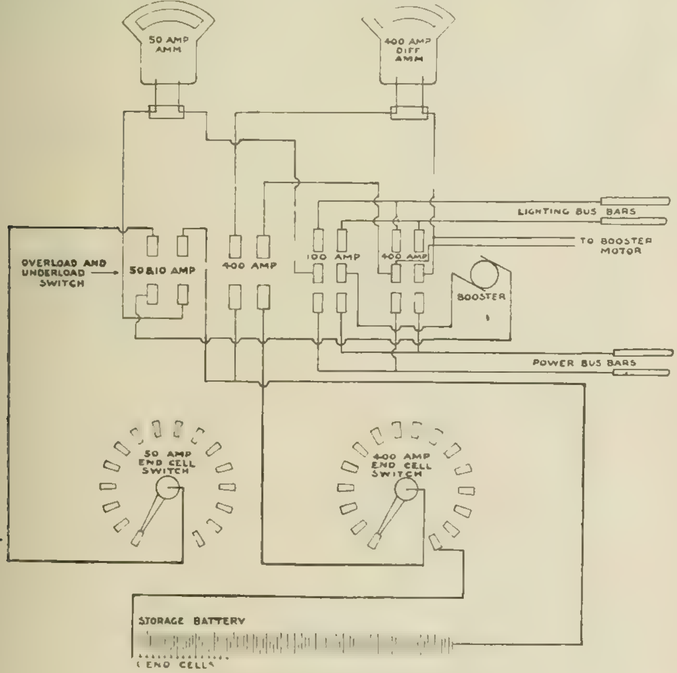
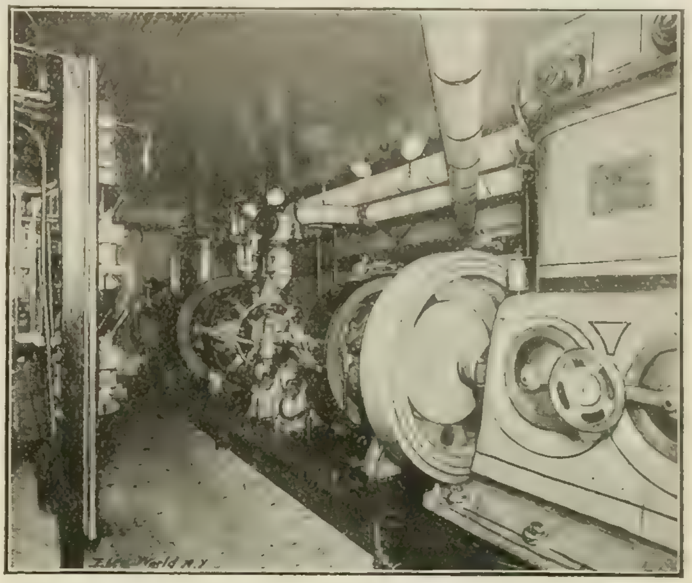


Diagram of Connections.

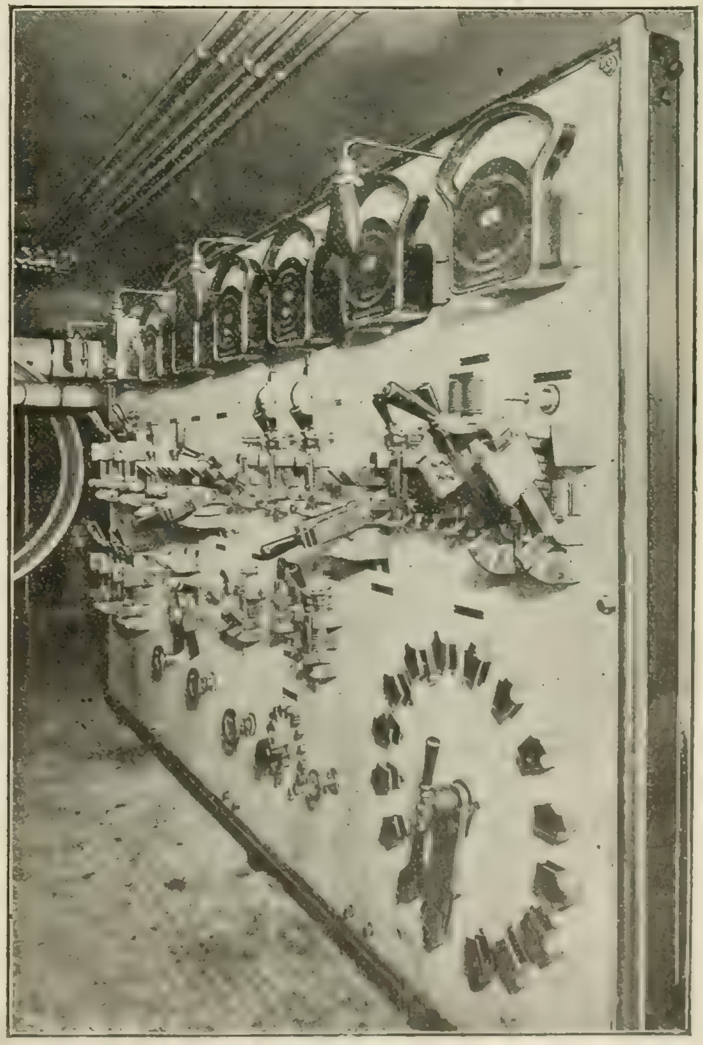
On each floor is a cast-iron cut-out cabinet lined with white Italian marble. The ends of the conduit are tapped into the cabinet by thread connections, and the wires in the cabinets are brought to the cut-outs without crossing of opposite polarities.

The first and second floors are to be occupied by the Land, Title & Trust Company for banking purposes, with a large deposit vault in the basement. The upper floors of the building are rented for offices. The different departments of the bank and safe deposit vaults are connected by a complete telephone and annunciator call system, all the wiring of which, as well as the watchmen's clock system, is installed in iron armored conduit.



Dynamos and Engines.

The specifications for this plant were drawn up by Mr. C. W. Wilkes, of D. H. Burnham & Co., architects of the building, and the work was installed under the supervision of J. H. Goehst and S. M. Bushnell, of the Chicago Edison Company.



Switchboard.

DIGEST OF CURRENT ELECTRICAL LITERATURE
AMERICAN AND FOREIGN
By Carl Hering

Dynamos, Motors and Transformers.

ALTERNATING CURRENT MOTORS WITH GREAT STARTING TORQUE. Deri. "Zeit. fuer Elek.," June 12.—The reprint of a recent paper. He gives the equation for calculating the torque of rotary field motors and discusses the characteristics graphically. He then describes his method of introducing the armature resistance necessary to obtain the great starting torque, and then cutting it out of circuit again in order to leave the armature in its simplest form, namely, of copper bars with slight insulation and without contact rings, rheostats or switches for the armature; all that is required is a switch for the field. The arrangement appears to consist in connecting across the end of the armature two points of the closed circuit winding which have unequal potentials, by means of a wire including a resistance; in a two-pole field the winding with these cross connections will then form a simple closed circuit winding, a diametrical winding with a divided wire; but when the inducing field has four poles the windings short-circuit themselves, and there will be no circuit in this connecting branch; all the armature windings should therefore be provided with connections between the points of unequal potential on one end or on both ends of the armature, and the resistances in these connecting branches should be so chosen that the starting torque should be as high as possible; in the field winding there is inserted a switch which alters the number of poles. He then applies the same principle to the single-phase induction motor; the fundamental principle of these is the same as that for rotary field motors if it is assumed that an oscillating field is the resultant of two rotary fields revolving in opposite directions, but with the same speed. The windings are illustrated, and are like those of the continuous current machines, being connected to a commutator on which there are two brushes, which are connected together; when the field has two poles currents will be induced which flow through the wires, connecting the brushes, and this will produce an armature field, which has a certain angle with the other field, thus producing a torque; for starting the motor the main field is to have two poles, and after the motor has reached a certain speed the field is changed into a four-pole field, when the current through the commutator and the brushes will cease and the armature will act like a regular short-circuited armature, the commutator and brushes being electrically inactive; the wires connecting the windings with the commutator form the necessary resistance to get the best starting torque; this will also tend to diminish the sparking at the brushes; the action is therefore different from that in which the resistance is usually inserted external to the brushes; when the motor has reached the desired speed the brushes may be raised from the commutator; there is a wide range of speed in which there is no fear that the motor will stop. The reversal of the motor is accomplished either by reversing the current in the field or by shifting the brushes through an angle corresponding to half the polar distance. He claims that the single-phase induction motor, then, has all the good qualities of the rotary field motor.

ALTERNATING-CURRENT MOTORS. Guilbert. "L'Eclairage Elec.," June 11.—Brief, illustrated descriptions of recent inventions taken from patent specifications. He claims that the recent device patented by Steinmetz for coupling polyphase motors in tandem is the same as was used by Siemens and Halske and de- [illegible]

INSULATING ARMATURE BOLTS. Boucherot. "L'Ind. Elec.," June 10.—A short, supplementary explanation to his recent [illegible] June 11).

Lights and Lighting.

VACUUM TUBE LAMPS. Lond. "Elec. Rev.," June 17.—A [illegible]

INCANDESCENT LAMPS. Rose. Lond. "Lightning," June [illegible] bon for the incandescent filaments, more particularly with the [illegible]

the bulb much more rapidly than a treated one; with the same make of filament the lower the pressure the higher may be the efficiency at which it is practicable to run the lamp.

OVERHANGING LAMPS.—Lond. "Elec.," June 17.—An abstract of the proposed by-laws for the regulation of overhanging lamps in public places. Briefly they are as follows: Sanction by the authorities must first be given; the clear height above the footway must not be less than 10 feet nor must they be nearer to the carriage-way than 3 feet from the outer edge of the curb; no lamp exceeding 2 feet in width or 4 feet in height or weighing more than ——— pounds shall be allowed; no part of a lamp shall project more than 4 feet from the premises to which it belongs; no advertisements thereon are permitted; the owner shall keep the lamp lighted during the hours agreed upon.

Power.

CAPSTANS. Sartiaux. "L'Eclairage Elec.," June 11.—A long description, with a number of illustrations and results of tests, of the electrically operated capstans used by the Northern Railroad of France for drawing freight cars in the freight yards; three types are used and are described.

STEAM-USING PLANT. Jeckell. Lond. "Elec.," June 17.—A reprint of his Municipal Electrical Association paper.

BLAST FURNACE POWER GAS. Hubert. "Eng. Mag.," July.—A brief abstract of his tests at Seraing, Belgium, published in "Stahl und Eisen." He answers the objections recently made by Luermann (see "Digest," June 18). His conclusions are that a 100-ton blast furnace will produce about 18,000 cu. m. of gas per hour; assuming that 50 per cent. is used in the hot-blast stoves, there remain 9,000 cu. m. available for power, which, with an efficiency of 20 per cent. in the gas engine, gives 3000 horse-power for a 100-ton furnace, or from 3 to 10 times the power heretofore produced by burning the gas under steam boilers; the tests at Seraing showed a consumption of 4 to 5 cu. m. of gas per horse-power per hour in the gas engines, thus yielding 1800 horse-power, of which only 400 is required for the furnace, leaving 1400 available for other purposes.

GOLDEN GATES.—"Eng. and Min. Jour.," June 25.—A brief description of this mill in Utah, which is the largest cyanide mill in the world, and is operated by electric power transmitted a distance of 35 miles at 40,000 volts, in the form of a three-phase current; the current is delivered to the mine at $60 per horse-power per year, with a minimum consumption of 300 horse-power; the description refers chiefly to the mill itself.

NIAGARA. Dunlap. "West. Elec.," June 25.—An illustrated description of the enlargement of the power station supplied by the canal. One turbine and generator in this extension are now in operation, and are the first of the five to be installed.

Traction.

COMBINED TROLLEY AND ACCUMULATOR SYSTEM IN PARIS.—"L'Eclairage Elec.," June 11.—A brief description of a line running from Paris into the suburbs, and which is the first one in France in which this combined system is used. The total length of the line is 14.65 km, of which 7.87 is operated by the trolley system outside of the city and 6.78 by accumulators in the city; there are two circuits, one of 500 to 530 volts, for direct driving, and the other of 550 to 575, for charging the batteries in transit; there are 33 cars on the line, most of which are double-decked and carry fifty-six passengers; the car without passengers, but with accumulators, weighs 13.8 tons, the accumulators weighing 3.8 tons; each car consists of 224 cells, which are charged from the line at 500 volts.

ACCUMULATOR TRACTION AT OSTENDE.—"L'Eclairage Elec.," June 11.—A brief description of the 1.9 mile line, which has been run since last year. The charging, which is done while the batteries are on the cars, thus saving expensive handling, occupies two hours; the weight without accumulators or passengers is 7500 kg; the weight of accumulators is from 2500 to 3000 kg; the cars will carry fifty passengers, and the gauge is 1 metre; there are three cars in constant use; one charge will run 70 km.

LIGHT RAILWAYS. Lond. "Engineering," June 17.—An editorial, chiefly of local interest, giving a list of the applications for this year.

AUTOMOBILE VEHICLES. "L'Ind. Elec.," June 10.—A list of those which took part in the recent trials, eleven out of the twelve being operated electrically, the other using essence of petroleum (probably gasoline) as a source of power; a detailed description is promised.

MOTOR VAN TRIALS. Lond. "Engineering," June 17.—An account of the recent trials of the Royal Agricultural Society, of self-propelled vehicles carrying 3 and 1 tons respectively; it includes [illegible]

ELECTRIC LAUNCHES.—Lond. "Elec.," June 17.—A short, illustrated article on these launches on the Thames, which now consist of a fleet of twenty vessels.

DETERMINING THE MAXIMUM CURRENT FOR A RAILWAY CIRCUIT. Tripier. "L'Eclairage Elec.," June 11.—A short, mathematical article in which he describes an analytical and graphical method; it is theoretical in character and cannot be applied with precision to ordinary lines, on which the cars start and stop frequently; it appears to be limited to a line on which the cars are running with perfect regularity.

AUTOMOBILE VEHICLES. Czischek. "Eng. Mag.," July.—An abstract of a long, profusely illustrated article in the "Zeit. des Oesterr Ing. u. Arch. Ver." He gives tabular results compiled from the French and the Chicago trials, in a form available for future designs; these are not reproduced in the abstract. The article seems to refer more particularly to internal combustion motors, electric vehicles being merely referred to briefly. He claims that the most difficult point in the design lies in the transmission of the power to the point of application.

Installations, Systems and Appliances.

UNIFORMITY IN PLANT AND APPARATUS. Wordingham. Lond. "Elec. Rev.," June 17.—A reprint of his Municipal Electrical Association paper. He shows the great importance of adopting more uniformity in the plant and apparatus. To show the want of uniformity now existing he gives a number of tables compiled from 109 stations, about half of which use the continuous and half of which the alternating current; the first shows the great difference in the voltages, which vary from 50 to 230, the most frequent being 100, which is used in three continuous and twenty-nine alternating current stations, and 100 and 200 used in ten of each. Another table shows the great difference in the frequency; seventeen of the fifty-eight use a frequency of 100 periods per second, while in the others it varies between forty and 125. Another shows the great difference in the voltage of the high-pressure generators; thirty-five of the fifty-nine stations use a voltage of 2000, the others varying from 1000 to 3000; a similar table refers to the size of the generators, showing the very large number of different sizes in use. He refers to this as "the utterly chaotic state of central station practice as regards standardization in this country." He suggests that 100 volts and multiples thereof would be the most convenient standard pressure; he recommends the adoption of standard candle powers for incandescent lamps, suggesting that no more than four sizes below 100 candle power are really necessary; arc lamps might well be reduced to three sizes for ordinary purposes. Regarding the size of the generating units he recommends having the reserve plant in the shape of machines with considerable margin of possible overload beyond the maximum economical load, rather than in the form of spare machines, which are of use only in case of a breakdown; assuming that they will stand an overload of 20 per cent., then the first installation of a plant should consist of six machines of equal capacity, so that when one is injured the overloads on the other five will make up the difference; the parts should all be interchangeable; all the units might to advantage be of the same size. Regarding the mains he recommends that only a few sizes of conductors should be used; there should also be standard tests for dielectrics of different kinds for different pressures, and manufacturers could then carry stock ready for delivery. There is little use to endeavor to standardize unless there is co-operation. A committee of that Association has been appointed to consider this question; it is not recommended to try and make it international. The paper is editorially discussed in the Lond. "Elec. Rev.;" it is recommended that the output per revolution of dynamos and motors be taken as the basis of any standardizing of sizes; the statement regarding the overload of machines in the reserve plant amounts to saying that the most economical results should be obtained at three-fourths of a load, or thereabouts; many of the recommendations are concurred in. The discussion is published in the Lond. "Elec. Eng.," but contains nothing of special interest; the necessity of standardization was generally indorsed. It seems that the suggestion referred only to new stations, and not to existing ones. Wordingham, in replying, made the remark that in ten years the single-phase alternating plant would be almost extinct.

PARIS AND BERLIN. Brylinski. "L'Eclairage Elec.," June 4.—A long article in reply to the recent one by Bos, in which the electric lighting systems in Paris and Berlin are compared; he endeavors to show that some of the conclusions arrived at by Bos are erroneous, and that a direct comparison between the two cities is not possible, as the conditions are quite different.

FRIBOURG.—"L'Ind. Elec.," June 10.—A long, illustrated description of this accumulator station, which contains two batteries of 83 cells each, of 2600 ampere hours' capacity at a rate of 130 amperes; the diagrams of the switchboard arrangements are given.

SWITCHBOARD APPARATUS.—Lond. "Elec.," June 17.—The discussion of Blaikie's paper (see "Digest," last week).

CENTRAL STATION ACCOUNTS.—Lond. "Elec.," June 17.—An analysis of the accounts of the Great Yarmouth and the Cambridge stations.

PROFITS AND LOANS. Maclay. Lond. "Elec. Rev." and "Elec. Eng.," June 17.—An abstract of a Municipal Electrical Association paper on the appropriation of profits and the repayment of loans in central stations. It is also discussed editorially in the former journal.

MUNICIPAL COMPETITION WITH SUPPLY COMPANIES.—Lond. "Elec.," June 17.—An editorial discussion.

PARIS.—"West. Elec.," June 25.—Some of the illustrations of the recent descriptions of the new station at the Quai Jemmapes, referred to several times before in the "Digest."

Electro-Physics and Magnetism.

CATHODE AND ROENTGEN RADIATION. Swinton. Lond. "Elec.," June 17.—The first part of a long abstract of a Royal Institution paper, with the illustrations. He discusses the concentration of cathode rays by means of a magnetic field, and describes a method of showing this, which consists in placing the tube axially over the end of a magnet toward the pole of which the beam is projected, and it will then be drawn to a fine point, which will rapidly pierce the glass, or if moved around will engrave a trace on the glass. He then describes his vacuum table lamp, to which several references have already been given in the "Digest;" an illustration is given; the two concave cathodes oppose each other, both focusing on a small piece of quicklime; an alternating current of 20,000 volts is used, when a very brilliant and beautiful light is produced; but it lasts only for a short time, then dies out and recurs again at unequal intervals; it appears to be due to absorption of the residual gas by the lime while it is white hot, and its expulsion again at a lower temperature. After allowing the waves to fall on the lime for a short time, perfectly straight and very minute holes were found to have been produced, showing the great accuracy with which cathode rays can be focused; although the current is an alternating one, the light appears to be given off sometimes on one side and sometimes on the other; he thinks it may be eventually possible to produce commercial high-voltage lamps of much higher efficiency in this way, possibly even rivaling arc lamps; the material in this case need not be a fairly good conductor, and there is, therefore; a much wider range of available refractory substances; an electric furnace might also be constructed on these lines for delicate chemical investigations. He thinks it is generally conceded that Crookes's original theory concerning the nature of cathode rays is to a large extent correct; according to this theory the cathode rays consist of material particles of the residual gas, which, being similarly electrified by contact with the cathode, are violently repelled by the latter; the chief point of difference is whether the particles are single atoms, single molecules, or larger aggregations of matter. An apparatus for showing the cathode ray spectrum is described, and some illustrations of the spectrum are given; the greatest photographic effect is always produced by the least deflected of these rays—that is, by the one in which the stream is traveling at the greatest velocity.

RE-ENFORCED RADIOGRAPHS. Lond. "Rev. Gen. des Sc.," June 15.—A short article in which he describes experiments made with the use of fluorescent screens behind the photographic plate, for the purpose of re-enforcing the radiograph or producing a darker impression in a shorter time; others who tried it came to the conclusion that such images were not as clear and that it was due to the granular nature of the re-enforcing plate. He made a systematic study of this, using strips of five different re-enforcing screens on the back of the same impression and also a band in which the image was not re-enforced; the resulting print is reproduced. It shows that the actions of the various screens are quite different; the greatest re-enforcing was obtained with the sulphide screens of Becquerel, and especially with those of Kahlbaum, both of which fluoresce with a violet tint; with a phosphorescent screen, or those made of the platinum salts, the impression was less pronounced than when no screen was used. The sharpest definition was where there was no screen, the others showing a sort of halo around the edges, but this he found was not due to the granular nature of the material, but to a true halo caused by the diffusion of the light, and which, therefore, increases with the time of exposure, and is due to the fluorescent radiations.

ANODE RAYS. Sandrucci. "Nuovo Cimento," March; abstracted in the Lond. "Elec.," June 17.—He showed that both electrodes in a vacuum tube emit so-called cathode rays, the only difference being that they are of greater strength at the true cathode; at a certain exhaustion there proceed from both cathodes two cones of rays, one inclosed in the other or partly separated, which bear charges of opposite signs; both are deflected by a magnet; there is no radical difference between the two kinds of rays.

CALORIFIC ACTION OF ROENTGEN RAYS. Dorn. "Wied. Ann.," 63, p. 160; abstracted in "L'Eclairage Elec.," June 14.—He measured the calorific effect by means of the differential pressure indicator of Toepler.

VISIBILITY OF ROENTGEN RAYS. Dorn. "Wied. Ann.," 64, p. 650; abstracted in "L'Eclairage Elec.," June 4.—A reply to the criticism of his recent publications on this subject.

X-RAYS. Kalischer. "Elek. Zeit.," June 16.—The beginning of a review of the subject of X-rays, with special reference to that which may be of permanent value.

ELECTRICAL ENERGY FROM THE ATMOSPHERE. Winkler. "Zeit. fuer Elek.," June 12.—A short article on the "current economizer" of von Leon; with this the inventor claims that he could obtain part of the current used for lighting and motors from the atmosphere or the earth; one of the devices is described and illustrated. The author ridicules the device and refers to some experiments that show that there is no such saving.

ATTENUATION OF ELECTRIC WAVES. Barton. Lond. "Elec. Rev.," and "Elec. Eng.," June 17.—An abstract of a Physical Society paper on the attenuation of electric waves along a line of negligible leakage.

HALL EFFECT IN LIQUIDS. Bagard. "Nuovo Cimento," March; abstracted in Lond. "Elec.," June 17.—He defends his discovery against the attacks of others, and describes some decisive experiments.

MECHANICAL CONCEPTIONS OF CURRENTS. Weyde. "Elek. Zeit.," June 16.—The conclusion of. his article noticed in the "Digest" last week.

ELECTRO-DYNAMIC EQUATION. Larmor. Lond. "Elec.," June 17.—A short abstract of a recent Royal Society paper on "The Complete Scheme of Electro-Dynamic Equations of a Moving Material Medium, and on Electro-Striction."

ELECTROMAGNETIC EQUATIONS. Heaviside. Lond. "Elec.," June 17.—A note referring to Lord Rayleigh's paper in the "Phil. Mag." for June. He thinks that a wrong method of calculating the "mechanical forcive" has been used in that paper on the apparent failure of the usual electromagnetic equations.

ELECTROMAGNETIC AND MECHANICAL SHIELDING. DuBois. "Elek. Zeit.," June 16.—A reprint of a paper read at the recent meeting of the Union of German Elec. Engs. He discusses the application of such shielding, with special reference to armatures with teeth and holes. He defines the shielding action as the ratio between the external field and that inside of the shielded space, and gives an equation for it, as also for approximate simplifications. He also discusses the mechanical forces on conductors imbedded in such shields, including some experimental results and illustrations of the distortion of the field; in all three cases—that is, for the wire alone, the shielded wire, and the ferro-magnetic conductor—the same number of lines of force will be cut.

MAGNETIC AFTER-EFFECT. Fromme. "Wied. Ann.," No. 5, abstracted briefly in the Lond. "Elec.," June 17.—He describes experiments, studying the so-called magnetic after-effect—that is, the time lag of magnetization or magnetic creeping; he investigated the case in which the magnetizing force is reduced to a small value or to zero.

MAGNETIC PROPERTIES OF TEMPERED STEELS. Mme. Curie. "L'Eclairage Elec.," June 11.—The beginning of a very full, illustrated abstract of her paper, a briefer abstract of which was noticed in the "Digest," February 5 and March 12.

POWERFUL ELECTROMAGNET. Sagnac. Lond. "Elec. Rev., June 17.—A translation of his French Physical Society paper, without the illustration, which was noticed in the "Digest" June 11.

A CONDUCTOR WITHOUT RESISTANCE.—"Science," June 24.—In concluding a brief account of the recent liquefaction of hydrogen by Dewar, it is stated that the platinum resistance thermometer was used and was cooled to within 6 "platinum degrees" of its zero point when immersed in liquid hydrogen, so that if cooled these few degrees more, as can be done by boiling the hydrogen under reduced pressure, the platinum would have become a conductor with no resistance. (Presumably this statement was made by Dewar.) Liquid hydrogen boils at 35° C. above the absolute zero and by boiling it in vacuum this may be reduced 10 or 15° more.

ALTITUDE OF THE AURORA. Abbe. "Terres. Mag.," June.—A continuation at great length of his collection of publications on this subject.

EARTH'S MAGNETISM. Ester and Geitel. "Terres. Mag.," June.—A short article (in German) suggesting a method of determining the direction of the vertical earth air electric currents by observations of atmospheric electricity; such currents are thought to be a cause of a proportion at least of the earth's magnetism.

EARTH'S MAGNETISM. Putnam. "Terres. Mag.," June.—A short article with charts, on the results of Eschenhagen's magnetic investigations in the Harz Mountains, in Germany.

Electro-Chemistry and Batteries.

ELECTROCHEMICAL PREPARATIONS.—"L'Ind. Electrochimique"; abstracted briefly in "L'Eclairage Elec.," June 4.—An article by Winterler on the preparation of perchlorates by electrolysis; one by [illegible] on the preparation of cyanides and of ammonia in the electric furnace, and one by Gin and Leleux on the preparation of [illegible] by the [illegible] of [illegible]. Also a description of the production of hypochlorites of sodium [illegible], which is of interest on account of its simplicity.

PROGRESS IN ORGANIC ELECTROCHEMISTRY. Krueger. "Elektrochem. Zeit.," June 1.—The continuation of his long article.

ELECTROLYTIC ANALYSES. Arth. "L'Eclairage Elec.," June 11.—The continuation of his [illegible].

ELECTROLYSIS OF SULPHUR. Gross. "Elektrochem. Zeit.," June 1.—The continuation of his article on the alleged decomposability of sulphur by electrolysis.

CYANIDE PROCESS. [illegible]. "Eng. Mag.," July.—An account of the cyanide process as applied on the Rand. This process is said to be the most important advance in gold metallurgy achieved since the Rand became a mining centre. The process is described with the aid of illustrations of the plant; the precipitation of the gold is effected either by zinc shavings or by the electric process, the latter being referred to only briefly. The tailings treated by the cyanide process yielded over 30 per cent. of the whole return of gold from the mines.

ELECTRO-CHEMISTRY IN THE METAL INDUSTRIES. Cowper-Coles. "Eng. Mag.," July.—Brief, illustrated descriptions of various processes (most of which appear to be his own), to which fuller descriptions have already been referred to. He describes the electro-galvanizing method of large iron pieces, the manufacture of reflectors, the recovery of tin and the manufacture of white lead.

Units, Measurements and Instruments.

VERIFYING WATTMETERS. Aliamet. "L'Elec.," June 18.—A description of a short method for verifying a wattmeter which has been carefully calibrated, in order to find whether it will give correct results in all cases, and showing how the correction factor may be determined. For exact readings in all cases both windings should have a negligible reactance, but this is not always the case with the fine wire coil; the shunt winding of a good wattmeter should have an impedance practically equal to its resistances, so that the phase of the current will be the same as that at the terminals. With the aid of vector diagrams and simple equations he discusses each of the three cases in which the circuit to which the wattmeter is connected has a positive, zero or negative reactance First, when it is positive the instrument will give too high readings, although the current in the derived circuit is lessened by the reactance of the fine wire coil; if the reactance of that circuit is zero the wattmeter will always give the correct results, whatever be the reactance of the circuit to which it is connected. If the shunt circuit has a negative reactance—that is, if the capacity of the additional resistance coil predominates—the correction coefficient is greater than unity. In the second case the circuit to which the instrument is connected has zero reactance; if the wattmeter has a positive reactance the readings will be smaller the greater the frequency, or if it has a negative reactance the readings will be less proportionate with the frequency. In the third case, in which the reactance of the external current is negative, then if the shunt circuit of the instrument has a positive reactance the readings will be too low; they will be too high if that shunt coil has a negative reactance, the coefficient varying with the frequency. In summarizing these results he states that a wattmeter whose shunt circuit has a reactance gives incorrect results, although it may have been carefully calibrated; these results will be too high when the reactances of the circuits, the principal and the derived, have the same sign and they will be too small when the reactances of these circuits have different signs; when the reactances are equal and of the same sign the results will be exact, but this case seldom occurs. To verify the wattmeter rapidly as regards the reactance of its shunt circuit, it should be connected to a circuit whose reactance is negligible, as, for instance, one consisting of incandescent lamps, supplied from a constant source of potential but with a current whose frequency can be varied greatly; the real power will then remain constant and the wattmeter should always show the same reading; if the readings diminish while the frequency increases it is certain that the reactance of its shunt coil is not negligible; to determine its value the real power should be measured with a voltmeter and amperemeter, and the coefficient of correction and reaction can then be calculated from the formulas which he gives; it will not be shown whether the reactance is positive or negative, but this is not important; if it is found that it has a reactance it will nevertheless be possible to use it, but it will be necessary to use also a voltmeter and an amperemeter, so as to introduce the correction factor.

HYDROGEN VOLTAMETER. Naber. "Elektrochem. Zeit.," June 1.—A short article giving the results of what appear to have been very extended experiments made by him to test the reliability of well-constructed hydrogen voltameters; he placed these in series and varied the various factors, from which he concludes that it may be a very reliable instrument; inside of a half hour he obtained results correct to within 1-15 of a per cent.; in special cases an accuracy of one-hundredth of a per cent. can be obtained without special trouble in a laboratory. He suggests that this should be used as a standard instead of the silver voltameter, and in conclusion gives an illustrated description of his improved instrument.

DETERMINING THE MECHANICAL EQUIVALENT OF HEAT. Baille and Fery. "Comptes Rendus," May 23; abstracted in "L'Ind. Elec.," June 10, and briefly in the Lond. "Elec.," June 17.—They determined this equivalent by measuring the tendency of a copper cylinder to rotate in a rotary magnetic field.

MAGNETIC OBSERVATORIES AND ELECTRIC RAILWAYS. Bezold. "Elek. Zeit.," June 16.—An article on the interference of electric railways, with the observations at magnetic observatories. The limit of 15 km radius, inside of which no electric railroad is to be allowed to approach the observatory at Potsdam, is thought to be insufficient, as disturbances have been noticed up to distances of 17 km; he shows that while there may be no disturbance in the declination, it may be considerable in the horizontal and vertical intensities, and it is therefore a mistake to limit the distance by the effects on the declination. Magnetic forces are now measured to 1 unit in the fifth decimal place, and in Potsdam the measurements are even made to one-twelfth of this, all three elements, namely, the declination, the horizontal and vertical intensities, should be considered in connection with the protection of such observatories; the distance to the railway is no criterion, as its position with reference to the observatory is also important. The simplest solution would be to use double circuits on the electric lines or else accumulators.

MAGNETIC OBSERVATIONS AND ELECTRIC RAILROADS. Eschenhagen. "Terres. Mag.," June.—A short article (in German) calling attention to the very injurious effect of electric railways on the measurements in such observatories; in the one at Potsdam, Germany, the effects of the railway currents would have to be reduced 1000 times before they would be negligible; a radius of 15 km, within which it is intended to prevent electric railways from passing, would, therefore, not be sufficient. Measurements are at present being made to determine the effect of such railways at different distances, and also to find whether bodies of water would act as shields to the current circulating in the earth; meanwhile he recommends that observations in this direction by other observatories should be published.

INTERRUPTERS FOR INDUCTION COIL. Margot. "Sc. Am. Sup.," July 2, translated from "La Nature."—An illustrated description of his device, which is based on the action of the well-known Roget coil, which is a suspended spiral that will contract when the current is passed through it, the contraction breaking its own circuit in a mercury cup; the advantage claimed is simplicity; the whole apparatus should be placed in a wide-necked bottle, which is closed; a bar of soft iron is placed in the middle of the coil, the object of which is to give greater amplitude to the oscillations without affecting their rapidity; the amplitude may reach 2 centimeters with currents from 15 to 20 amperes; to vary the rapidity of the oscillations a clamp is used to make any desired number of the turns of the spiral immovable. Another device illustrated consists of a fixed solenoid with a movable core suspended by a spring.

PREPAYMENT METER.—"Elec. Rev.," June 29.—An illustrated description of the Bastian device as attached to the Thomson meter, which was referred to in the "Digest" last week.

Telegraphy, Telephony and Signals.

ACOUSTIC TELEGRAPHY THROUGH THE SEA. Hardy. "L'Ind. Elec.," June 10; "L'Eclairage Elec.," June 11; "L'Elec.," June 18.—An abstract of an Academy paper on the use of the microphone in connection with acoustic telegraphy through water. It is well known that sound vibrations are transmitted to great distances through water, but the vibrations are so small that a very sensitive receiver must be used; experiments made by the French Navy Department at Cherbourg have shown the great superiority of the "pivot microphones" for such purposes; these are made of a small disc of carbon secured to the centre of the vibrating diaphragm; the "pivots" or carbon points are placed around this disc, each being mounted with a counter weight for regulating the pressure on the carbons; there is a small quantity of mercury around each pivot for making connection without interfering with the movements.

WIRELESS TELEGRAPHY. Ducretet. "L'Ind. Elec.," June 10.—A short account of his recent paper before the International Society, describing experiments with the "radio-conducting tube" of Branly.

SUBMARINE CABLES IN TIME OF WAR.—Lond. "Elec.," June 17.—A reprint of the recent correspondence in the London "Times," which has already been noticed in the "Digest."

COMMON LINES FOR SEVERAL TELEPHONES. West. "Elek. Zeit.," June 16.—A reprint of a long, illustrated paper, describing his system, in which several subscribers on the same line may be individually called or may call each other. Last year he described in that journal a similar system (see "Digest," Dec. 11), in which, however, only one of the subscribers could be called from the central station, although each could call the station; in the present system this objection is overcome.

TELEPHONY. Wehrenalp. "Zeit. fuer Elek.," June 12.—The conclusion of his long serial.

ANNUNCIATOR. Tournaire system. "Elek. Zeit.," June 16.—An abstract, with the illustration of the description noticed in the "Digest" June 11.

TRANSMITTING PICTURES. Armengaud. "Sc. Am. Sup.," July 2; translated from "La Nature."—An illustrated description of the (proposed) device of Dussaud, which he calls a "teleoscope," a briefer description of which was referred to in the "Digest," June 11. The article speaks of the "conclusive results" obtained by M. Dussaud. The illustrations (which are not reproductions of photographs) show an extremely simple apparatus. Nothing is said of actual tests nor of actual existing apparatus, the illustrations being said to show merely the "principles" in their "essential elements."

Miscellaneous.

ELECTRIC HEATING.—A four-page monthly paper, entitled "Chauffrage Electrique," has just been started in Paris; it is devoted to the processes and apparatus of Le Roy; an article begins the description of this process and another describes some of the apparatus.

AMBROINE.—"L'Ind. Elec.," June 10.—A description of this new insulation material, which was referred to some time ago in the "Digest."

MEETING OF GERMAN UNION OF ELEC. ENGS.—"Elek. Zeit.," June 16.—A brief running account of the annual meeting in Frankfort o. M., June 2 to 5, but referring only to the business and social features. The attendance was very large; the traction lines in that city were visited; all the lines are run electrically, and require 980 kw, which is obtained from the alternating-current central lighting station, and is transformed at a sub-station into continuous currents. It was decided to revise the rules and regulations for installations; those concerning high-tension circuits adopted provisionally last year were now finally adopted. The committee on incandescent lamps was continued. The method for electrically measuring incandescent lamps which was provisionally adopted last year was definitely adopted. The standard screw sockets and lamp bases recently described by Handhausen (see "Digest," June 11 and 25) were adopted. The membership is now 2112; the new president is Wilhelm von Siemens. The Lond. "Elec. Eng.," June 17, begins an account of this meeting; no papers are abstracted in the present portion.

PARIS EXPOSITION.—"L'Ind. Elec.," June 10.—A list of the electrical commission appointed by the Government; Mascart is president and Fontaine vice-president; the commission consists of a large number.

ELECTRICITY FOR HEATING PURPOSES. Smith. "Wisconsin Eng.," April.—A discussion of a general nature giving some data to show what has been accomplished in this direction; it is very favorable to electric heating. He claims that the statements show that the electric heating of buildings is and can be done efficiently and economically. Among other statements he cites an experiment made in Philadelphia, which showed that in preparing an excellent dinner for eighty-one persons 328 to 498 watt hours per week of six dinners per individual were required, or 64 watts per meal, costing 7⅛ cents per week per person.

Notes of the Independent Telephone Convention.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY made no exhibit at the hotel, but invited everyone interested to witness the lively exhibit at its factory on the West Side.

THE AMERICAN ELECTRIC TELEPHONE COMPANY showed in one of the corridors a pair of wall sets which attracted no little attention on account of their unusual character. One was enameled in white and the other in black, the mechanical details being carried out to correspond; for example, the use of white and black connecting cords and wires, nickel and black japanned fittings, etc. Magneto boxes are provided with plate glass windows, through which the interior mechanism could be seen as customary with instruments made by this company.

THE ERICSSON TELEPHONE COMPANY, of New York, made an extensive exhibit in the hotel, including samples of the large line of imported Ericsson apparatus, and also the material made up in this country. Among the devices shown was one horizontal row of jacks from the standard sectional trunking board, which is now coming into extensive use on the other side; in fact, one 24,000-line board—that in Stockholm—has recently been changed from multiple to the Ericsson transfer system. Ericsson Swedish desk sets, a new all-nickel desk set designed like that used by the American Bell exchanges, breast-plate operators' transmitting sets and many other instruments and details were on exhibition, including a line of wall instruments. The demand for a type resembling in appearance that commonly used in this country has caused the company to get out the woodwork for such an instrument, the mechanical parts being imported and mounted thereon. This combination makes a highly satisfactory instrument. Mr. L. P. Smith, president of the company, was in charge of the headquarters at Chicago.

THE VICTOR TELEPHONE MANUFACTURING COMPANY, of Chicago, occupied one of the parlors of the Palmer House, and had there on exhibition samples of its various specialties. One of these is a receiver which ingeniously provides against the adjustment of the air gap being affected by temperature, and still uses a standard type of shell. This is effected by mounting the soft iron pole pieces on a disc fastened firmly to the head end of the receiver, a sliding joint being left between the pole pieces and the permanent magnet. A 100-line board for common return systems was also shown, the interesting features of this board being the fact that the drop frames are entirely insulated from each other, not being connected together at all, even by the night bell circuit, so that there is no chance of cross talk through defective insulation in the drop coils. Each jack is provided with an independent ringing key, which cuts off both poles of the line in case a metallic circuit is used, giving no possible chance for ringing back. Machine-wound induction coils, with even layers and paraffin paper between the layers, were also on exhibition, as was a section of cross-connection board by the company for use with Maxstadt link or wire fuses. One of the wall sets is interesting in that the cells of battery are mounted in the case back of the magneto box and transmitter. Here there is room for three cells, no more space being provided than in the ordinary instrument with battery box, although, of course, the instrument stands out a little further from the wall. The transmitters, with carbon granules about 1-32 of an inch in diameter, were shown, as was also a line of generators guaranteed to run through 12,000 ohms resistance. The Victor Telephone Manufacturing Company has purchased the entire business and patents of the Phœnix Telephone & Manufacturing Company. The general manager of the new concern is Mr. W. T. Blaine, and the general superintendent is Mr. E. E. Yaxley. The new company will continue to manufacture the Phœnix products, with improvements, and Mr. Blaine wishes it understood that the name of the company is intended to be a guaranty of all apparatus before and after purchase.

A New Self-Oiling Engine.

The engine represented in the illustration is conspicuous for its attractive design and massive proportions, and has, besides, many features of exceptional merit. It is known as the Skinner self-oiling automatic engine, and is made by the Skinner Engine Company, Erie, Pa.

The slide valve is used in this engine, it being, it is claimed, balanced within 20 per cent. of perfection. It is guaranteed to remain steam tight for a period of five years without any attention. It is operated by a governor of peculiar construction, consisting of but three parts, namely, the eccentric arm, weight and spring. The governor is mounted in a wheel on frictionless roller bearings, and is said to be the only type, in which friction is entirely eliminated, that will maintain perfect regulation. The manufacturer claims that it will maintain the same regulation with steam pressures ranging from 30 to 100 pounds. It is stated that the whole load may be thrown on or off the engine instantly, and that the sudden change will not cause a variation of over 1 per cent. above or below the normal speed of the engine. The speed of the engine can be changed 40 per cent. by simply bolting on or taking off weights, and maintain the same regulation.

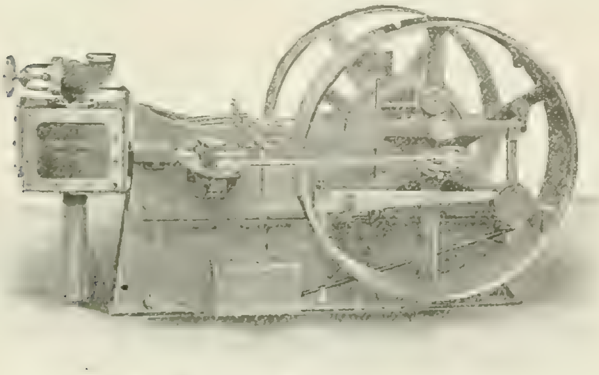


Fig. 1.—Engine with Outside Governor.

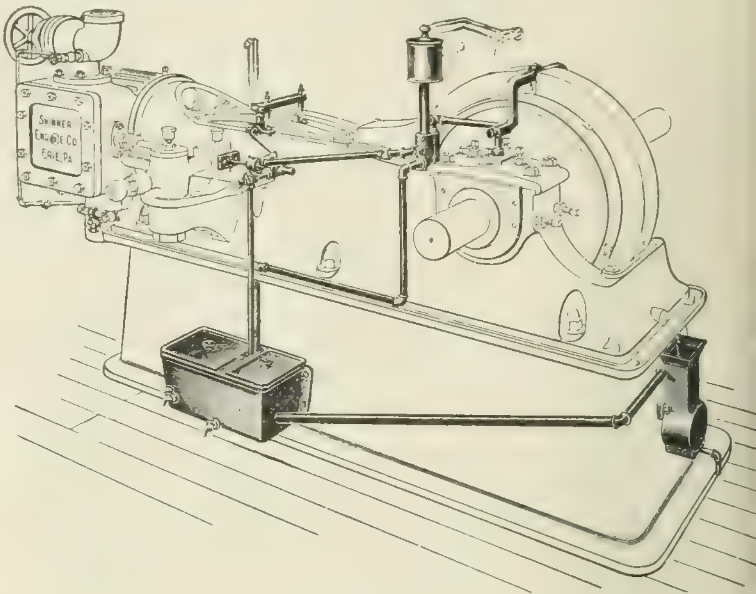


Fig. 2.—Lubricating System.

Fig. 1 shows the engine provided with an outside connected governor. This engine is also built with the valve operated by inside connected governor with eccentric on the shaft.

Particular attention is called to the new system of lubrication with which this engine is provided, and the accompanying diagram will aid in obtaining a clearer understanding of it. A constant stream of oil is delivered to every bearing, in full sight of the operator. After leaving the engine the oil and entrained water coming from the stuffing box are separated; the oil returns to the supply tank on the inside of the sub-base, which is provided with a filter in which the oil is purified to be returned to the engine in as pure a condition as when first entering. The engine is just as accessible for examination and adjustment as any open engine, oiled in the ordinary way. It is claimed that an engine of 50 horse-power can be operated ten hours per day for one year on a consumption not exceeding 5 gallons of new oil, which is added from time to time, as required.

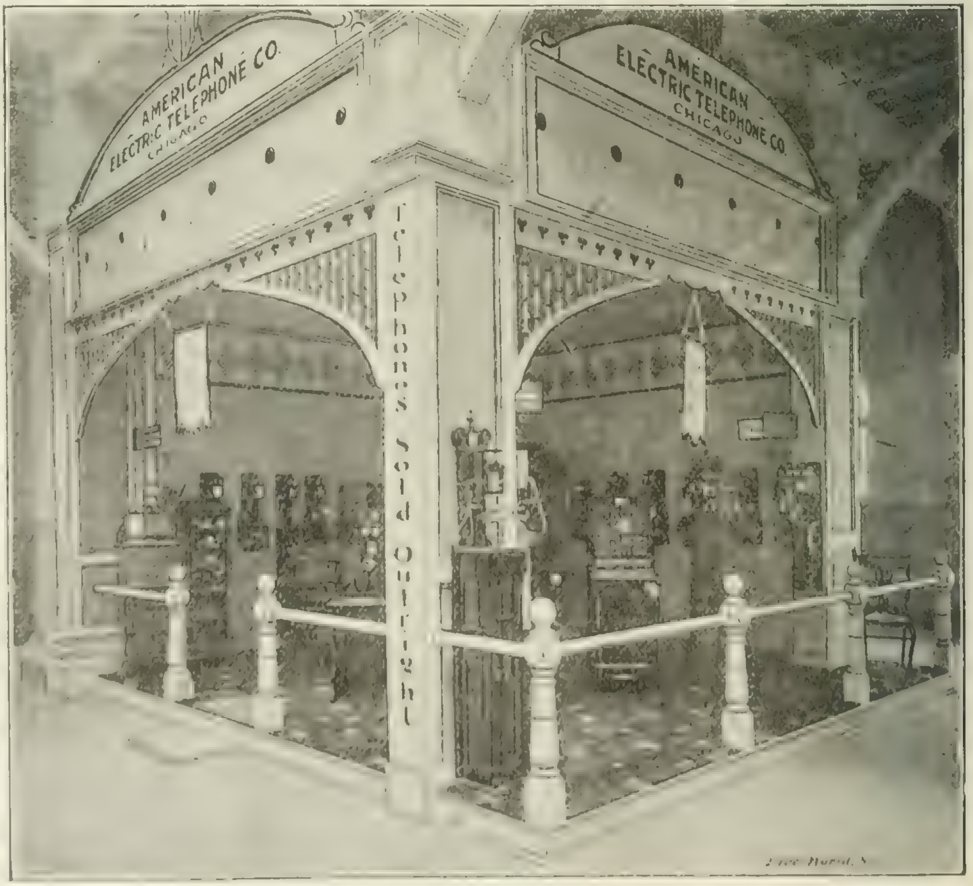
The various devices that are combined in the make-up of this system are said to be entirely new. They consist of jointed oil feeders, which can be lifted away from the parts oiled; a noiseless positive motion pump supplying the reservoir above the engine with oil; an oil and water separator, which is said to be something new in mechanics, and a filter and supply tank. The oil [illegible] returned to the supply tank through an overflow pipe. Every part of the oiling apparatus is in plain sight of the attendant, [illegible] there fibrous filtering material to interfere with the free circulation of oil.

Electrical Exhibits at the Trans-Mississippi Exposition.

[illegible]

[illegible] draw which is removable from the front of the board, and is firmly fastened in place by screws and nuts on the back of the board, which also make the line contacts. The connecting line wires are soldered to lugs, and need never be unsoldered for removal or replacement of the drop and jack.

Another board, called the "Universal," made by the same company, is also exhibited. This has the jacks in a separate panel from the drops, the latter being restored manually by means of a common drop lifter for each two vertical rows of drops. Beside these boards the company shows an extensive line of wall and desk sets, cabinet instruments, sound-proof cabinets, bridging 'phones, etc. The Burns two-pole receiver with adjustable air gap is used universally with these instruments, as is a solid back microphone with carbon cap and carbon plate. A new method of mounting the microphone for vertical adjustment is used on some of the instruments, comprising a simple two-arm parallel motion by which the direction of the mouthpiece is always maintained horizontal. These arms are also arranged to swing in a horizontal plane about a vertical hinge. Some of the magneto boxes are constructed with plate-glass windows, by which the neat design and high-grade finish of the parts within [illegible] induction coils, power generators, testing sets, etc., is exhibited in a showcase. Mr. S. J. Bear has charge of the exhibit.


AMERICAN ELECTRIC TELEPHONE CO.
CHICAGO
AMERICAN ELECTRIC TELEPHONE CO.
CHICAGO
Telephones Sold Outright
American Electric Telephone Company

WESTERN TELEPHONE CONSTRUCTION COMPANY.

Occupying an advantageous position between two aisles on the south side of the building is the exhibit of the Western Telephone Construction Company, of Chicago. One of the main features of this exhibit is a section, comprising three 100-line panels, of the Western multiple switchboard, built for 1000 or more lines. A few details of the construction of this board may not be out of place, owing to its recent development and up-to-date character. The so-called multiple feature of the board is not obtained on the jacks, but is obtained on the cords, requiring on this account manipulation by two operators to complete the connection, but effecting this much more simply than by means of plain trunk-line transfer systems. Each pair of cords at each operator's position has connected to it a number of single ended cords ending in plugs which multiple it at every third operator's position along the board. Each operator also has a number of buttons by which she may multiple her microphone and head telephone with the talking and listening set of anyone of one-third of the other operators. On receiving a call for a jack out of her reach, the answering operator speaks to another operator who can reach this jack, tells her the number of the cord with which she answered the call and also the number of the line wanted, the second operator picking up the corresponding multiple plug and completing the connection in the proper jack. A board of this kind, while not strictly a multiple board, is obviously much simpler than a board in which all the subscribers' lines are multiplied within reach of each operator's position. The boards are fitted with ringing-off drops, and are further equipped with visual disconnecting signals for proper signalling between the operators. When a subscriber rings off, the ringing-off drop opposite the answering operator for that call drops, the operator pulls out the corresponding plug on the spring jacks and manually restores the ringing-off drop. The dropping of the plug into its seat makes a contact which illuminates a lamp corresponding to that cord in front of both operators concerned, the lamps being extinguished only when the multiple plug with which the connection was completed is removed. Many other details of this board are of interest. The front of the board is finished in black oxidized copper, the drop shutters falling over the spring jacks so that the insertion of the plugs restores them. The drop coils are cut out by the insertion of the plug, and the ringing-off drops are bridged across the line, thus removing any inductance from a series insertion in the circuit. Single cams are used for ringing both ways in the line, and also for listening in, being fitted with a catch in the listening-in position, so that the operators may remain in the line with both hands free for other work. This is found of value particularly in toll line service. The switchboard cords are reinforced with extra heavy insulation for about 15 inches back from the plugs.

In smaller switchboards there is shown a 200-drop table board, and a 100-drop standard cabinet board. These boards, as are all the smaller boards made by this company, are cabled out 6 feet to reach lightning arresters, without any splicing. They are wired with tin-reed wire, covered with one winding of silk and two of cotton, and the whole paraffined. Besides these boards, the company shows a 1000-line lightning arrester, distributing and cross connecting board, fitted with lightning arrester discharge gaps each side of the fuses.

EXHIBIT OF THE WESTERN TELEPHONE CONSTRUCTION COMPANY.

There is also shown a large line of cabinet desk sets, patrol boxes, extension bells, induction coils, Western "Giant" batteries, bridging and series bells, etc. Mr. S. C. Platt has charge of the exhibit.

THE AMERICAN BELL TELEPHONE COMPANY.

Through the agency of the Nebraska Telephone Company the American Bell Company makes one of its complete exhibits, which are becoming such attractive features at all modern expositions. As it has done at several previous expositions, it shows here an extensive line of historical instruments laid out in showcases in their chronological order, beginning with Professor Bell's early instruments and running down to the most up-to-date transmitter and receiver. In the centre of the booth is mounted a specially sensitive microphone, assembled with a large diaphragm connected with instruments in booths in another part of the exhibit across the aisle. With this experiments are shown illustrating the sensitiveness of the modern microphone. Two loud sounding receivers are mounted overhead with megaphonic sound concentrators and are connected, as are a large number of hand telephones, with a circuit running in from a roof garden in Omaha, by which the music there can be plainly heard. In addition to these a number of interesting telephone instruments for peculiar uses are shown, including a complete diver's set, shown with the diver's suit at one end and the boat arrangements at the other. There are also a marine bridge set, a marine set specially designed for use in military tops, and a set for use in mines ingeniously fitted with the shaft of the bell striker as well as the shaft of the magneto crank projecting through oil glands in the water-tight case. A signal set for use in military or other field operations is shown, comprising a reel mounted for carriage on a man's back, holding some 2 miles of rubber covered twin wire and an instrument consisting of a solid back transmitter, receiver and microphone battery, which may, if desirable, be cut into the main line with a key by which Morse signals may be transmitted and read by means of a telephone receiver. Large maps of the long-distance lines are mounted on the wall, red lines indicating the copper wires, which now run from Kearney, Neb., some distance west of Omaha, clear to Bar Harbor, Me., and from North Dakota to Mississippi. Diagrams showing the number of exchange subscribers and the estimated annual number of connections between the same give the latter figure for 1898 as almost exactly 1,000,000,000.

THE AMERICAN BELL TELEPHONE COMPANY'S EXHIBIT.

The Nebraska Telephone Company plans later to put in a complete 2000-line exchange board of the very latest common battery type, with all the up-to-date improvements, and show it in service with a complete equipment of auxiliary exchange apparatus, such as motor generators, storage batteries, etc., carrying on the work of the exposition. The exhibit is in charge of Mr. H. Vance Lane, who is ably assisted by Mr. A. S. Rodgers and Mr. W. L. Richards..

THE CHICAGO EDISON COMPANY.

The Chicago Edison Company deserves great credit for the educational exhibit it has prepared, giving a most complete insight into all the affairs and business of the company. An attractive booth has been built, containing a very large number of photographs of all the buildings, boilers, engines, machines, etc., of the company's works, plans and elevation of the largest engines, forms and blanks of the company's contracts, records and load curves for the last ten years, feeder reports and charts from Bristol recording gauges, photographs of the officers and the employees in groups, and a chart administration of the company, branching out from the president, Mr. Samuel Insull, through the heads of the various departments to the minor employees.

Beside these paper exhibits, the company has installed in its booth a full-sized equipment of its distributing system from the underground duct to the lamp socket. Heavy lead-covered cables are brought in through a vitrified duct, passed through a feeder coupling box and from there through a Tailleur three-wire feeder junction box of about 4000 amperes capacity. On account of the radical differences between this and the standard Edison feeder junction box, a brief description may be of interest. The box is rectangular in shape, built to be placed against the wall of a man-hole, with a cast-iron door opening on hinges. Three heavy bus bars run across the box one above and behind the other, with six lugs arranged to be fused to each bus. The whole box is about 2 feet wide, 2 feet high and about 15 inches deep. It is most completely fitted out. Around the door are tap bolts to fasten the latter down firmly on a rubber gasket. A lamp is operated by a flush switch so that it automatically lights up when the door is opened, and two test lamps are also included. An ingenious feature is the provision of holes for plugs in the lugs and busses, whereby a flexible cable can be used to join the lug to the bus while re-fusing.

Exhibit of the Chicago Edison Company.

From the junction box, mains are laid to a Tailleur service box, and from there by means of standard open interior work to a main cut-out and a T-H wattmeter and two Hale discount meters for the application of the Wright demand meter system. This meter, which is now becoming well known, has been extensively adopted for the Chicago Edison Company's feeder work, having been found very reliable on account of its simplicity. The current simply heats a spirit thermometer bulb, raising a certain amount of the liquid, corresponding to the maximum load, over a bend in the tube, the amount sent over reading directly on a triple scale. One reading of this scale gives the maximum number of amperes passing for anything but a very brief period; another reading gives the number of kilowatt hours to be charged for at full rate during the summer; and another the same for the winter months. These correspond with contracts made with the customers, which read that the amount consumed shall be paid for at a rate of 1 cent per lamp hour until the total monthly consumption reaches, in the winter, the equivalent of forty-five hours' use of the maximum current taken at any one time, as shown by the discount meter, and in summer fifteen hours. All current used above this amount is charged for at one-half cent per lamp hour. Thus on the scales of the meter (one of which is used on each side of the three-wire system), ten amperes correspond to seventeen kilowatt hours for summer and fifty-two for winter.

Beside this apparatus the exhibit includes other underground details designed by Mr. George Tailleur, the superintendent of the underground department of the company, and, like the apparatus mentioned above, manufactured in the company's own shops. Among these details are high tension couplings, one of which is shown on an arc light single conductor and others on a three-phase power transmission line. These couplings consist of ground copper discs with a centring pin in one and a corresponding hole in the other, the two discs respectively sweated to the ends of the conductors they are intended to join and arranged to be tightly drawn together face to face. They are surrounded by hard rubber sleeves, which are tapped to the cable insulation and further surrounded by brass sleeves tapped and threaded in such a way that they may be screwed together much as is a fire hose coupling. Between the abutting ends of the hard rubber sleeves is placed a soft rubber gasket to maintain the continuity of the insulation.

Still other apparatus of the company's make is shown, one piece being a marble-lined, cast-iron, cut-out box equipped and in service for the lighting of the booth. Current is supplied for this purpose by means of two G. E. type C A shunt-mound motors, coupled together and running as a motor generator, transforming the 500 volts supply to 110 volts delivery. The Chicago Edison exhibit is in charge of Mr. H. E. Niescz.

THE GENERAL ELECTRIC COMPANY.

The General Electric Company makes a most comprehensive exhibit covering electrical apparatus for all purposes with the sole exception of telegraph and telephone equipments. One of the most interesting features of the exhibit is a series of current transformations made therein, power being taken from the equipment in the power house, which, by the way, is entirely General Electric, passed through a large number of machines and finally consumed in the lamps scattered about the exhibit. The power is taken in the form of direct current at 500 volts by a 110-kw generator running as a motor and joined by means of a flexible coupling to a 150-kw, three-phase, compound wound, alternating current generator. This generates current at 1000 volts, which is transformed down in three stationary transformers with both primaries and secondaries arranged in delta connection, from which it is delivered to a three-phase, four-pole, sixty-cycle rotary converter. This delivers it as direct current at 220 volts, which is used to charge a battery of chloride accumulators. These are arranged with

The General Electric Company's Exhibit.

end cell switches for voltage regulation, and deliver current to 110-volt lamps on three-wire lines, the accumulator acting also as an equalizer.

Among these machines of most recent development stands the original Edison generator from the steamer Columbia. This, until very recently, has been giving continuous service from the time it was first operated in 1879. It is surprising to notice how closely this machine resembles modern dynamos of the same type. This machine is to be sent to the Smithsonian Institution.

In the centre of the exhibit is a large pyramidal tower on which are mounted all sorts of electrical auxiliaries, porcelain fittings, overhead line details, etc. The tower is surmounted by a sphere studded with miniature lamps. In a showcase there is also shown a full line of samples of miniature and decorative lamps made by the General Electric lamp works. On tables are shown a large number of fan motors, both direct and alternating, circuit breakers, motor starters, instruments, etc. In one corner is a complete X-ray exhibit in operation in a light-proof booth. In the line of street railway motors, one G. E. 1000 motor and one of the new G. E. 57 motors with the four internally projecting field poles and other improvements are shown. The latter is equipped with a magnetically operated clutch brake and the appropriate controlling therefor, viz., B13. A complete switchboard is fitted up with the latest instruments. A line of stationary transformers is shown, the largest having a capacity of 15 kilowatts. Open and enclosed arc lamps, among which are several of the new baby 1½-ampere lamps, illuminate the exhibit. Induction motors, running up in size to 15-kw capacity, show the application of the manually operated internal short circuiting device in the revolving secondary for obtaining a good starting torque. In the line of meters the new Thomson induction integrating wattmeter, whereby the bothersome commutator can be done away with for A. C. work, is of interest, as is the new two-rate wattmeter with self-winding clock, for charging a higher rate at the time of day covering the peak of the load. Mr. R. A. Swain is in charge of the exhibit.

CHAS. A. SCHIEREN & CO.

A mammoth 72-inch three-ply belt is the most prominent feature of the belt exhibit of Charles A. Schieren & Co., of New York. This belt is of a type termed "Electric," and is perforated to run properly at the high speeds common in dynamo work. The capabilities of the belt in this respect are well illustrated by a photograph in the possession of Mr. H. A. Giese, who is in charge of the Schieren exhibit. This photograph shows a belt running looser than is customary with link belts, the slack side above almost touching the tight side below and no flapping is apparent. In smaller belts there are shown quite a number with a new method of fastening the various plies together along the edge of the belt, this method comprising a series of headless wire screws. The same method is used in fastening together the parts of solid round belts. A patented link belt manufactured by this house is shown, and the advantages of the American joint, by which the belt is allowed to hug tightly the most steeply crowned pulleys, are explained. In the background of the exhibit are some mammoth oak belting butts, one of which is about 6 x 10 feet in size. A large line of lace leathers, twisted round belting, belt cord, belt dressing, etc., is also shown.

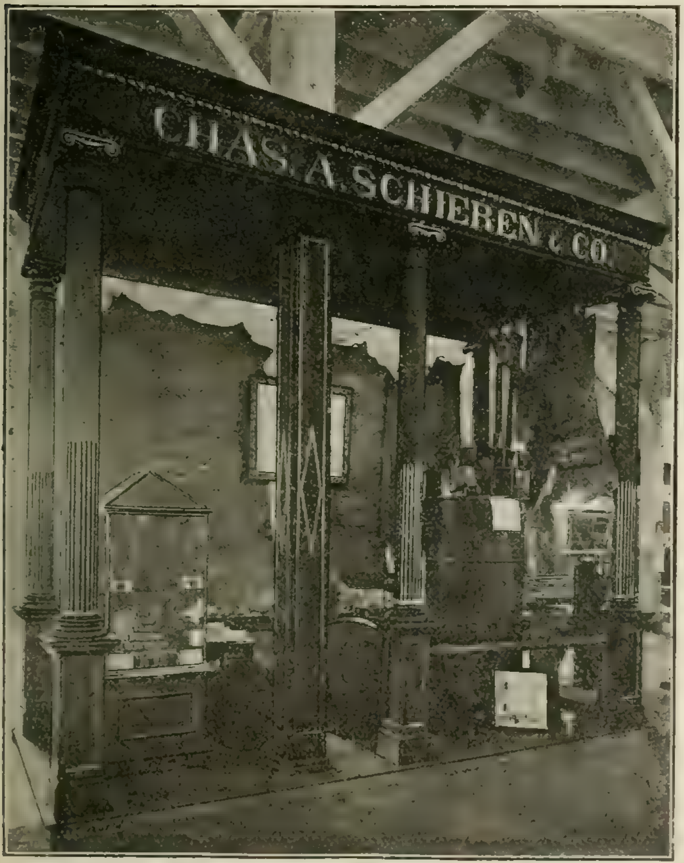


Exhibit of Chas. A. Schieren & Co.

A Marine Generating Set.

We illustrate herewith some of the latest types of apparatus built by the Rushmore Dynamo Works, Jersey City, N. J., which concern has for years made a specialty of marine equipment.

Fig. 2 shows the latest type marine generating set, with multi-voltage dynamo rated at 15 kilowatts at 500 r. p. m. The engine is built after the latest torpedo boat practice, all parts being of finished forged steel and the governor being of the improved Rites pattern. The governor is said to control the speed within one-fourth of 1 per cent. The dynamo has a simple parallel armature, and will deliver its entire output through a single circuit at one voltage, or at as many voltages and through as many separate circuits as there are pairs of poles.

In marine plants with storage batteries the machine runs in parallel with the battery at full load, and at light load one pair of brushes is connected at the switchboard with the lighting circuit and the other pair to the battery, the voltage in the battery being increased to any amount required to charge the cell, thus doing away with boosters and wasteful resistances. This is a great improvement on shipboard, as it has always been necessary heretofore to run the dynamo all day to charge the batteries, even though they form but a small load for the plant. The machine is exactly the same as other multipolar dynamos, the only difference being in the method of connecting up, and the machine works on the same principle as the Rushmore larger dynamos used in connection with feeder and main and elevator systems.

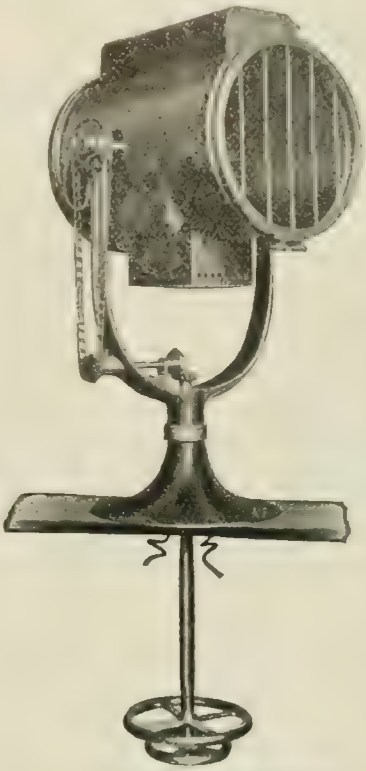


Fig. 1.—Pilot House Projector.

Fig. 1 shows the new type pilot house projector. The same apparatus is made with tall base for mounting on deck, while the 24-inch and 30-inch sizes built for the navy have two small motors in the base with wires leading to a distant controller for swinging the beam in any direction. Within the past sixty days the Rushmore Dynamo Works has shipped over 100 complete searchlight equipments for the use of the government on auxiliary cruisers and transports.

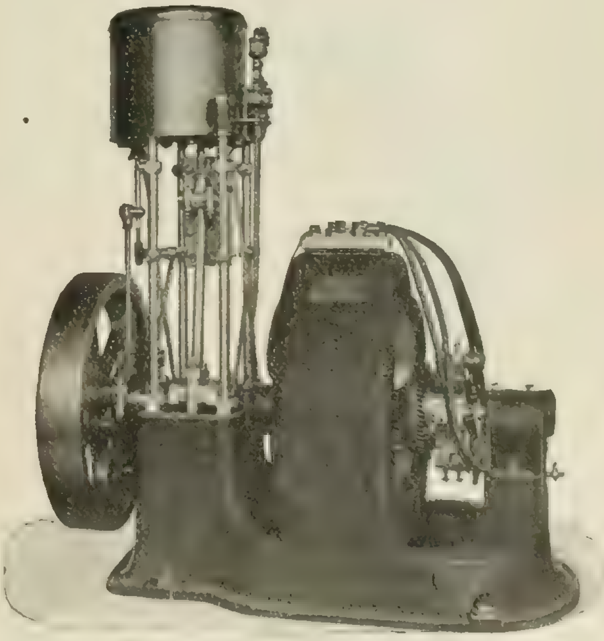
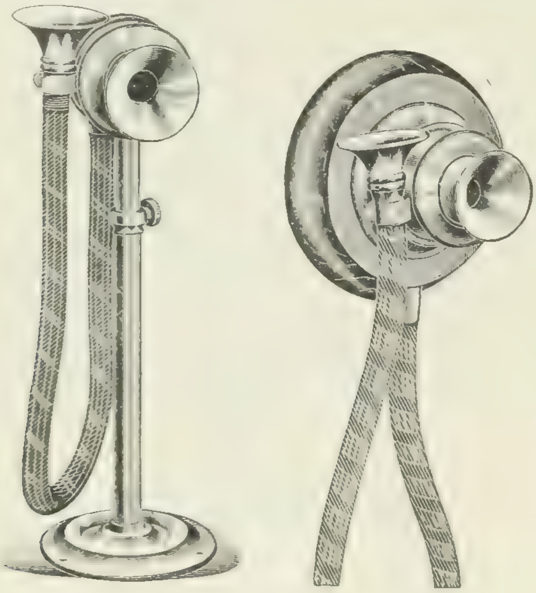


Fig. 2.—Marine Generating Set.

A Hotel Telephone.

The instruments illustrated herewith are designed for hotel use by Messrs. Plummer, Ham & Richardson, 619 Main Street, Worcester, Mass. They possess some special advantages, among which attention may be called to the following: First, there are no receiver cords in rooms to break; second, the instrument is claimed to be the simplest and neatest 'phone made for hotel and school use; third, the battery is cut in and out at the office, where a constant watch can be kept on it; fourth, the receiver cannot be broken as it is stationary and a part of the instrument proper, and fifth, owing to the simplicity of the instrument it can be sold at a figure low enough to enable hotel men to install a large number of them when required. The instrument is attractive in design and well made. The system can be applied to the same wires used for annunciator and return call purposes.

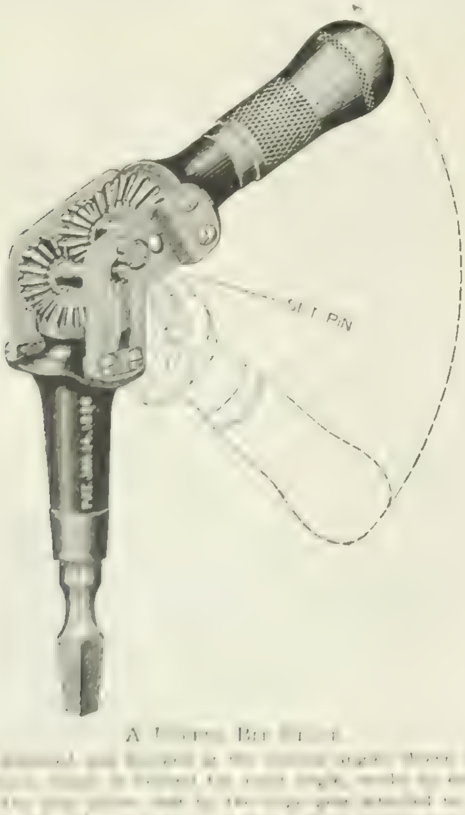


Hotel Telephone.

The firm is ready to arrange with construction houses throughout the United States to act as agents for this instrument.

Improved Bit Stock.

A most useful angular bit stock which will no doubt prove of great value to telephone construction men and electrical wiremen in general, has just been placed upon the market by Messrs. C. Meister & Co., Allentown, Pa. By referring to the illustration it will be seen that by pulling out the set pin this and can be adjusted and locked at [illegible]



A [illegible] Bit Stock.

Grooming and Clipping with Electric Power.

The electric motor has become a necessary adjunct to every well appointed modern stable, whether livery or private, and horses are now groomed and clipped by electricity, with both neatness and dispatch.

The advantages of the application of the electric motor to grooming and clipping machines were early realized by the American Shearer Manufacturing Company, of Nashua, N. H., and its efforts toward supplying a demand for electrically driven groomers and clippers has met with considerable success. Hitherto, however, it has supplied merely the machinery, exclusive of the motor, but owing to a demand which has arisen for complete grooming and clipping installations, it is now supplying the motor as well. In doing this, however, it has found it is necessary to simplify in a large measure the driving mechanism.

Fig. 1 shows the No. 8 grooming and clipping machine, driven by a bipolar motor through double countershafting with conical and idle pulleys. This method, while it allows of the operation of two or more groomers and clippers from one motor, was by no means satisfactory on account of the complication of belts and pulleys necessary, and when it became a question of furnishing both driving and operating machinery it was felt that some more direct method of drive was needed. This was found in the small power moderate speed motors developed by the General Electric Company, which, in addition to its line of small power induction motors, has also recently perfected a line of direct-current small power motors known as the C. A. type. These motors may be run in any position either attached to the wall, set on a bracket or hung from the ceiling and have been found peculiarly adapted to drive the groomers and clippers of the American Shearer Manufacturing Company.

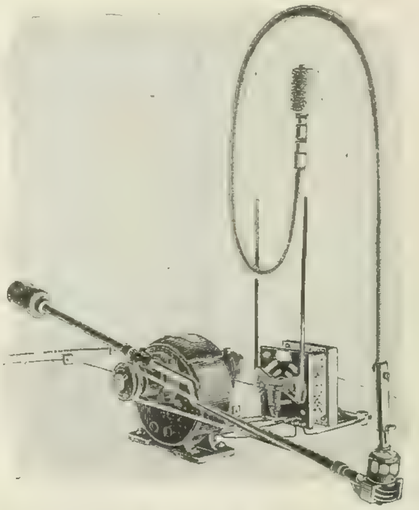


Fig. 1.—New Method of Direct Drive.

Fig. 1 shows the No. 9 machine complete, with a 1-hp C. A. motor and automatic starting rheostat. In this case no floor space is occupied by the motor, the countershafting is eliminated, and the belting is reduced to a single belt from the motor pulley to the pulley attached to the flexible shaft of the groomer and clipper. The motor is fastened to the ceiling beams in an inverted position and the counterpoise or balance arm is attached to a swivel on the motor case. The automatic starting box, also fastened to the ceiling, is of the reversing type, with the contact arms pulled in either direction by leather straps. This clipping and grooming outfit is exceedingly compact and simple, and requires almost no attention beyond an occasional oiling. In ordering, it is simply necessary to state the nature and voltage of the current and, if alternating, the phase and number of alternations.

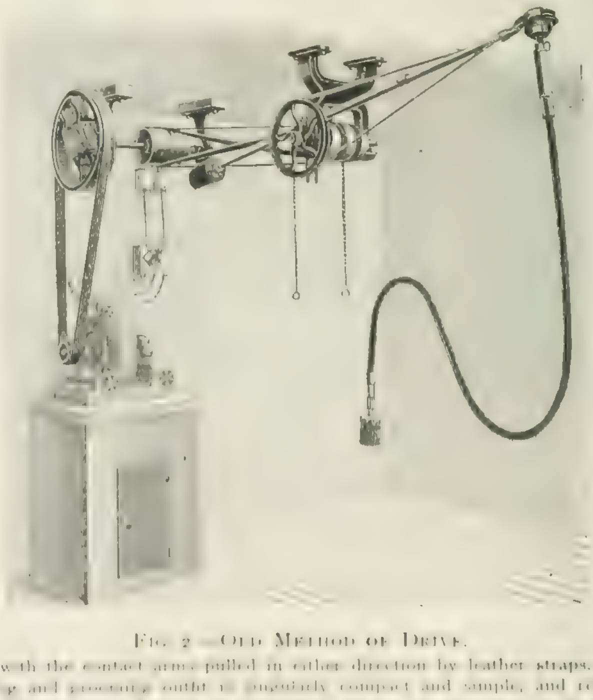


Fig. 2.—Old Method of Drive.

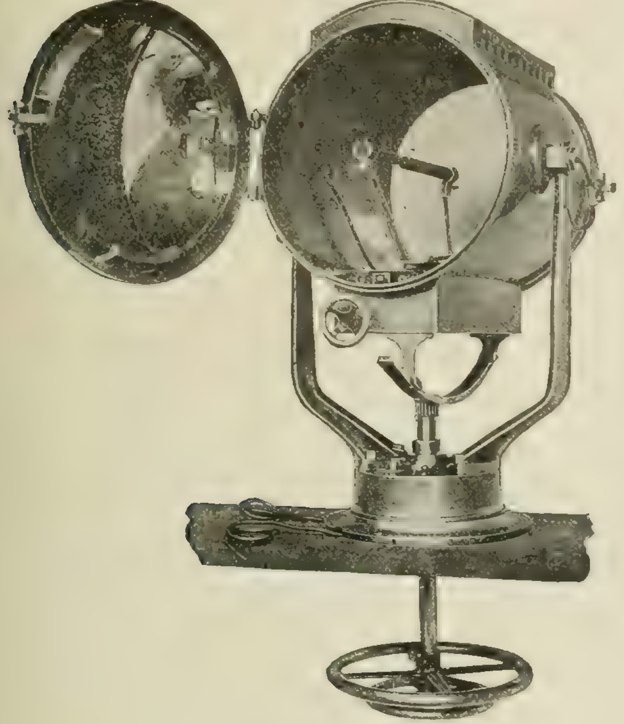
With the electric motor-driven groomer and clipper a horse may be thoroughly brushed [illegible] and clipped in about thirty-five minutes.

Improved Electric Searchlight.

Searchlights on steamboats have become invaluable aids to night navigation. Their use is valuable for picking up buoys, making landings, distinguishing distant objects, etc., and their simplicity and ease of manipulation and certainty of operation render them extremely desirable.

The Carlisle & Finch Company, Cincinnati, Ohio, makes a marine searchlight that has several commendatory features. The recent type of mirror lens lamps embodies the most approved and latest designs. The mirrors are high grade throughout, and the curvature is so carefully ground that a very strong ray of light is obtained. The 9-inch lamp, which requires five amperes of current for its operation, enables the picking up of a buoy at a distance of half a mile, the large lamps illuminating correspondingly increased distances. All lamps are fitted with the Carlisle & Finch Company's improved devices. The lens mirror lamps have double screw mechanism, which permits of a much shorter and lighter body than is usually made. The lamp works equally well in any position, and may be started while pointing straight upward.

The accompanying illustration represents the lens mirror lamp, with pilot house steering gear attachment, the reflector end being open to permit inspection of the lamp. The door is swung to one side, thus avoiding the danger of injury to the expensive lens, which is liable to result when the door is dropped down. New carbons may be placed in position from the front. The ends of the case are heavy brass castings highly polished. The hinges are cast solid with these rings, and are always secure and cannot work loose. The doors are also brass castings, polished and highly finished.



Lens Mirror Searchlight.

The 9-inch lamp referred to is particularly adapted to launches and yachts. Complete it weighs 30 pounds, and is only 19 inches high over all. It is handsomely finished and in keeping with the bright fittings in any yacht.

Electric Overhead Traveling Cranes.

BY W. G. HILDEBRAN.

The important part which electrical machinery takes in lessening the cost of production in the various branches of manufacturing industries is well exemplified in the improvements made in hoisting machinery since the advent of electricity.

Previous to the application of electric motors to overhead traveling cranes, these were usually driven either by an endless wire rope, or through the aid of a square shaft located along one side of the building, near the runways, from which power was taken by a sliding sleeve bevel pinion. While this method of driving worked very satisfactorily for slow speeds, it necessitated the continual driving of the square shaft at its full speed to enable the crane to be promptly put in use. Considerable noise was also occasioned by the different trains of mitre gears required on cranes of this construction. All these objections have been overcome in the modern electric overhead traveling cranes built by the Morgan Engineering Company, of Alliance, Ohio, one of which is illustrated.

The crane shown is one of four built by the above company for the Westinghouse Machine Company, East Pittsburg, Pa., each of which is driven for four two-phase alternating current motors of the induction type, made by the Westinghouse Electric & Manufacturing Company. The span of crane from centre to centre of longitudinal runways is 58′ 6″, with a total clear lift from the floor level of 38′ 8″ and a longitudinal travel on runways of 750 feet. The main hoist has a lifting capacity of 20 tons, and the auxiliary hoist a lifting capacity of 5 tons.

The girders composing the bridges are of box section, and consist of two web plates joined to top and bottom cover plates by four angles. This construction gives the lateral stiffness which is so essential for cranes of high speeds. Distance pieces are provided at proper intervals between the webs to assist in supporting the trolley rails. These distance pieces are machined on their ends and top face, and the top cover plate rests directly upon them, and, as the rails supporting the trolley rest directly over the centre of these distance pieces, the load is evenly distributed between the two webs. The girders are built under the standard specifications adopted by the Association of American Steel Manufacturers.

The bridge trucks are also made of open box section, the girders resting directly upon them. At the ends of each truck are placed the track wheels, which are of steel, and revolve on bronze bearings. The girders are held to these trucks in such a manner that it is impossible for the crane to get out of square.

Resting directly over the centre of each girder is placed an open box section trolley frame, supported upon steel track wheels, which revolve on bronze bearings. These frames are connected by steel axles held stationary in such a manner that the span of the trolley, or distance between track wheels, is accurately maintained. Resting directly over the trolley frames is placed a lifting beam or support for upper chain block. This beam supports sixty-six and two-thirds of the total load suspended from hook, the location of the beam being such that there is an approximately even load on each track wheel. The hoisting drum revolves on bronze bearings, and has right and left-hand grooves turned on its face to receive the chain. The ends of the chain are fastened to the ends of the drum and lead under the active sheaves in the bottom block, then over the sheaves in the upper block, and then down to an idler or equalizing sheave in lower block, forming an inverted pyramid that tends to stop the swinging or pendulum action liable to occur at high traveling speeds. This method also secures a perfectly vertical hoist and an equal distribution of the load on the girders at all positions of the hook.

The following motors of the induction type, made by the Westinghouse Electric & Manufacturing Company, are applied to the different motions: The main hoist is driven by a 20-hp motor, the auxiliary hoist by a 10-hp, the trolley cross travel by a 5-hp and the bridge longitudinal travel by a 10-hp motor. These motors are operated by specially designed Westinghouse controllers located in the operator's cage, which is suspended from the crane close to one runway. Beside the controllers, the operator's platform or cage contains all the necessary switches and cut-outs.

All gears throughout the crane have cut teeth, except the drum wheel and pinion gearing into same, which are shrouded. Ample provision is made for the constant lubrication of all journals and bearings, and great care was taken to reduce friction to a minimum.

The speeds of the different motions of the crane are as follows: Main hoist, with full load, 10 feet per minute; auxiliary hoist, with full load, 40 feet per minute; trolley cross travel, 129 feet per minute; bridge or longitudinal travel, 248 feet per minute.

The patented auxiliary hoist makes an important and valuable addition to a crane, as three-fourths of the work in most shops consists of light loads which can be rapidly handled with the auxiliary hoist without the use of the heavier equipment, thus saving unnecessary wear on the latter.

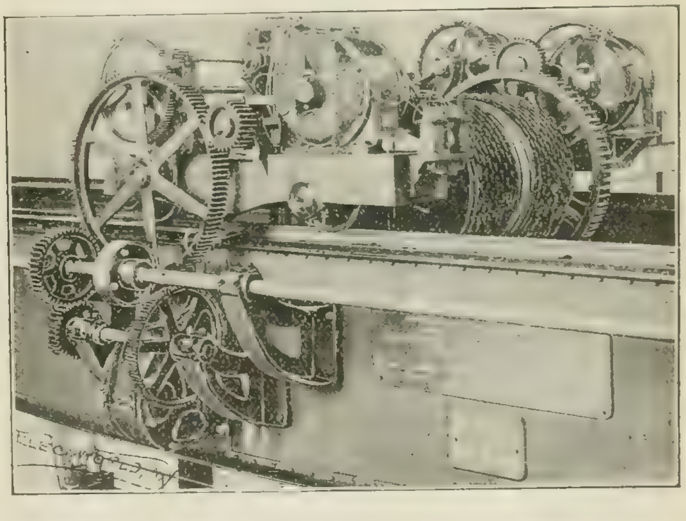


Fig. 1.—Overhead Traveling Crane.

Fig. 1 is an enlarged end elevation of trolley and crane bridge on tracks, showing the main hoisting machinery.

The armature of the hoisting motor is provided with an automatic electric brake operated by special alternating current solenoids (shown at right of trolley in Fig. 1), connected in such a manner that should the supply of current fail from any cause the brake will immediately apply itself and prevent the running down of the load. This brake is applied by gravity, and is not dependent on springs or other arrangements liable to fail at critical moments.

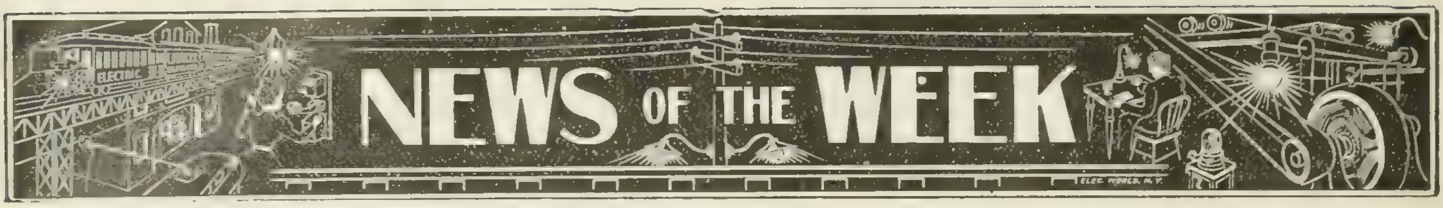
The main hoist is also supplied with an entirely independent mechanical brake in addition to the electric brake described above. This brake is arranged to absolutely prevent the load from lowering unless the motor is revolved by power in the lowering direction. By this arrangement all strain due to load is taken from the motor and the gears between motor and mechanical brake, except in the act of hoisting.

The longitudinal travel gearing is provided with a powerful foot brake, which positively enables the operator to stop the crane without reversing the motor.

Current is conveyed to the crane through wires located along one of the longitudinal runways, from which it is taken by sliding contacts and conveyed to the wires located on side of bridge, and from them conveyed to the motors by sliding contacts depending from trolley.

Both the mechanical and electrical construction of the crane is of the very best, giving the greatest efficiency and satisfaction possible.

The Morgan Engineering Company, Alliance, Ohio, by whom the above crane was made, has a capacity for turning out four complete cranes per week, and has over 1000 such cranes in successful operation in various parts of the country.



NEWS OF THE WEEK

Financial Intelligence.

THE BOSTON ELECTRIC LIGHT COMPANY has declared a regular quarterly dividend of $1.50 per share, payable on July 15.

THE ERIE TELEGRAPH & TELEPHONE COMPANY has made application to the New York Stock Exchange for the listing of $200,000 additional capital stock.

A MEETING of the stockholders of the New England Telephone & Telegraph Company is to be held in Boston on July 6, to consider a proposition to increase the authorized capital stock of the company from $12,000,000 to $15,000,000. It is stated that the increase has been recommended by the directors in anticipation of the needs of the company for funds which will be required from year to year for extension of the property and business, and with a view of taking up with funds realized from the sale of new stock the 6 per cent. bonds of the company, which will mature within the next few years, at the rate of about $500,000 a year. The company's exchange and private line subscribers now number 46,000, and it operates 28,000 miles of wire.

THE GENERAL ELECTRIC COMPANY.—The directors of the General Electric Company, at a meeting on July 1, voted to recommend to the stockholders a reduction in the share capital of the company, both common and preferred, of 40 per cent., so that each holder of 100 shares of present stock will get sixty shares of the new stock. This settlement, while satisfactory to the common stockholders, is regarded as particularly favorable to the preferred shareholders, inasmuch as it will render unnecessary the taking of any steps for the liquidation of the company, in which event the preferred stockholders would receive only the same amount as the common stockholders, and no back dividends. The plan now adopted contemplates the payment, from the surplus earnings of the company as they are hereafter made, of the accrued dividends on the preferred stock. On the basis of the new capitalization $1,275,000 will be required annually to pay 7 per cent. upon the preferred stock and 6 per cent. upon the common stock. The stockholders' meeting will be held at Schenectady on August 10.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
9 Murray St., NEW YORK, July 5, 1898.

COL. EUGENE GRIFFIN on June 29 assumed command of the First Regiment, United States Volunteer Engineers, which has its temporary headquarters at Camp Townsend, Peekskill, N. Y.

UNDERGROUND CONDUIT ROAD ON SIXTH AVENUE.—It is stated that the Metropolitan Street Railway Company will at once proceed to install the underground electric conduit system on the Sixth Avenue line, which is at present operated by horse-power. The work of laying the conduit on Sixth Avenue was begun several months ago at Fifty-ninth Street, and was carried on down to Fiftieth Street, when it came to a halt on account of litigation. The question was raised and carried into court as to the right of the Metropolitan Company to make use of the Sixth Avenue franchise which it had obtained. The matter having been decided in favor of the company, and all obstacles having thus been removed, the company will proceed at once to push the electrical construction work on this avenue. It is stated that the new line will be ready for operation in about three or four months' time. Mr. H. H. Vreeland, president of the company, is reported to have said that the Metropolitan Company [illegible] Broadway for the change of motive power on the Broadway line from cable to electricity, but that it was not likely that any move toward the change would [illegible]

[illegible] and general manager of the Sprague Electric Company, New York, has written a most interesting and instructive article on the "Evolution and Revolution of the Electric Motor, from 1888 Up to the Present Time," which appears as the leading article in the [illegible] had an intimate acquaintance with the electric motor from its very birth, in a [illegible] and thought. The character of this development is, however, made instantly [illegible] the motor of to-day. We see the same general form, the same basic principles, [illegible]

CHICAGO NOTE.

Branch Office of THE ELECTRICAL WORLD,
936 Monadnock Building,
CHICAGO, Ill., July 2, 1898.

CAPT. JOHN W. MACCONNELL, of the United States Signal Corps, and fifty-five of the most prominent electricians and telegraphers of Chicago, left for Washington on June 29, where they will await orders to proceed to the front. This corps was recruited from the offices of the Western Union and Postal Telegraph Companies, and also from the Chicago Telephone Company. Several of the best linemen are among the number.

PHILADELPHIA NOTE.

Branch Office of THE ELECTRICAL WORLD,
929 Chestnut Street,
PHILADELPHIA, Pa., July 2, 1898.

MR. JOHN A. BRILL, of the J. G. Brill Company, is kept so closely confined to business, owing to the extreme rush of work, that he is unable to serve as a director in the General Electric Automobile Company, which was recently organized under the laws of West Virginia, with headquarters in this city.

BUFFALO AND NIAGARA FALLS NOTES.

BUFFALO, N. Y., July 2, 1898.

THE CONTRACT for power to run the new malt house of the Curtis estate at Black Rock has been closed by the Conduit Company. About 200 horsepower will be used. The Westinghouse Company will furnish the machinery.

THE NIAGARA POWER & CONDUIT COMPANY has put a large force of men at work on Niagara Street to lay the new subway that is to take the place of the pole line within the Buffalo city limits of the Niagara tunnel current. It will take most of the summer to do the work. Work of extending the subway up Genesee Street to the Urban flour mill will begin soon.

THE NEW LOCKPORT trolley line of the Ely Company is not to be opened as soon as was expected. Legal complications have arisen which must be straightened out first. The work goes on, though, being mostly concentrated on the setting up of the new transformers in the power house at Lockport. There is also a hitch in the effort to get across the line of the steam roads at North Buffalo.

THE NEW steel arch bridge at Niagara Falls is finished, and the first trolley car crossed it on June 30, taking with it Manager Phillips, of the Niagara Falls Park & Railway Company, and Superintendent Dill, of the bridge. Cars will be run across the bridge every five minutes during the summer, which will add very greatly to the facilities for seeing the falls from both sides. Till now the accommodations have been very poor.

FRENCH NOTES.

(From Our Own Correspondent.)

PARIS, June 16, 1898.

ELECTRICAL TRACTION IN FRANCE.—In France, electrical traction is gaining ground from day to day, and one hears continually of this or that city having adopted electricity for its tramways. The most important towns that have recently adopted electric traction or have systems under construction are: Cette, Toulon, Brest, not to mention the smaller towns which, like Castres, are soon to be covered with a network of tramways.

COMMERCIAL NOTES.—In an open letter addressed to the French Boards of Trade, the Minister of Commerce and Industry announces the formation of a new special bureau in his department and that of Foreign Affairs, which will receive inquiries from business men who need reliable information concerning French or foreign firms, both in the colonies and abroad. Any request for information addressed to the Minister of Commerce and Industry will receive a prompt answer free of charge.

THE BELT RAILWAY FOR THE EXPOSITION OF 1900.—M. Henry Boucher, Minister of Commerce, in accordance with the unanimous recommendation made by the special commission and with the approval of M. A. Picard, Commissary-General, has awarded to M. de Maucomble, an engineer, the concession for the electrical belt railway, which is to serve the left bank of the river at the exposition in 1900. The project, as finally planned, includes, beside the electric railway proper, a moveable sidewalk in three sections running at three different speeds, which will be able to carry a large number of passengers. Of the five plans that were submitted, the one chosen was the only one which proposed to combine the railway and moving sidewalk. It was this idea which gave this proposal the preference over its competitors.

THE ELECTRIC RAILWAY AT ST. GERMAIN.—It is expected shortly to open the first electric railway built by the Heilmann Company. It connects [illegible] with the belt line cooperating with [illegible] The trials which have been in progress several weeks are very satisfactory. Only single locomotives were tried at first, and they attained a speed of [illegible] miles an hour. Then trials were made with trains, and a speed of [illegible] miles per hour was reached, with a comparatively heavy train, made up of ten cars. The route covers a distance of about 2.1 miles. The current is furnished by a generator of 1100 amperes capacity at 400 volts. This current is delivered to the locomotive over a third rail on the portion of the road lying between the belt line and the power station, while the overhead trolley is used on the portion between the power station and St. Germain. The locomotives are made of a framework of steel, with a cab, for the protection of the machinery, and are carried on four driving axles. A quadruple pole changer reverses the locomotives by reversing the current in the armatures. The motors have four poles and two field coils. The stability of the locomotives at highest speed is remarkable. The rails are used throughout for the return current.

MECHANICAL TRACTION IN PARIS.—From the standpoint of mechanical traction Paris is, as we have already, a rather peculiar museum. The systems in the field include almost every form except the trolley system. The following figures on the relative lengths of the various lines deal only with what is strictly in the city, "intra muros." These figures bring out the fact that in spite of the great opposition that has been exerted against mechanical traction it is making advances; nearly 30 per cent. of the total mileage is mechanically operated, and to this should be added the Aubervillers line, consisting of a mixed system of electrical traction (trolley and accumulators), which has been in operation for two months. This leaves out of the question the numerous enterprises which will see completion during this year and 1899.

Independent Motor Cars.	Number of Lines.	Mileage.	Number of cars Operated.
Steam { Rowan	1	4.68	4
Steam { Serpollet	2	4.16	22
Steam { Serpollet (Improved type)	2	7.15	30
Superheated Steam } Frauch	1	.72	16
Compressed air	5	21.61	47
Accumulators (slow charging)	2	5.3	16
" (rapid charging)	3	5.87	35
Train and locomotive System.	**Number of Lines.**	**Mileage.**	**Number of cars Operated.**
Claret Weisllesemier (electric)	1	2.34	20
Cable	1	1.25	21
Totals	18	53 08	211
Horse traction	39	129	478

We hope that by 1900 this table will have changed and that electrical traction, which makes so poor a showing, will be at the head.

THE DUSSAUD TELESCOPE.—For several weeks there has been much talk in Paris about an invention of M. Dussaud, called by the latter a teleoscope. This instrument is for transmitting images to a distance. It is already looked forward to as a chief feature of the exposition of 1900, and everybody is wondering at this marvelous invention and speculating on the applications and uses to which it may be put. It is perhaps well not to go too fast in this matter; if we are a little late in bringing it to the attention of our American readers, it is because we put little credence in the wonderful claims that were being made for it; and we were right, as we have since been informed that this invention has not yet been sufficiently perfected to be of much use in practical life. M. Dussaud was the inventor of the microphonograph, which amplifies sound and is of such great and constant service to deaf and deaf and dumb people. He has made a lengthy experimental study of the problem of transmitting images to a distance. He makes use of the well-known properties of selenium, which Graham Bell made use of in his experiments on the photophone with Sumner Tainter. M. Dussaud's instrument, the teleoscope, consists of a rotary circular diaphragm pierced by small holes arranged in spirals, and driven by clock work. Lamina of selenium are arranged in front of the diaphragm, and are in circuit with a battery and an induction coil. This arrangement may be considered as the transmitter. The image thrown on the transmitter acts in much the same way that it does in photography, traveling the openings in the diaphragm and acting with more or less intensity on the selenium plates, according to whether the parts exposed are more or less brilliantly lighted. Hence, currents of varying strength are sent over the line setting up vibrations of varying intensity in a kind of telephone, which is made very sensitive. The diaphragm of this receiver acts (?) on an opaque plate furnished with transparent lines, causing it to move before another, stationary plate. Luminous projections are thereby produced in synchronism with those at the starting point, or transmitter, and the image is reproduced on a screen. (?) The two interrogation marks which we insert purposely point out the inference. It is perhaps within the bounds of possibility that M. Dussaud may be able to transmit to a distance very simple images, but to reproduce, as it is said he does, persons, groups, living beings, walking and gesticulating is something that must be seen to be believed. We can scarcely hope to see such a wonder accomplished as early as the exposition of 1900.

THE COMPAGNIE DU NORD AND SELF-PROPELLING CARS.—The first type, which has a single second-class compartment, seating twelve people, is made in two forms: one is fitted with the Serpollet steam system, and the other has electric accumulators. This first type is intended chiefly to carry mail matter over the system and to obviate too frequent stopping of ordinary trains at small stations, and also to make the leaving time of trains more convenient for travelers. They can also take a few passengers if there should happen to be some. The postal clerk will act also as conductor with a machinist or electrician to act as driver. The second type is entirely electric and is intended for passenger service on some of the lines during the bathing season (Boulogne, Le Treport, etc.). It is possible with the electric car to stop at any station on the route, and to return without much shifting, thanks to the connections between the main tracks which have been laid down at all the stations of the Compagnie du Nord. The electrical cars are still under construction; the steam car of the first type has been in service a number of days. The first type of car has four wheels and is driven by a motor directly connected to the rear axle. The commutator of this machine is placed in the cab near the controlling apparatus. Power is supplied from a battery of accumulators in a box hung between the axle under the longitudinal side beams of the car. It is possible to add to this battery by placing cells in two compartments built above the flooring on either side of the motorman's place. The total weight is 17.1 tons. The motor has four poles, and is mounted directly on the rear axle. The field is suspended on the same axle by means of two specially designed lubricating journal boxes. Two horizontal rods fastened by limbs to a cross beam of the car frame hold the field from turning. The mean effort exerted by the motor measured at the rim of the wheel is 352 pounds, normally, but reaches 627 pounds when starting. Experiments have shown that these efforts equal 1.76 pounds per ampere supplied to the armature. Thus the current required to produce an effort of 352 pounds would be 200 amperes. The battery can furnish an effective E. M. F. of 80 volts, which makes the available power 20 to 22 horse-power, and 30 horse-power at starting. The commutator is entirely separate from the motor, and is driven by a small special motor running in step with the main motor. This piece of apparatus, being placed within reach of the motorman, is easily cared for and watched while in operation. The controlling apparatus is all placed on a table in front of the motorman, and is made up as follows: A double-pole switch for putting the battery on charge, another for putting it on discharge, these two switches interlocking with each other. A double-pole switch for separately exciting the field. A reversing switch which is interlocked with a switch controlling a starting rheostat situated on the car roof. There is also the usual supply of meters and indicators. Lastly, within reach of the motorman, is the lever of a hand brake, and also a long-range trumpet like those used on tramways. The battery placed below the framework is made up of forty chloride cells of nine plates each, with hard rubber jars, and are made by the Société pour le Travail Electrique des Métaux. These forty elements are fitted in a case which can be removed from the car when it is desired to inspect the battery. For this purpose the case is furnished at each end with a piece of iron which rests on hooks firmly fastened to the framework of the car. Bolts prevent the case from becoming displaced while the car is running. When the accumulator case is to be removed, the car is run over a track at right angles to the one it moves on. A small truck furnished with screw jacks is pushed under and the case is lifted slightly to allow the hooks to be disengaged, and the whole thing is dragged out from under the car. The running boards are made so they can be lifted up level with the floor beams to permit the case to be dragged out. Eventually it is expected to have a case of twelve more cells in the box to the left of the motorman and another of six cells on his right. The entire number of cells may therefore be raised to fifty-eight if necessary. Under these conditions the complete operating weight given above would be increased by 2.42 tons, but on the other hand the available power becomes 30 to 32 horse-power normal, with a maximum of 54 horse-power at starting. The forward and rear lights, three in number, are electric. The passenger compartment is also lit by incandescent lamps. Two other lamps light the controlling apparatus and the motorman's cab. The electric car of the second type has fifty seats, and weighs, all complete, 26½ tons. The motor and batteries are of the same type as in the car with twelve seats. We have dilated rather more than we intended on this type of car because of the newness of the application and the peculiar service to which these cars will be put on the railways of the large companies.

General News.

NEW INCORPORATIONS.

THE ATCHISON TELEPHONE COMPANY, Atchison, Kan., has been incorporated, with a capital stock of $20,000.

THE CITIZENS' ELECTRIC LIGHT COMPANY has been formed at Xenia, Ohio, with a capital stock of $10,000.

THE CAYADUTTA ELECTRIC GENERATING COMPANY, Gloversville, N. Y., has been formed by Supervisor A. Z. Wemple and Dr. H. W. Post and J. S. Wilson.

THE MUTUAL ELECTRIC COMPANY, Chicago, Ill., has been formed, with a capital stock of $2500. The incorporators are E. H. Cheney, F. S. Richmond and H. C. Hall.

THE UNITED TELEPHONE COMPANY, Swanwick, Ill., has been incorporated, with a capital stock of $700. Among those interested are John I. Higgs, P. Fearnsen and Hall Rebb.

THE ILLINOIS TELEPHONE COMPANY, Chicago, Ill., has been formed, with a capital stock of $250,000. The incorporators are Ralph N. Bowman, Samuel N. McLaughlin and Thomas J. Holmes.

THE MARIETTA TELEPHONE COMPANY, Marietta, Ga., has been organized with the following officers: I. L. Clark, president; A. A. Towers, secretary and general manager; G. N. Gantt, treasurer.

THE DEERING ELECTRIC LIGHT COMPANY has been incorporated for the purpose of lighting the towns of Deering, Westbrook, Gorham, Cape Elizabeth and South Portland, Me. Capital stock, $25,000.

THE EVANSVILLE TELEPHONE COMPANY, Evansville, Ind., has been organized, with a capital stock of $150,000. The incorporators are William L. Holmes, Charles Flowers, Edward H. Parker and Alexander J. McLeod, Detroit, Mich.

THE MUNSON COMPANY, Laporte, Ind., has been formed as an electrical manufacturing concern, with a capital stock of $100,000. The directors are William R. Everett, John H. Munson, William A. Roberts, Peter J. Heldt and Leroy A. Stringham.

THE SUSQUEHANNA VALLEY TELEPHONE COMPANY has been incorporated at Albany, N. Y., with Dr. C. S. Butler as president; E. A. King, vice-president; G. W. Hobbs, secretary; B. Badger, assistant; J. H. Brownell, treasurer. Capital stock, $1000.

THE FRANKLIN TELEPHONE & TELEGRAPH COMPANY has been organized at Chambersburg, Pa., with the following named officers: President, D. K. Appenzellar; secretary, H. B. McNulty; treasurer, David McClay. The capital stock of the company is $40,000.

THE SEBAGO TRANSMISSION COMPANY has been incorporated at Portland, Me., for the purpose of supplying electricity for heating, lighting, etc.

The officers of the new company are: President, Harry L. Jones; treasurer, George W. Brown. Capital stock, $50,000.

MR. H. E. BOCKER, formerly of Seneca Falls, N. Y., has incorporated a company in Colorado for the purpose of supplying the mines of that State with electric lights, to be used in place of the oil lamps now used by the miners. The company has a capital of $20,000.

THE ERICSSON TELEPHONE COMPANY, Utica, N. Y., has been incorporated in West Virginia. Among those interested are Langdon P. Smith, John F. Hemenway, Alice M. Hemenway and William C. Wilson, of New York City, and Henry E. Higgins, of Jersey City.

THE KENDALLVILLE & CRESCO FARMERS' TELEPHONE COMPANY has filed articles of incorporation with the Secretary of State at Des Moines, Ia., its headquarters being in Cresco. Among those interested are C. C. Brown, Thomas Hynes and M. H. Culbert. Capital stock, $360.

THE EUREKA & MOUND CITY TELEPHONE COMPANY, Sioux Falls, S. Dak., has been incorporated, with a capital stock of $2000. The incorporators are T. W. Boettcher, Walter C. Poehler, Eureka; Louis H. Clyborne, Chauncey E. Eckert, Mound City; Alvin H. Poehler, Minneapolis.

THE PEOPLE'S ELECTRIC LIGHT, HEAT & POWER COMPANY, Nanticoke, Pa., has been formed, with a capital stock of $75,000. The incorporators are M. W. Morris, Pittston; C. E. Stegmaier, Dr. J. A. Bullard, Sol. Hirsch, S. Wormser, W. Mulligan, Dr. W. G. Weaver and J. W. Morris, of Nanticoke.

THE CARROLL COUNTY TELEPHONE COMPANY has been formed at Carrollton, Ohio, with the following officers and directors: President, H. J. Eckley; general manager, J. C. Ferral; treasurer, T. J. Saltsman; secretary, George S. Tinlin; directors, U. C. De Ford, Ed. De Ford, Gus Elson and Conley Patterson.

THE HOME TELEPHONE COMPANY, Marion, Iowa, has been incorporated. Among those interested in the new enterprise are J. S. Alexander, S. W. Rathbun, F. C. H. Schminke, William Downie, T. J. Davis, J. S. Ovington, E. I. Alderman, Levi Wright, B. F. Mentzer, J. W. La Grange, J. M. Thompson, J. W. Bowman, White-shumack Company, A. J. and Allen B. McKean, T. H. Gruelich, C. L. Nye, John Cone, Mrs. Sarah Graham.

THE TELEGRAPH AND TELEPHONE.

HUNTINGTON, W. VA.—A telephone line is to be constructed between Hamlin and this place.

BELVIDERE, ILL.—The Belvidere Telephone Company has certified to an increase in its capital stock from $10,000 to $25,000.

WINDSOR, ONT.—A special meeting of the Windsor Council granted a twenty-year franchise to the People's Telephone Company.

BIRMINGHAM, ALA.—The City Council has granted to the American Telephone & Telegraph Company the right to enter the city with long distance wires.

WILMINGTON, DEL.—Local men now control the Delmarvia Telephone Company, $4000 worth of stock owned by Baltimore capitalists having been purchased by them.

NEW ALBANY, IND.—The Home Telephone Company has purchased ground and will erect thereon a building exclusively for its own use. It is putting up considerable cable, using in connection with the work the terminals of the Sterling Electric Company, of Chicago.

BOSTON, MASS.—The Bell Telephone Company's instrument statement for the month ended June 20 shows a gross output of 23,971; net output, 14,321. The total number of instruments in service at that date was 1,012,159. This is the first time the statement has shown 1,000,000 instruments in service.

NEW ALBANY, IND.—The Hoosier Telephone Company has completed its line from Salem to Hitchcock, Campbellsburg, Saltillo, Claysville and Livonia, connecting with the Martinsburg extension of the Home Telephone Company, of this city. The patrons along the Hoosier Telephone Company's line now have excellent service with New Albany.

MINNEAPOLIS, MINN.—Mr. P. G. Reynolds has been appointed superintendent of the Northwestern Telephone Exchange Company. Mr. Reynolds has been at the head of the construction department of this company since 1882, and for the past six years was superintendent of construction of the [illegible] Telegraph & Telephone Company, which covers Arkansas and [illegible].

[illegible] has one of the most successful [illegible] in the independent telephone field of [illegible]. [illegible] that the best is none too good. The outside construction is fine, and the central office equipment is the standard [illegible] of the Sterling Electric Company, of Chicago. The exchange was [illegible].

[illegible]

[illegible]

[illegible]

connecting of new subscribers. The company is now operating five exchanges and has under consideration the establishment of two more, one in the southeastern part of the city and another the location of which has not yet been selected.

CROOKSTON, MINN.—All the stock of the Crookston Telephone Company held by Chicago gentlemen has been bought by local capitalists, and a new set of officers for the company has been chosen. The officers of the reorganized company are: W. E. McKenzie, president; J. W. Weaver, vice-president; DeForest Bucklen, treasurer, and E. M. Welsh, secretary and manager. The capital stock of the reincorporated company has been fixed at $10,000. The local company has completed and operated a line between here and Fisher, and this will be sold to the Northwestern Telephone Company, which will extend it to Grand Forks to make connections with its long-distance system at that point.

NEWARK, N. J.—The Newark Telephone Company, Newark, N. J., has awarded a contract to Thomas Nevins & Son for a new 2000-wire Western multiple switchboard for its main central exchange. This board, it is stated, will make the Newark exchange the largest and most comprehensive strictly first-class, independent telephone exchange in operation in the United States. The main exchange, together with the branches, will have a total capacity for connection of upwards of 3100 individual lines. The Western Telephone Construction Company will supply the new board for the Newark exchange. The apparatus is so constructed as to obviate the necessity for the multiple jack system.

SAGINAW, MICH.—The Valley Telephone Company, which is operating in Saginaw, West Saginaw, Bay City, West Bay City and Flint will probably have all its exchanges in operation by July 1. It is stated that the engineering work on these exchanges is the best that has been displayed in the construction of independent exchanges, the conduit work, the cable work, the pole line work, the inside wiring and the arrangement of the exchanges themselves being models of workmanship and of perfect arrangement. These exchanges are equipped with a full line of the apparatus of the Sterling Electric Company, Chicago, including switchboards, distributing boards, cable terminals, pole-top terminals and protective devices. The exchanges are well worth a visit by prospective builders or telephone users.

ELECTRIC LIGHT AND POWER.

BRACEVILLE, ILL.—At a recent election in this place a vote was cast in favor of establishing an electric light plant here.

HOMER, N. Y.—Electric lights will be furnished this village for a period of five years by the Cortland & Homer Traction Company.

WILKESBARRE, PA.—The Wilkesbarre Electric Light Company has decided to borrow $50,000 for the purpose of meeting the cost of the new building and sub-plant in this city. It is the company's intention to improve its plant and furnish first-class service.

ALBANY, GA.—The Albany Edison Illuminating Company's plant has been purchased by the city of Albany, and is undergoing a complete renovation. The old Edison incandescent dynamos are being taken out and new Thomson-Houston arcs put in their place.

DETROIT, MICH.—Articles reorganizing the Peninsular Electric Light Company for a period of thirty years have been filed. The object is to take possession of the plant, property and franchises of the old concern and continue the business. The capital stock is $150,000.

LOWVILLE, N. Y.—Mr. Lafayette Wettmore, of Martinsburg, has bought the grist mill and side and water power at Belfast, and intends to harness the power for the purpose of generating electricity, which will be transmitted to Lowville for lighting and manufacturing purposes. Belfast is 14 miles northeast of Lowville.

THE ELECTRIC RAILWAY.

WAUKEGAN, ILL.—The Chicago & Milwaukee Electric Railway Company is rapidly pushing to completion its line between this city and Highland Park, and expects to have cars running very soon.

PORTLAND, ME.—The management of the Cape Elizabeth Electric Railway Company contemplates extensive improvements along the line. It is proposed to equip the road with a private telephone service and signal system. Six of ten stations will be established along the road from the main office in the city to the power house.

HARTFORD, CONN.—It is expected that the new power house of the Hartford Street Railway Company will be ready for operation by September 1 next. A 1350-hp engine, built by the Pennsylvania Iron Works Company, Philadelphia, will be direct connected to an 850-kw General Electric generator. The engine will be cross compound condensing. There will also be installed a 500-hp Worthington condenser. The new power is to be auxiliary to the present supply and will give the company all that will be needed for emergencies for some time to come. The new building is 75 x 40 feet.

OBITUARY NOTE.

MR. EDWIN H. BENNETT, president of the Babcock & Wilcox Company and general manager of the Singer Manufacturing Company, died on Monday afternoon, June [illegible], at the Plaza Hotel, New York City, where he lived with his family. A widow, two daughters and a son survive him, the son being Mr. E. H. Bennett, Jr., general manager of the Diehl Manufacturing Company.

LEGAL NOTES.

[illegible] PARALLEL CONTROLLER CASE.—Judge Townsend, of the Circuit Court of the United States, has ordered that the petition for a rehearing in the [illegible] Electric Car Company of America and the Thomson-Houston Electric Company vs. the Hartford & West Hartford Railroad Company, [illegible] June 4, [illegible] be denied. The petition was for permission to reopen the case [illegible] the patent of W. J. and S. B.

Paine, No. 321,748, in answer. In the same case Judge Coxe, of the United States Circuit Court, has ordered that a preliminary injunction be issued against the Hoosick Railway Company, enjoining it from using series multiple controllers covered by letters patent No. 393,323, and has ordered that a preliminary injunction be suspended pending the hearing and determination of the appeal in the same cause in the Connecticut District.

THE ELECTRIC RAILWAY MOTOR SUSPENSION CASE.—Judge Lacombe, of the United States Circuit Court, has ordered that a preliminary injunction be served against the Nassau Electric Railroad Company, of Brooklyn, enjoining it from using the railway motor suspension covered by the Sprague patent, No. 324,892. This is the patent on which the Sprague Electric Railway & Motor Company obtained a favorable decision in its case against the Union Railway Company, in the United States Circuit Court of Appeals, May 17, 1898. The real parties in the present injunction are the General Electric Company and the Steel Motor Company. The injunction orders that the defendant shall remove at least 250 of the suspensions within thirty days, 250 within sixty days, 250 more within ninety days and the balance within 120 days from date. A preliminary injunction has also been ordered enjoining the Hoosick Railway Company from using Walker motor suspensions infringing the same patent.

Trade and Industrial Notes.

THE ELECTRIC GAS LIGHTING COMPANY, Boston, manufacturer of the Samson battery, informs us that the number of exchanges in which its battery is used is constantly increasing, which would seem to prove that the cell is well adapted for the work it is claimed to perform.

THE ELECTRIC STORAGE BATTERY COMPANY in Circular No. 41 describes the installation of chloride accumulators in the Waldorf-Astoria Hotel, New York. Illustrations of the cells and of other features of the electric plant are given. Two interesting and instructive curves are presented, showing the method in which the battery performs its functions as a regulator.

THE WESTERN ELECTRIC COMPANY, Chicago, has placed in stock a large and complete line of interior conduit, iron armored, brass armored and plain. Prompt shipments can be made and the demand for a variety of sizes satisfied. It is the desire of the Western Electric Company to be considered headquarters for conduit.

THE GEORGE M. MAYER MODEL & MACHINE WORKS, Chicago, Ill., recently made a large rotary slide wire bridge for the Chicago Telephone Company, and during the past week furnished the stock yards in Chicago with 2000 four-stand switches of unique design. They are now about to construct a station switchboard of thirty-five switches, ranging from 25 to 1500 amperes each.

THE CUTLER-HAMMER MANUFACTURING COMPANY, Chicago, states that since its consolidation with the American Rheostat Company it has been working overtime to fill orders promptly, and has more men in its employ than ever before. The company has received large foreign orders, and reports that if its business continues to increase it will be obliged to seek larger quarters.

THE WARREN-MEDBERY COMPANY, Sandy Hill, N. Y., has just completed the addition to its new works, and is setting up some very heavy machinery to be used in the construction of its heavy inductor alternators. The sale of these machines is reported to be steadily increasing, and the works are running to their utmost capacity. The line of knife switches which the company is producing is very extensive, and the demand is rapidly improving.

MESSRS. EUGENE MUNSELL & CO., 117-119 Lake Street, Chicago, are sending to their Western customers a very neat blotter, on which are embossed the Cuban and American flags, under which are the words, "Victorious on Sea and Land!" The printed matter beneath these words refers to the rapid development of a great business in a great city, and the firm does not need any better advertisement as to the superiority of its "Mica" or service rendered.

THE CASE MANUFACTURING COMPANY, Columbus, Ohio, reports a steadily increasing business in the sale of its electric cranes, which are meeting with success all over the country. Among the list of sales and installations, which extend pretty much over the country, we find the following: The National Electric Company, Brooklyn, one 92-inch 25-ton crane, and the Bullock Electric Manufacturing Company, Cincinnati, Ohio, one 20-ton electric crane. Two 30-ton electric traveling cranes were sent to Sydney, N. S. W.

A NEW BELT DRESSING.—The Joseph Dixon Crucible Company, Jersey City, N. J., is now placing on the market a solid belt dressing in round bars, about 8 inches long and 2 inches in diameter. It makes a package convenient to the hand, and easy to apply even to fast running belts. The company does not claim that the solid dressing is as good a preservative of the life and elasticity of the leather as the Dixon paste, but it is quick to apply and quick to act, and that is what is wanted by the general run of belt users.

THE HANSELL SPRING COMPANY, formerly of Newark, N. J., has removed to its new and excellently equipped factory in Ambler, Pa., where it is turning out in greater quantities and in quicker time its well-known street railway cars and locomotive springs. William Henry Hansell is the president of this company, and Mr. William Stiles is the treasurer. This company has branch offices all over the United States and in England, France and Japan. The high quality of its output necessitated the building of this new factory and the establishment of many branch offices.

THE GENERAL CATALOGUE of Messrs. Zimdars & Hunt, 127 Fifth Avenue, New York, has just made its appearance. It is divided into three sections, A. B. and C., corresponding to the firm's three-special catalogues previously noted. Section A is devoted to illustrations and descriptions of all types of the firm's knife switches, lugs, connections, switchboard fittings, etc.; Section B treats of panel boards, feeder boards, etc., and Section C is given up entirely to automatic switches and motor starters. The cover is in imitation of marble, with copper embossing, and is very attractive.

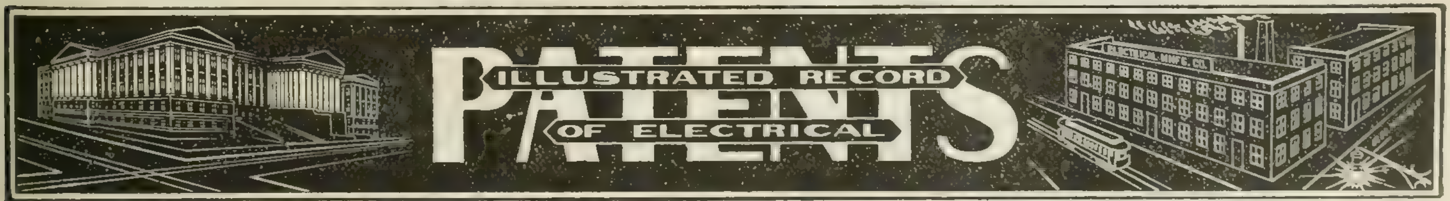
THE SYRACUSE CONSTRUCTION COMPANY, Syracuse, N. Y., is erecting new buildings in connection with its electric railway plant. The buildings consist of a boiler house 60 feet x 90 feet, which is an all-fireproof building, having steel framework covered with corrugated iron on the sides and roof. There is also an engine room 65 feet wide x 80 feet long, having a steel frame and brick sides. The other building is a car barn and repair shop, 65 feet wide and 170 feet long. This building also has steel framework construction, with corrugated iron sides. All these buildings have been designed and are being erected by the Berlin Iron Bridge Company, East Berlin, Conn.

EVERY SPRING and summer season brings the advent of a number of new devices for lightning protection. Many of these are on the market for only one season, and are then not heard from again. It is probably this fact that gives the Electric Appliance Company, Chicago, great satisfaction in calling attention to the Swinging Ball lightning arrester, which has now been on the market for nearly ten years. It is made in practically the same way to-day as when first put on the market, showing that the inventor evidently succeeded in producing a satisfactory device. The Electric Appliance Company as general Western agent for the Swinging Ball lightning arrester carries a large stock in Chicago, and reports that each year brings an increased sale of this specialty.

THE MICA INSULATOR COMPANY, New York and Chicago, reports a gratifying demand for its "Micanite" segments for electric light and power generators. Some heavy orders are being executed at the factory in Schenectady, N. Y. Many of the large generators now under construction have "Micanite" for their commutator insulation. The heavy increase in the company's business during the last months is said to be largely due to the improved process of manufacturing these segments. The company offers to send free of expense to any machinery builder or electrical repair concern a set for anyone of the smaller machines. Those interested in the economical insulation of electrical machinery will do well to write the company at its office, either in New York or Chicago.

Business Notice.

THE ILLUSTRATIONS in this issue were made by the Photo-Engraving Company, 9-15 Murray Street, New York City.



UNITED STATES PATENTS ISSUED JUNE 28, 1898.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

606,199. INSTRUMENT FOR CALKING SHIPS; W. P. Freeman, of New York, N. Y. App. filed June 22, 1897. In combination, the double-field magnet and two armatures mounted on a shaft, which is supported between the armatures at the central and neutral point of the field magnets, and a tool actuated by the said shaft and supported upon the field magnets.

606,208. TRANSFORMER BOX AND HANGER; L. Gutmann, of Peoria, Ill. App. filed Nov. 22, 1897. In a transformer hanger the combination of a main body tapering toward the upper end, a tapering rim forming part of said hanger, located in a parallel plane to the main body, and holes or recesses in said main body for retaining screws, bolts or other devices for fastening, as and for the purpose described.

606,279. ELECTRO-MECHANICAL MUSICAL INSTRUMENT; G. H. Davis, of New York, N. Y. App. filed May 1, 1896. In an electro-mechanical musical instrument, the combination with electrically operated playing mechanism of a base plate carrying a series of insulated contact points, a music roll holder drawer sliding upon said base plate, and carrying a contact roller or bar arrangement to contact with all of said contact points when the drawer is closed, means for holding said drawer closed, and means for automatically opening said drawer when the latter is released.

606,329. PRINTING TELEGRAPH; B. A. Brooks, of Brooklyn, N. Y. App. filed Jan. 20, 1894. In a printing telegraph, a combined transmitter and distributer, comprising a continuously revolving shaft, a set of key levers, a circuit changer or changers and mechanism between the levers and shaft whereby the depression of any key changes the circuit to send an impulse over the line after a predetermined time corresponding to the key.

606,342. APPARATUS FOR WELDING, BRAZING AND SOLDERING BY ELECTRICITY; A. Hirsch, of Berlin, Germany. App. filed Dec. 21, 1897. In a hand-tool for electric welding and analogous operations, the combination of a handle, a stem supported thereby, a plurality of electrode carriers pivoted to the stem, electrodes carried by the carriers and inclined toward each other at an angle, and manually operated means for swinging an electrode carrier so as to bring the electrodes into such position as to strike the arc.

606,356. ELECTRICAL SIGN; M. Norden, of New York, N. Y. App. filed April 12, 1897. In an automatic mechanism for electric signs, a shaft and heads, means for revolving such shaft and heads, removing letter bars and contact pins carried by such heads and a circular range of bars and contact springs carried by the same and circuit connections, a segment bar upon one of the heads and a contact brush and circuit connections.

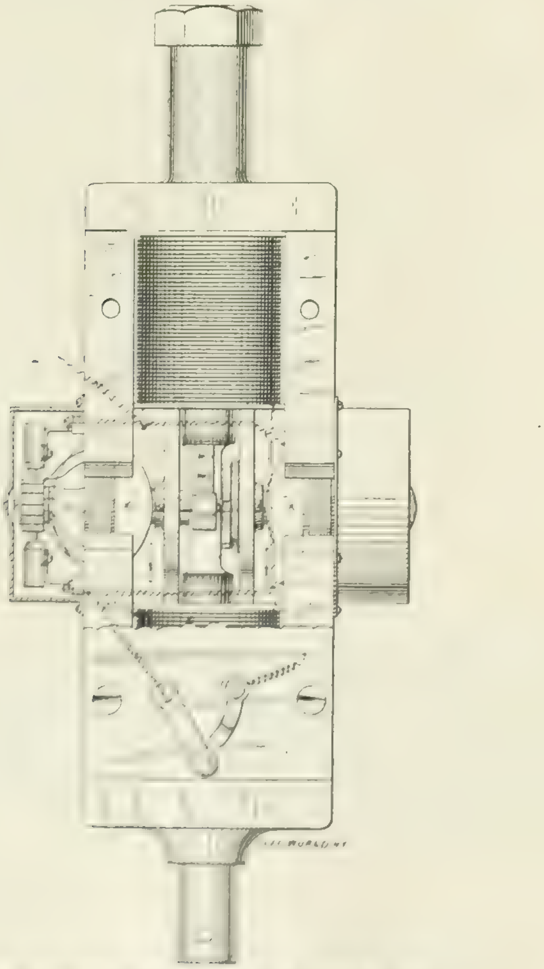
606,369. CURRENT INDICATOR; Thomas W. Varley, of New York, N. Y. App. filed July 2, 1897. In combination with the astatic needles and an indicating arm extending out from one of the needles, of an arch connection between the needles and beneath the arm, a counterweight at the opposite side of the pivot to the arm and a support for the pivot that allows the astatic needles to be applied above and below a stationary connector.

606,405. ALARM SYSTEM; C. Coleman, of Chicago, Ill. App. filed Sept. 3, 1897. The combination with a vault or other inclosure to be protected, of a Hertzian wave transmitter thereat, and alarm system for actuating said transmitter by an attempt to enter the vault, a Hertzian wave receiver at the alarm station and a signal device actuated by said receiver.

606,407. DYNAMO-ELECTRIC MACHINE; R. S. Dobbie, of Jersey City, N. J. App. filed June 6, 1892. A multipolar dynamo-electric machine or electric motor provided with means for causing it to produce a bipolar or multipolar effect in accordance with the work it is called upon to perform.

606,449. TELEGRAPH INSTRUMENT; James L. Cutter, of Cincinnati, Ohio. App. filed Oct. 18, 1897. In a telegraph instrument or the like, a magnet comprising a core, a coil wound thereon and a soft-iron bar connected at its central part to one end of the core and having its end bent to form arms 1897. A circuit closer, consisting of an escutcheon provided on its inner face with a chamber and cross bar, forming a contact point, a push button extending through the escutcheon and having its inner end broadened or formed into a disc, the wire forming the other electrode being coiled around and upon said disc.

606,450. RAILWAY SIGNALING SYSTEM; Chas. H. Davis, of New York, N. Y. App. filed Dec. 29, 1897. In a railroad signal system, a railway line, a single series of signaling devices in proximity thereto, each device being constructed to exhibit a danger signal and a safety signal and interlocking mechanism connecting said devices, the said devices and interlocking mechanism being constructed and arranged so that each device successfully, from one end of the line to the other, may be set to exhibit a safety signal ahead of a train provided the two or more immediately succeding devices in rear of said train are previously set to exhibit "danger."



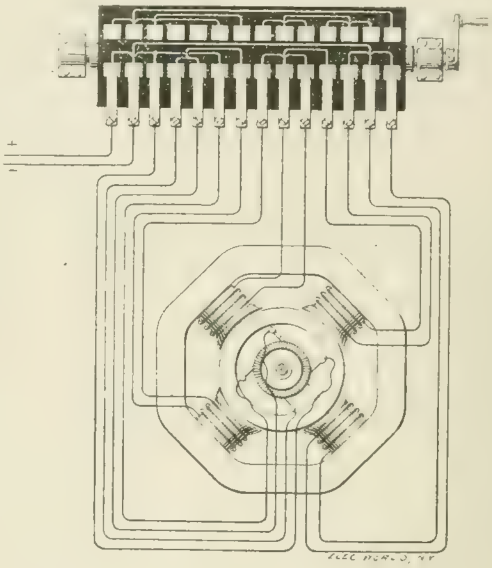
No. [illegible].—Instrument for Calking Ships.

606,[illegible]. SECONDARY VOLTAIC BATTERY; L. Epstein, of London, England. App. filed [illegible]. In a secondary [illegible] having negative [illegible] positive plates coated [illegible] positive plates [illegible] negative plates [illegible] which [illegible] except in their lower portions.

[illegible]. REGULATION OF ROTARY TRANSFORMER DIRECT CURRENT; C. F. Scott and B. G. Lamme, of Pittsburg, Pa. App. filed Feb. [illegible]. In a system of [illegible] distribution [illegible] a stationary transformer [illegible] varying the E. M. F. supplied by its sec-

ondary, of a rotary transformer receiving current from said transformer secondary, one or more choke-coils, means for connecting the same in said extending along opposite sides of the coil with their extremities adjacent to the free end of the core, in combination with an armature lever located in the field of the magnet pivoted on one of the arms and extending in line with the free ends of the arm and core.

606,562. PUSH BUTTON; F. J. List, of Chelsea, Mass. App. filed Nov. 5, secondary circuit for varying the field magnet excitation of the rotary transformer, whereby a wide variation of potential at the direct-current terminals may be secured.

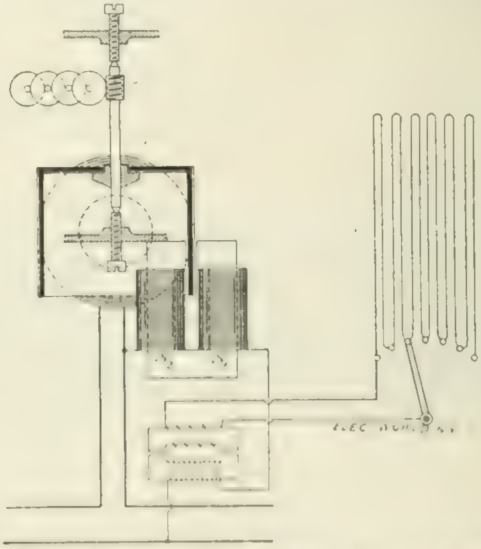


No. 606,407.—Dynamo Electric Machine.

606,589. SYSTEM OF ELECTRICAL DISTRIBUTION; C. F. Scott and B. G. Lamme, of Pittsburg, Pa. App. filed Jan. 28, 1897. A system of electrical distribution comprising an alternating current supply circuit, one or more direct-current motors, a rotary transformer taking alternating current from said supply circuit and supplying direct current to said motor or motors, and means for varying the alternating current electromagnetive force supplied to the rotary transformer, and thereby varying the direct-current E. M. F. and consequently the speed of the motors.

606,605. ELECTRIC MOTOR; J. G. Truman, of Lemon City, Fla. App. filed Jan. 10, 1894. In a motor the combination with a movable armature of a series of connecting bars or plates attached thereto and electromagnets with which the plates are also connected.

606,620. SYSTEM FOR ELECTRICAL COMMUNICATION; A. T. Brown, of Syracuse, New York. App. filed April 9, 1896. A party line system comprising a metallic circuit, two or more stations, each having responsive devices in the metallic circuit, one or more stations having a ground-tap and a responsive device thereon, a source of electrical energy with an optional ground-tap placeable in the metallic circuit between the ground-tap, having a responsive device thereon and other station in the metallic circuit adjacent thereto, and telephonic devices at each station placeable in the metallic circuit.



No. 606,630.—Alternating Current Motor Meter.

606,630. ALTERNATING CURRENT MOTOR METER; J. A. Mollinger and E. [illegible], of Nuremberg, Germany. App. filed Dec. 27, 1897. An alternating current motor meter having a shunt field, consisting of two inductive resistance coils placed in series with the coil of a choking device, the core or cores of the shunt field magnet being constructed of thick sheet iron, [illegible] and the cores of the choking device of thin sub-divided well isolated sheet-iron

The Electrical World.

Vol. XXXII. NEW YORK, JULY 16, 1898. No. 3.

PUBLISHED EVERY SATURDAY BY

The W. J. JOHNSTON COMPANY,

9 Murray Street, New York.

Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York.

New England Office, 620 Atlantic Ave., Boston.
Western Office, 936 Monadnock Block, Chicago.
Philadelphia Office, 929 Chestnut Street.

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THE ELECTRICAL WORLD,

9 Murray Street, New York.

Vol. XXXII. NEW YORK, JULY 16, 1898. No. 3.

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THE INDUCTION GENERATOR.

That the alternating-current induction machine with a short-circuited or squirrel-cage rotor winding will generate current from mechanical power is well known, but the advantages and disadvantages of its use in this manner are not generally appreciated, such machines having never been run commercially as generators.

To run such a machine as a generator some means of excitation must, of course, be provided, and the simplest and most obvious method of exciting the machine is the use of condensers connected straight across the mains. This method is perfectly practicable, the main objection to it being due to the fact that the machine acts as does a self-exciting shunt-wound direct-current generator, the voltage being very unstable, until the excitation is carried above the bend of the magnetization curve, since below this point any slight change of speed or load changes the voltage, which in turn reacts upon the excitation, further changing the voltage, the condition being a very unstable one, as the voltage is dependent on the excitation and the excitation is dependent on the voltage. Above the bend of the magnetization curve the magnetization is not proportional to the voltage and the excitation becomes more stable. This is a serious barrier to the use of such excitation with alternating-current induction generators, since the running of the iron above saturation at commercial frequencies involves a serious hysteresial loss. This objection, of course, does not apply to direct-current self-exciting shunt-wound machines. Another objection to this means of excitation is the fact that any change of the power factor of the load interferes seriously with the excitation. The addition of a lagging current equal in magnitude to the leading current taken by the condensers for field excitation purposes would immediately kill the excitation completely. There is, moreover, no apparent means of compounding an induction generator with such excitation.

Another and more promising means of exciting induction generators is the running upon the same circuits of synchronous excited field machines which, under such conditions, automatically adjust their phase relations with that of the generator so as to give the latter an exciting current, this action continuing with any variation of the magnitude or power factor of the external load within limits, the synchronous machine taking up, so to speak, all leading or lagging currents in itself, with the exception solely of that necessary to excite the induction generator to a voltage approximately equal to that determined by the speed, field excitation and armature reaction of the synchronous machine. A system consisting of an induction generator running a synchronous motor acts very much as does that consisting of a synchronous or ordinary generator running an induction motor, with one notable exception, which is to the great advantage of the induction generator for power transmission purposes. With the generator of the induction type and the motor of the synchronous type the wattless currents on the line are leading, while with the reversed combination (that common in contemporaneous practice) the wattless currents are lagging. With long lines, step-up and step-down transformers these lagging currents increase materially the ohmic drop of the system, while on the other hand, the leading currents would not only not increase the ohmic drop, but reacting upon the self-induction of the line would compensate for it and with proper conditions compound the voltage to a constant value independent of the load at the point of consumption, or even over-compound it, if desired. Furthermore, the regulation of the voltage would be entirely at the motor end of the system, the point where it is definitely known what voltage is desired.

It is certainly unnecessary in well-designed installations to have the system excited at both ends, and the advantages of placing the excitation at the motor end certainly indicate that present practice is in the wrong direction. Where rotary converters are used and some of the excitation must on their account necessarily be at the receiving end of the alternating system, and where, further, the direct-current voltage is intimately dependent upon the excitation of the alternating-current system, it would certainly be advisable to use induction generators whereby the determination of the voltage would be taken absolutely out of the hands of the attendant at the generating station and put into the hands of the attendant at the rotary, who, by adjusting his field rheostats for the proper direct-current voltage, would thereby fix the alternating-current voltage to suit. A still further advantage of this system is the ease with which such generators can be handled, there being no necessity of synchronizing apparatus, the machines adjusting their own phase relations on being switched together and there being further no real necessity of their running in exact synchronism, thereby eliminating the difficulties now obtained with isochronous or practically isochronous governors on synchronous generators run in multiple. With induction machines there would also be no trouble with the beating or oscillating of the rotating parts of the generators.

THE TROLLEY SWITCH CASE.

The United States Circuit Court of Appeals has rendered a decision in the case of the Thomson-Houston Electric Company vs. the Elmira & Horseheads Railroad Company, which, as is well known, is the case of the General Electric Company against the Walker Company, claiming an infringement of the Van Depoele patent No. 424,694 on overhead trolley switches. This decision, although it decrees some of the claims as void and others as not infringed, upholds in general the opinion of the lower court and considers a large number of claims valid and infringed. These claims cover the device universally used to switch overhead trolley wheels, consisting of a Y-shaped plate with depending flanges forming a shallow open bottom box into which the trolley wheel may run with its flanges bearing against the plate and in which it may be deflected to one side or the other by the lateral movement of the car on the track switch below.

The argument advanced by the defendant was that the claims were void for want of patentable novelty and that the invention had been previously patented by the same inventor. With regard to the first point it was argued that the switch was simply a track frog inverted, modified in detail and hung from the trolley wire supports. The decision states that "the ordinary track frog as a constructural device has only a remote resemblance to it. The suggestion that it could be utilized in the overhead line wire junction would seem ridiculous, and it could only be done by denuding it of its most conspicuous characteristic. * * * It was not a great invention, but that it was an invention requiring a degree of ingenuity somewhat beyond the ordinary skill of the calling we are unable to doubt." The question of previous patenting by the same inventor hinges upon certain fine points of patent law, the previous patents all having been applied for when the application for the patent in suit was pending in the Patent Office. The decision holds that the previous patents were not for the same invention, but for structural improvements in the same, and that, therefore, the broader claims in the patent in suit are valid.

The decision is a most important one, as trolley switches are vitally necessary in the operation of overhead trolley systems. An injunction obtained under this decision may be noted in another column in this issue.

UNDERGROUND INSULATION.

Since the number of wires in large cities has become absolutely too great for overhead accommodation, thereby necessitating the placing of the wires under ground, many solutions of the apparently overwhelming difficulties of this problem have been found. The highest achievement of good engineering, however, is the successful accomplishment of a purpose at a low cost, and in this respect the insulation of underground wiring has been a notable failure. Every successful system so far introduced has been expensive, and those most successful are ruinously so for anything but use in districts of highly concentrated population where correspondingly large returns from the service which the wires perform can be obtained. The whole problem is the covering of the copper conductor with an insulating material which in turn must be protected from moisture and mechanical disturbances. This is usually accomplished by a covering of india rubber or some equivalent insulation surrounded in turn by a shell of lead which in turn may be surrounded by an iron pipe and this again by concrete. The reasons for the need of this number of protections are obvious on a little thought. The rubber is, of course, the insulating medium; the lead is essential to protect the rubber from moisture, the iron in turn is needed to protect the lead mechanically, and the external concrete or cement to protect the iron from corrosion.

The production of an insulating duct has never been successfully accomplished, the difficulty apparently being that the duct, if vitreous, is brittle and easily broken, and if not vitreous is not moisture-proof. The use of conductors made up in short lengths in metallic pipes and joined together by junction boxes is going out of favor wherever drawn-in systems can be substituted, the troubles and difficulties encountered with the many junction boxes being the chief cause of this disfavor. The troublesome junction boxes are, however, of value where branches are frequent, so that in low tension lighting service, it has become now quite customary to use drawn-in conductors for the feeders and sectional conductors for the mains, from which the services are tapped off.

In Europe the concentric cable is in favor where two or three polarities run together, while in this country it is more customary to lap up three-round conductors in one cable. The concentric arrangement undoubtedly economizes both space and insulation for a given minimum distance between conductors, but involves considerable difficulties in joints and taps. European manufacturers have also adopted quite generally the use of a cable made up of close-fitting strands with segmental instead of circular cross section, whereby the diameter of the conductor for a given number of circular mils and the quantity of insulation required to surround it are considerably reduced. Concentric cables with the outer annular conductors made up in this way, the segments becoming copper tape, make a very compact and flexible arrangement.

A New Cable Steamer.

A four masted twin screw steamship, said to be the largest cable steamer afloat, has been launched for the Telegraph Construction & Maintenance Company. The craft is 440 feet long between perpendiculars, fitted with vertical cable drums, and in four of the holds are circular cable tanks about 45 feet in diameter and from 17 to 32 feet in depth.

The Construction of a 150,000 Volt Transformer.*

BY ELLERY B. PAINE AND HARRY E. GOUGH.

As a subject for post-graduate thesis work at the Worcester Polytechnic Institute during the past year the writers have designed and constructed a 150,000-volt transformer, and as some radical changes from the usual method of transformer construction are necessary when dealing with such high potentials a short description of this piece of apparatus may be of interest.

The source of supply of current for the transformer is the 30-kw Westinghouse smooth-core alternator situated in the power laboratory. This machine has a frequency of 133 cycles and its virtual voltage is 1000. Since it would not be convenient to arrange the necessary switches and circuit breakers in a 1000-volt circuit, it was decided to reduce the pressure by means of small transformers, and in this way the supply for the high-potential transformer could be either 50 volts or 100 volts as desired, with the alternator excited so as to give 1000 volts on the line.

As there were ten transformers available for this purpose, and the capacity of each was 2 kilowatts, the output of the high-potential transformer was limited to 20 kilowatts. From this it is seen that the problem was to design a 20-kw transformer for a frequency of 133 p. p. s. to give 150,000 volts at the terminals of the secondary with 100 volts supplied to the primary. In working out the design the end kept in view was to produce a transformer which would give the highest insulation for the lowest first cost of materials, and an efficiency sufficiently high to maintain good regulating qualities.

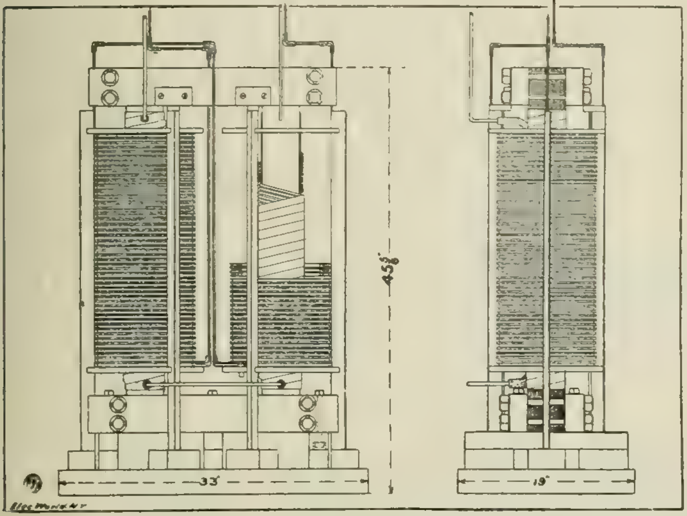

FIG. 1.—DETAIL ELEVATIONS OF TRANSFORMER.

The core type of transformer was selected for this case because that form seemed to offer better means for insulation than did the shell type, and would at the same time be easier to build. With a virtual voltage of 150,000 at the terminals of the secondary the maximum voltage to which the insulation will be subjected is 150,000 x 1.4, or over 200,000 volts, since the E. M. F. wave of the alternator is very nearly sinusoidal. With this voltage a spark will jump across an air space of about 15 inches, whence it is evident that the transformer must be surrounded by some better insulating dielectric than air. To determine what was the best oil to use for this transformer a series of comparative tests was made with different commercial oils. In making these tests an induction coil giving an E. M. F. of approximately 15,000 volts was used. From the results obtained in this way, together with the results obtained by other experimenters, it was decided that kerosene oil would be used, and it was estimated that 3″ of this oil would withstand a potential of 200,000 virtual volts. To find out if the oil would be apt to take fire if it were used and sparks should pass through it heavy arcs were formed in a sample of kerosene; and in no case was the oil observed to take fire.

From preliminary calculations carried through with different values of magnetic density in the core and different core areas, it was decided that a maximum core density of 8128 gausses per square centimeter should be used. The core is rectangular in form and the windings surround the two vertical legs. It is built up of soft iron strips 0.025 inches thick, and the over-all dimensions are 18½″ by 39″. The two upright parts are composed of strips of different widths, so that the form of cross section is approximately a circle a little over 4 inches in diameter. The actual area of cross section of iron in the core limbs is 78.7 square centimeters, so that the total flux passing through the windings is 640,000 webers. The yoke pieces are built up of strips 4 inches wide, and the area of cross sections at this point is 92.9 sq. cen. At the joints some of the laminations overlap, and the remainder are butted together. The laminations are held in place by means of two pairs of wooden pieces placed on either side of the yokes and drawn up by bolts.

This construction is shown in the accompanying drawing, Fig. 1, and also in the reproduction of a photograph, Fig. 2. The limbs of the core are covered with four thicknesses of heavy duck, and over this is wound one even layer of braided cotton rope about three-sixteenth inch in diameter. This is covered with two more thicknesses of duck, and over this is wound the primary conductor. This winding consists of six No. 4 B. & S. double cotton-covered wires connected in parallel. There are thirteen turns around each limb, making twenty-six turns in the primary coil. The primary wire is covered with two thicknesses of duck.

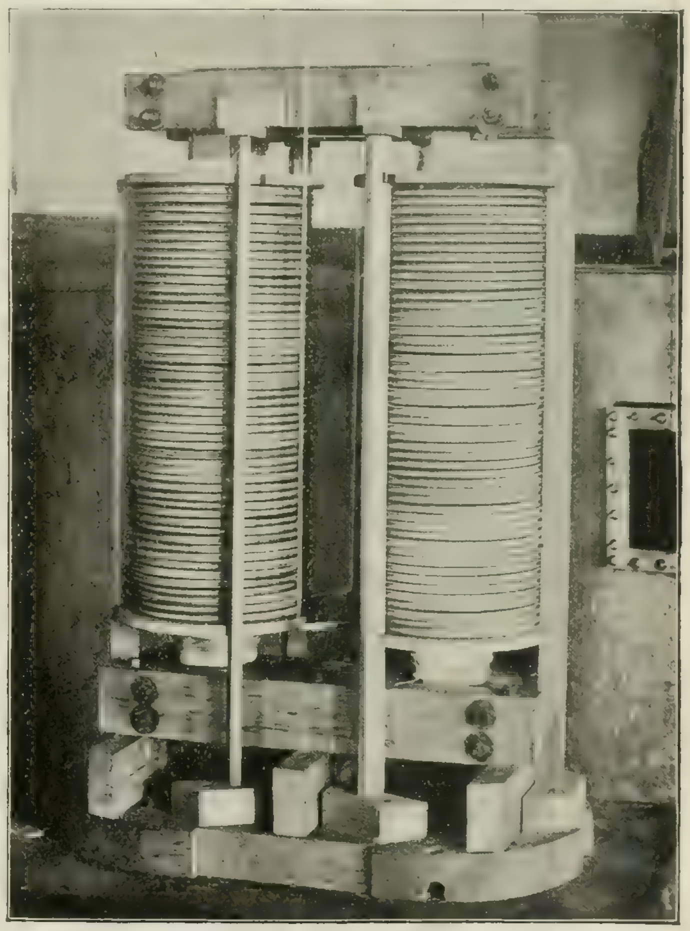

FIG. 2.—VIEW OF TRANSFORMER.

The secondary coil consists of 39,200 turns of No. 30 B. & S. double cotton-covered wire. In order to increase the insulation of the coil it is divided into a hundred sections, fifty of which are placed on each limb. Thus the number of turns in each section is 392, and the potential between any two consecutive sections is 1500 volts. These sections are wound upon wooden rings, as shown in the cut. These rings are turned from well-seasoned soft pine and are 10¾ inches in outside diameter. The wire is placed in a groove ¼″ wide and 1″ deep. The inside diameter is 8¼″, which allows 1½″ of clear oil space between the ring and the primary wire. This forces the spark to traverse 3″ of oil should it break down through the primary winding or the core. The wooden rings are supported by wooden frames, as may be seen in the cuts. Both these frames and the core are fastened firmly to a plank 2⅝″ thick, which serves as a base, and the whole is placed in a galvanized iron tank filled with oil. In two opposite sides of this tank are placed two glass windows, and through these one is able to observe the condition of things within the tank.

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*Written for the "Journal of the Worcester Polytechnic Institute."

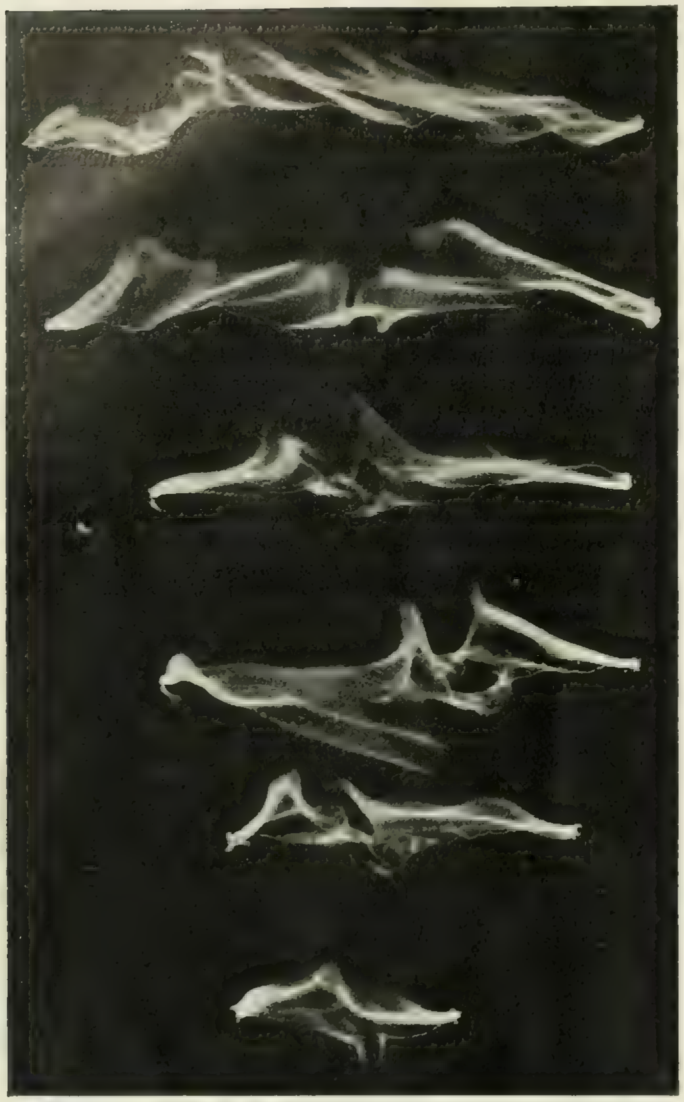

Fig. 3.

The tank contains 110 gallons of kerosene oil, and the top is covered by plates of glass. All connections to the two windings are made through the top of the tank. The primary wires are not insulated, but the secondary terminals are inclosed in glass tubes with glass elbows at the bends. After the terminals of the secondary leave the oil they are kept at least 14" apart, besides being inclosed in glass tubes.

Before the secondary coils were connected permanently in series experiments were made with the sections joined in parallel to determine:—

The no-load current.
The core loss at various voltages.
The ratio of transformation.
The efficiency.
The resistances.
The regulation curve.

The following table shows a comparison of the calculated and observed values:

	Calculated.	Observed.
NO-LOAD CURRENT.		
Pri. voltage, 50,	19.2 Amp.	18.8 Amp.
" " 100,	33.2 "	34.3 "
CORE LOSS.		
Pri. voltage, 50,	815. Watts.	875. Watts.
" " 100,	2,821. "	——— "
Ratio of transformation,	1,508.	1,504.
Drop at full load.	2.1	2.2%
Pri. resistance, 18° C.,	0.0023*	0.003 ohms.
Sec. " 18° C.,	10,029.	9,860 "
EFFICIENCY.		
10 K. W. 75,000 volts,	89.7%	89.3%

The fields of work in which a transformer of this character may be used are many. One of the most important and practical of these is the study of insulating materials with regard to their properties for preventing disruptive discharges. Another subject which has, as yet, received comparatively little attention is the production of ozone. Perhaps the most interesting experiments are those showing various sorts of discharges in air. What is known as a brush discharge may be produced by connecting the secondary terminals to wires inclosed in glass tubes, placed parallel to each other 8 or 10 inches apart. When the voltage is raised to about 80,000 volts, the space between the tubes will be filled with a violet colored flame, and at the same time brilliant sparks will be seen darting in crooked paths between the tubes. Another interesting display may be obtained by placing the two terminals on opposite sides of a glass plate, when, if the distance is not too great, the

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*No allowance was made in the calculations for the resistance of six soldered joints in the primary winding.

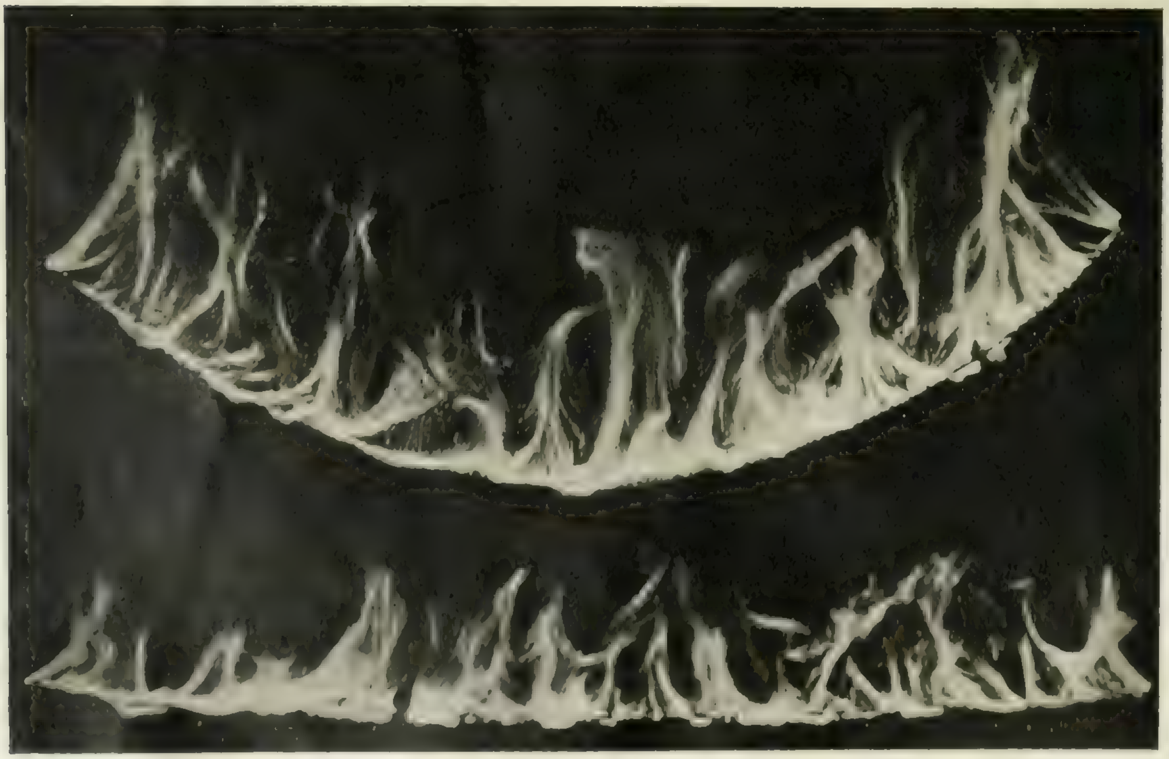

Fig. 4

sparks will pass around the edge of the plate causing brilliant flashes and a peculiar crackling sound. In both of these discharges a large quantity of ozonized air is produced, and the glass soon becomes very warm.

The most interesting form of discharge is produced by forcing the current to jump from one terminal to the other through a clear air space, thus establishing an arc. These discharges are studied best by the aid of a camera, since it can record many of the effects produced which are of such short duration as to be scarcely noticed by observing the discharge with the eye.* The plates show reproductions of a few photographs of this variety of discharge. The group of Fig. 3 shows a series of disruptive discharges between rounded terminals separated various distances. All of these arcs were of very short duration, since as soon as the arc was once formed the current taken by the transformer was so great that the circuit-breaker in the primary circuit was thrown out. The longest of these arcs was 14 inches and the voltage for this discharge was about 190,000 volts maximum. The two reproductions in Fig. 4 show the discharge that takes place when a string slightly moistened with salt water is stretched between the terminals. The first of these discharges was 23 inches long, and the second was 31 inches.

The lower reproduction in Fig. 5 shows a disruptive discharge through air 18 inches long. The potential required to start this arc was about 231,000 volts maximum, and from the readings of the instruments in the power-house it was estimated that the energy absorbed in this discharge was over 50 horse-power. The second reproduction on this plate shows an arc being maintained between two electrodes placed on the same level and over 20 inches apart. This arc was started with a short gap and low potential, and then the arc was drawn out and the voltage at the same time was raised. This illustrates the arched form always taken by the arc under these conditions on account of the ascending currents of heated air.

In Fig. 6 is seen a large triple petticoat potential insulator as it is breaking down under a maximum potential of about 130,000 volts. In this test one wire was connected to the wooden insulator pin, which was moistened, and the other to the top of the insulator. The oother reproduction shows a 13-inch discharge.

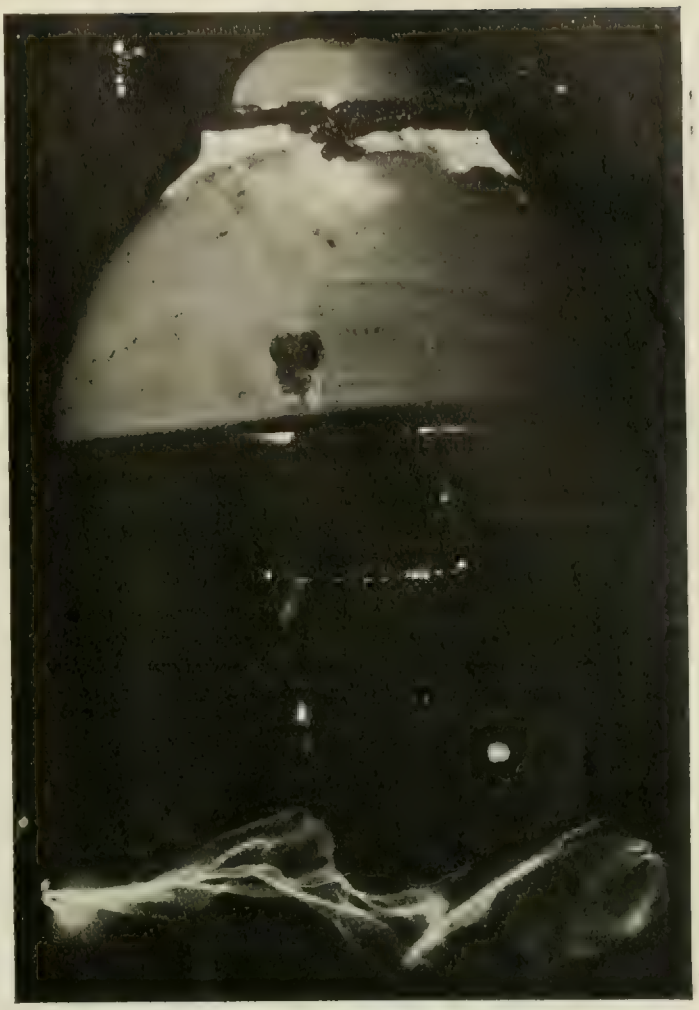
FIG. 6.

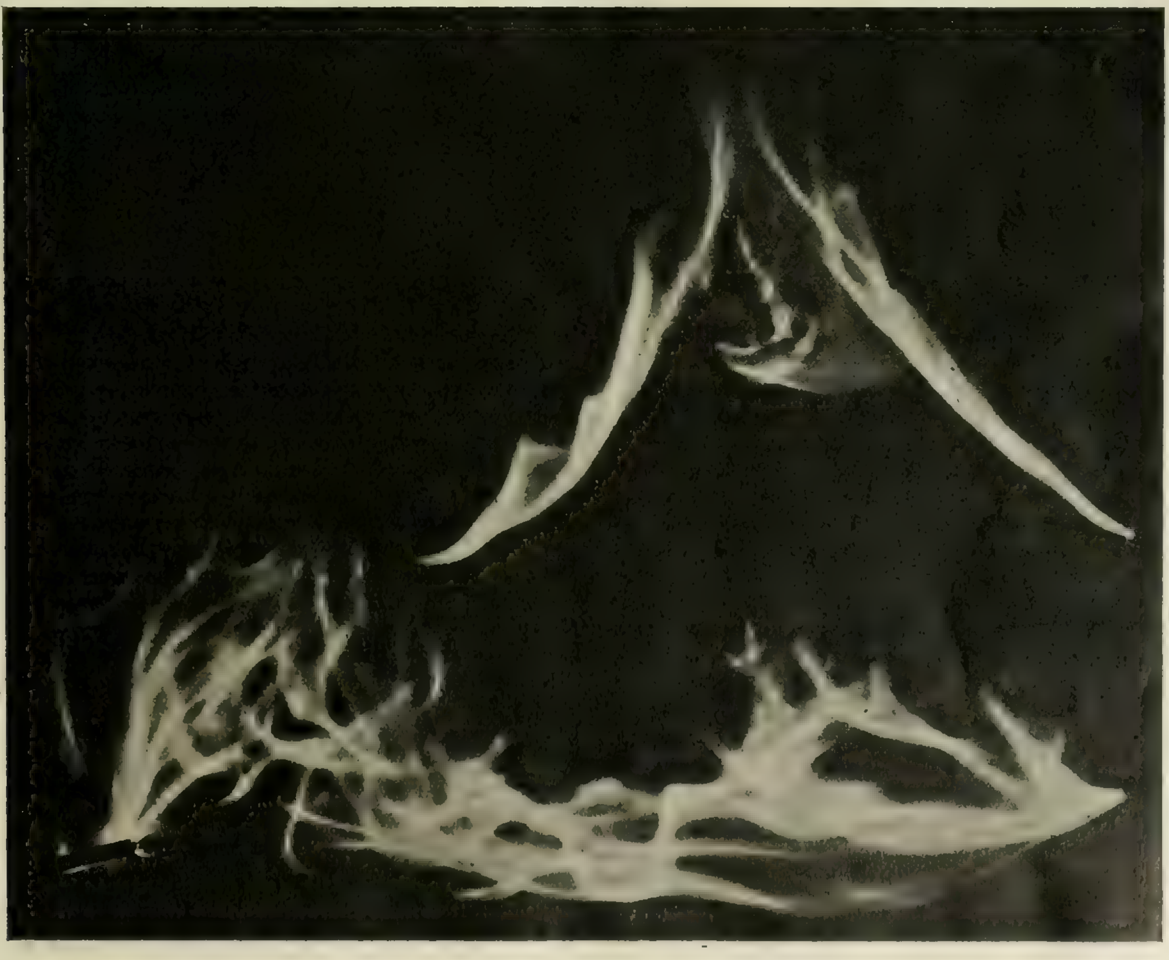
FIG. 5.

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*See article by Steinmetz in THE ELECTRICAL WORLD. Vol. XXXI, page 294.

Freight Traffic on Electric Railways.

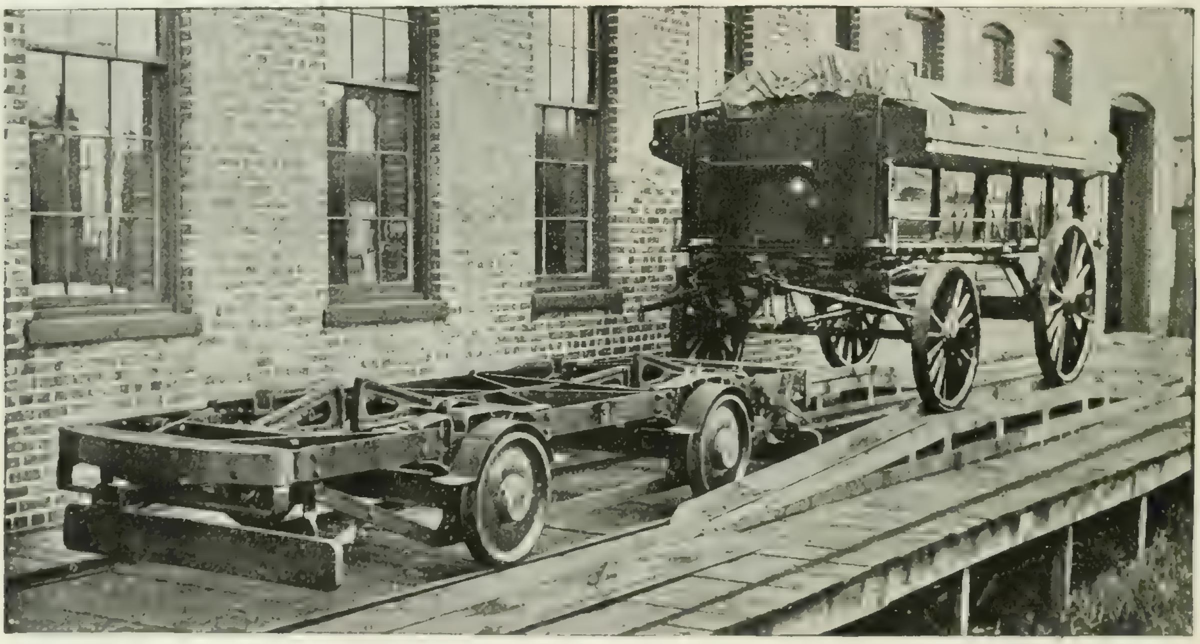
In a paper read before the convention of the Canadian Electrical Association, entitled "The Unconscious Ownership of an Important Key," Mr. W. T. Bonner described a novel method of handling farm produce and other highway freight by suburban and interurban electric roads. It was pointed out that the cost on ordinary highways is enormous compared with that on railways, so that a large amount of land quite near the large centres of population is handicapped in reaching the market in comparison with land situated perhaps thousands of miles away, but requiring a shorter wagon haul. On the other hand, the extensive terminal facilities required with standard railroad system run up the cost of short-haul business on railroads to a high figure per mile compared with the long-haul traffic.

A method of providing freight haulage to districts near the large centres of population at a low cost has been worked out by the Bonner Rail Wagon Company by means of trailer trucks fitted for the ready reception of ordinary wagons. By this means milk, market produce, express, baggage, and, in fact, any traffic that is now hauled at great expense from centres of population to the outlying districts by horses, or, in case this becomes too expensive, is sent by rail, freight or express with the attendant trans-shipment and terminal charges at both ends, may be carried in wagons directly from the place of shipment to destination without trans-shipment and without long and expensive animal haulage. The wagon is not materially different from those of standard construction, but is simply fitted with devices for its ready attachment to the truck over which it rides in loading. The truck is also practically the same as that in general use upon electric railways. The actual time required for [illegible] or [illegible] the wagon from the truck is said to be not more than that required for coupling cars.

It is obvious that this same principle can be made use of without any special devices other than flat cars and platforms by which ordinary wagons may be run on to the cars, to which they can be blocked and chained. The additional freight traffic secured in this way would in many cases increase materially the income of suburban roads with light service with a comparatively small increase in the total expenses.

The Visit of the "Yankee" to New York.

The United States auxiliary cruiser "Yankee," on which there are quite a number of men formerly connected with the electrical industries, arrived in New York on Wednesday morning, July 6, nominally on a trip for stores, provisions, ammunition, coal, etc. Mr. S. Dana Greene, of the General Electric Company, is the most prominent of those on board engaged in electrical engineering pursuits in times of peace, among whom are several of the officers and technical employees of the New York Edison Illuminating Company and others engaged in engineering work in New York City, all of whom joined the Naval Reserves and were called out on the "Yankee" when this ship, formerly the "El Nord" of the Morgan line, was converted into a cruiser. The electric light plant of the cruiser should certainly be well managed, as it has been placed in the hands of Mr. H. K. Coolidge, formerly of the New York Edison Company, who is assisted in handling the engine and dynamo by Mr. Thomas B. Cummings, formerly with Henry R. Worthington; Mr. John Gray, formerly consulting engineer of the Tidewater Oil Company, and Mr. John Gilmour, formerly with the Hall Signal Company. Among the others on board are Messrs. Kellogg, Stebbins and De Kay, of the New York Edison Company, who are now gunners' mates, besides many other gentlemanly fellows who are serving in similar capacities or as seamen, performing rather menial duties for men of their calibre, but taking pleasure in them for love of their country. The "Yankee" is fitted with ten 5-inch rapid-fire, ten six-pounders and two Colt automatic guns. She has not been backward in the war, her commander being ambitious to see plenty of fighting, and the experiences she has been through have not been tame at any time. The ship joined Admiral Sampson's fleet June 3, the same day the "Merrimac" was sunk in the mouth of Santiago harbor. June 5 with several other cruisers she engaged the Spanish fortifications, firing 120 shots from her 5-inch guns, as well as a great many from her six pounders. Later, she protected the "St. Louis" during the cable cutting at Guantanamo, and between that time and her return to New York she has had several brushes with the enemy. According to the present plans of the Government the "Yankee" will be sent with Admiral Watson's fleet to the coast of Spain.



Truck and Wagon for Freight Carriage on Electric Railways.

A Conductor Having No Resistance.

It appears that in Professor Dewar's recent experiments with the liquefaction of hydrogen, the platinum resistance thermometer which he used was cooled to within 6 "platinum" degrees of its zero point, and that if it had been cooled those few degrees more, which it is likely could have been done by boiling the hydrogen under reduced pressure, the platinum would have become a conductor of zero resistance. The question naturally arises what would be the conditions if the temperature is lowered still more?

Telephone Charges and Costs in Italy.

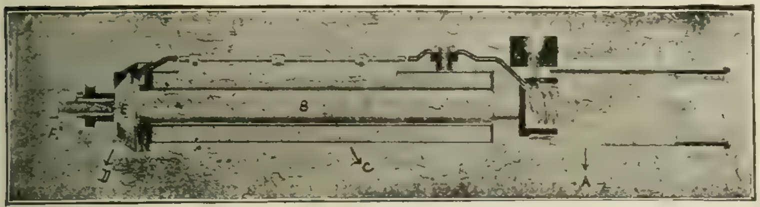
In an article in the London "Electrician" on "The Telephone in Italy," the tariff in Florence, where there are 900 subscribers, is given as the equivalent of $30 per annum within 1000 yards of the exchange, running up by steps as the distance increases. An interesting fact is that the switchboard operators receive a salary (?) of from $6 to $12 per month, working seven to eight hours per day. Linemen receive from 40 to 50 cents per day for ten hours' work, extra time being paid for at the rate of 4 cents per hour.

The Evolution of the Line Signal.*

BY ARTHUR VAUGHN ABBOTT.

Many forms of luminous signals have been suggested, but the only one in successful operation at present is the miniature incandescent lamp, which has, on the whole, proven itself of the greatest value. So far as the writer can ascertain, the idea of employing incandescent lamps for signal purposes arose with Mr. J. J. O'Connell, of the Chicago Telephone Company, who suggested in 1888 the employment of an incandescent lamp upon burglar alarm circuits in order to permit the legitimate occupant of a protected room to send to the alarm office an identification signal whereby his entrance to the premises could be made known.

In the latter part of the summer of 1890 some of the trunk lines in use in Chicago were provided with disconnect signals using miniature incandescent lamps. At the receiving office the trunk lines terminated in the ordinary cords and plugs used upon a telephone switchboard, in front of each of which an incandescent lamp was located. So long as the line was in use a relay in conjunction therewith was excited by battery current flowing over the line, and its armature drawn up. As soon as conversation was completed the operator at the originating office withdrew the plug from the trunk line jack at that office, thus opening the battery circuit and causing the relay to be de-energized; the release of the relay armature completed a local battery circuit, illuminating the incandescent lamp. The operator at the receiving office noticing the illumination of the lamp was thereby informed that conversation was completed and instructed to remove the trunk-line plug.



Section of Combined Relay and Lamp.

Combined Relay and Lamp.

As the local lamp circuit was carried through the operator's listening key the placing of this key in the testing position extinguished the lamp. A very short experience served to demonstrate the superiority of incandescent lamps over any other form of signal, for the illuminated lamp was at once so positive and distinct as to instantly attract the attention of the operator, thus markedly accelerating switchboard work. As a result of this experience most of the trunk lines in the main office of the Chicago Telephone Company were rapidly supplied with lamp signals.

In the spring of 1893 it was proposed to re-equip a large multiple board in the Chicago exchange with self-restoring drops, but the expense and difficulty of this change caused the management to hesitate, and at this time the writer suggested the employment of incandescent lamps as subscribers' line signals on the ground of greater economy in space and in installation, as well as improved signal efficiency. More conservative telephonists doubted the wisdom of such a recommendation, fearing that the numerous relay contacts would be a perpetual source of trouble, and no further steps were taken with this project. In the winter of 1894 a new type of switchboard known as the "express board" was introduced. As this board was designed to meet the wants of metallic circuit subscribers, particularly those whose telephonic business was large, it was decided to provide incandescent lamp line signals. The circuit of this board was so arranged that, on the removal of the subscriber's receiver from its suspending hook, the movement of the hook closed the circuit and allowed battery current to flow through the line. This current actuated a relay at the exchange, in the local of which the signal was placed, situated behind a ground glass shade upon which the number of the subscriber was painted. The illumination of this disc displayed a very distinct and conspicuous signal that immediately attracted the operator's attention. Notwithstanding some apprehension as to the possibility of trouble with relay contacts the service given by the lamp signal was, on the whole, so satisfactory as immediately to concentrate telephonic atention upon the use of lamps, and within the four years that have since elapsed the superiority of the incandescent lamp for this purpose has been so fully demonstrated that nearly all of the large switchboards which are at present being constructed are completely supplied with signals of this description.

As the service to which the incandescent lamp when used as a signal is subjected is peculiar, the employment of lamps upon telephone switchboards has afforded lamp manufacturers a new problem. In the early experiments ordinary miniature lamps of low voltage were employed. As these lamps were bulky and consumed a large amount of current, the first attempts at improvement were directed to obtaining a smaller and more economical lamp. The early lamps were designed entirely to fit a socket supplied with a screw thread, and the conductor was supplied with a spiral spring, the pressure of which it was expected would lock the lamp in its place and constantly maintain good electrical contact. This expectation was not fulfilled, for one of the greatest troubles encountered has been the loosening of the lamp in its socket, due to the almost inappreciable jarring to which all buildings are subjected. Lamps in sockets of this description will gradually unscrew, opening the electrical circuit; they are then incapacitated as signals and considerable complaint will arise. The present lamp occupies no greater volume than that required by a spring jack and may be inserted into sockets composed of pairs of springs arranged on a rubber strip. Such sockets so closely resemble standard spring jacks that they are called "lamp jacks," for they occupy the same space, and may be secured in the switchboard in the same manner. By placing alternate strips of lamp sockets and jacks, the subscriber's line signal and answering jack may be more closely associated than has previously been possible, space economized in the switchboard and service accelerated.

At first it was considered desirable by lamp manufacturers to preserve a large volume in the bulb of the lamp in order to secure an adequate vacuum. To attain the desired compactness, the bulbs of the lamps are made small and long. The bulb is a glass tube about one-quarter inch in diameter and 1⅛ inches long. For four volt lamps a straight filament is used, but for all others a horseshoe shape. Only sufficient platinum is employed in the leading-in wire to pass through the glass, and in other respects the general details of manufacture correspond closely to the best practice in standard lamp construction. The base of the lamp is a bit of boxwood, so shaped as to readily enter the springs forming the socket, and arranged to prevent the lamp from turning as it is pushed into place. The earliest lamps were all designed for low-voltage circuits, rarely more than four volts. Presently it became apparent that lamps of longer life, together with an economy in conducting circuits, could easily be attained by the use of higher voltages, and the next advance was secured by making lamps for ten and twenty volts, while at present twelve and twenty-four-volt lamps are standard.

When first used as signals, the lamps were placed in the local of a relay actuated by current passing over the line to which the signal was attached. In the early attempts the ordinary telegraph relay was employed, armed with extra heavy platinum contacts to prevent burning. It seemed possible to obviate the expense of installing and maintaining this relay by an appropriate lamp directly in series with the subscriber's line, so placed that the removal of the telephone from its hook should close the circuit and light the lamp. This experiment was first tried in the Chicago express office and, on the whole, worked passably well, there being a comparatively small mortality of lamps due to short-circuits and other accidents. A continuation of this experiment was attempted in another office, but resulted disastrously, as the lamps were burned out so rapidly as to cause an excessive maintenance expense. The occasion of this failure is to be ascribed to a preponderance of aerial lines in the last case. A wind cross occurring near the office on a long line would subject the lamp to an abnormal voltage and either injure or immediately destroy it. In an express office, where the lines were chiefly underground, little or no trouble was experienced from this cause, and in an office in St. Louis, similarly equipped with lamp line signals placed directly in the subscriber's line, the use of a very heavy filament lamp obviated the difficulty experienced with injury to lamps. But while economy in installation due to the omission of the relay is eminently desirable, present experience decidedly indicates that the relay is essential to the successful lamp signal.

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*A paper presented at the General Meeting of the American Institute of Electrical Engineers, Omaha, June, 1898. Abstracted.

For this purpose rather an interesting type has been evolved in an attempt to consolidate the relay, lamp and socket into a single piece of apparatus and at once obtain a device which should be absolutely dust-proof and free from trunnion trouble. A general view and a section of this relay, which was developed largely with the assistance of Mr. M. A. Edson, of the Chicago Telephone Company, are shown herewith.

From the latter illustration it will be seen that the front end of the "lamp relay," as it is termed, consists of a brass tube *A*, forming the lamp socket, carrying the screw at the bottom, supplied with round glass cap, carrying the subscriber's number. From the rear of the socket extends a core *B*, of soft iron surrounded by an iron tube *C*, between which the winding space is obtained. A hemispherical brass cap *D* covers the end of the iron tube, retained in its place by an appropriate set screw. The inside of this cap is hollowed out, containing a piece of soft iron *E*, in the form of a frustrum of a cone, that constitutes the armature. As this piece of apparatus is set horizontally the armature rests upon its edge in an unstable position, tending to settle backward and rest against the back of the cap. The excitation of the windings magnetizes the core, and, attracting the armature, draws it up sharply. A thin platinum spring placed on the front face of the armature serves to make contact with a corresponding platinum point set in the centre of the core. As the core is insulated from everything but one lamp wire, while the other is connected to the cap, the excitation of the relay lights the lamp. By this device a relay was obtained, the moving parts of which were completely dust-proof. All trunnions or hinges were obviated and the armature merely resting upon a sharp edge secures a minimum amount of friction. Notwithstanding the compactness and completeness of this piece of apparatus, it has been found desirable to disassociate the relays and lamps, placing the relays in a case by themselves, away from the switchboard.

Probably the most gratifying feature in the evolution of the line signal has been the improvement in the life of miniature lamps. When the luminous signal was first proposed the question of cost of lamp renewals was at once raised. As each lamp was only illuminated for a few seconds at a time the service seemed equivalent to constant flashing, and ominous prophecies were plenty as to the short life to be expected. It was confidently asserted that such small lamps would either immediately burn out, or else so rapidly become dim as to be valueless as signals. Some tests were immediately instituted in the hope of eliciting information on these points. There was no question but that the candle power of the lamps gradually declined, and photometric measurements showed that when a lamp failed to emit at least 0.5 candle power it became of no value as a signal.

To determine the resistance to flashing, a number of lamps were connected in circuit with a clock pendulum and flashed at intervals one second for nearly a month, with no signs of serious injury. During this test the lamps were illuminated more than a million times, so it seemed certain that a reasonably long life could be expected. Experience has since shown this conclusion to be justified, for in the main office switchboard in Chicago, there are now lamps at work that have been in service for upward of three years and seem still to be in fairly good condition. Observation has further shown that accidental injuries, rather than old age, are the cause of most lamp failures.

Much delay was experienced in obtaining the first lot of switchboard lamps, so on reception they were immediately placed in service without inspection. The rapid failure of a large number of these caused no small degree of consternation and it was determined to initiate a systematic inspection. As a result all lamps are now examined: 1.—Mechanically, to see if they will fit the sockets. 2.—Electrically, to determine if they have the proper voltage and consume current within the specified limits. 3.—Optically, to ascertain if they emit the required candle power and absorb the proper watts per candle. Also a certain number of lamps from each lot are placed on life test and burned to destruction.

The total cost of a luminous signal is evidently the cost of the lamp, plus the cost of current consumed during its life, and it is easy to show that this is a minimum when the cost of the energy consumed is equal to the cost of the lamp. Switchboard lamps now cost in the neighborhood of 45 cents each. With a life of, say, 2000 hours the cost of energy is about 60 cents, but it has been shown that accidental causes tend to reduce the actual life in the switchboard far below that shown by laboratory tests and it is doubtful if the average lamp lives for 1200 hours. Unless accidental destruction can be greatly reduced below the present amount, the cost of the lamp is now considerably above the cost of energy during its life and a still lower efficiency could profitably be employed, for it must be remembered that the thick heavy filament in the low-efficiency lamps is the best insurance against accidental injury. Theoretically, subscribers' line lamps should last twenty-five years; cord supervisory lamps from one to two years; trunk line lamps the same length of time, and pilot lamps from three to six months. Such a life as this has been obtained in the cord and pilot lamps, but it is doubtful if the theoretical limit for the line lamps will ever be closely approximated.

Even in the present probably only partially developed state of the luminous signal some 20,000 subscribers are now served upon boards thus equipped, and switchboards for as many more are in process of construction. Already the adoption of this form of signal has materially modified the arrangement and design of switchboard apparatus, and has been so efficient a factor in the improvement of telephonic service that it is difficult to prophesy the end of its effect.

Synchronizing Apparatus.

In an article on switchboard apparatus in "The Mechanical Engineer" (Manchester, England), Mr. J. R. Blaikie makes the following comments on synchronizing apparatus which may be of interest to electrical engineers in this country:

In alternating current stations this apparatus is of the first importance, and should be the object of the designer's special care and foresight. The possibility of a mistake on the part of the operator should be thoroughly investigated. The risk of breakdown in any part of the apparatus having been reduced to a minimum, provision should be made for replacing any defective detail within a minute or two, with no possible chance of reversing a connection, or there should be a simple method of throwing a spare set into circuit. There have been three or more methods suggested for synchronizing. First, two lamps, or one lamp and a voltmeter, in series, off the secondaries of two transformers in series, the primaries being one on each of the pair of leads required to be synchronized. Second, a similar arrangement, having a telephone or buzzer to indicate the flow of current through the secondaries. Third, gold-leaf electroscope, which can be used direct on 2000-volt mains. The first method is almost always employed, and it has the advantage of being easily seen by the driver, enabling him to adjust the speed of his engine. This information can also be obtained by lighting the station with alternating current arc lamps. When the armature is at the correct speed, the coil holders appear to be stationary, or revolve very slowly backward and forward as the speed is too high or too low. It might be almost worth while to switch on a lamp in broad daylight, when synchronizing, for this purpose. Where alternate current arc lighting is adopted a gold-leaf synchronizer could be used. It is more secure from breakdown for having no transformer. It is very dead-beat, but at present it has not been developed as a switchboard instrument, and requires modification to preserve the extremely high insulation necessary. While on the subject of synchronizing, it is instructive to notice that in English stations an artificial load on the incoming machine is considered unnecessary, although usually employed on the Continent.

In one English station it has been found advantageous to parallel machines through an impedance coil, and then short circuit the coil in two steps. As an extra precaution the paralleling of all machines up to 400 kw capacity is done through a 20 ampere fuse, and this fuse is not blown more than once a month. It may be mentioned that the armatures are of the coreless type.

Reduction to Practice.

It is always pleasant to hear a kind word from our English cousins. In referring to a certain work which is being done in this country in developing wireless telegraphy, a prominent English electrical journal says: "But to us the interest is more in the fact that America is taking up the subject, and will probably push it with characteristic energy to some practical purpose."

Underground Conductors.*

BY PROF. F. A. C. PERRINE.

The economical limit in the burying of wires is to be found in towns of such size that the number of wires for transmission purposes, installed in the streets, is not so great as to produce serious mutual interference, or interference with firemen or others whose work causes them to need a clear space above the street level. Simply the beautifying of a town will rarely compensate for the extra cost and difficulties encountered in underground construction, since the sight of the overhead wires does not become unbearable, until, at the same time, they are so numerous as to mutually interfere with each other.

Three general systems have been used for the installation of underground wires. The first and simplest is the "solid" or "built-in" system, where the wires, which are insulated thoroughly and thoroughly protected from mechanical disturbances, are buried in the ground. Secondly, we have the "draw-in and draw-out" systems. In these systems a passageway is provided underground for insulated cables, the passageways being simply tubular holes terminated at convenient distances by large underground working boxes or manholes—all connections of the cables being effected in the manholes, the cables themselves being drawn from manhole to manhole through the ducts, in which the cables loosely lie and from which they may be readily removed for repairs. The third, or "trench," system is an attempt to use the overhead construction in small closed trenches below the street level; the wires, which may be either bare or insulated, being supported on special forms of pins and insulators, thus reproducing underground the common form of overhead construction.

The simplest of the "built-in" systems are those in which each wire or cable is separately insulated and mechanically protected by some metallic covering in such a manner that it need not be feared that street disturbance will destroy the insulation. Across private grounds, where the cables may be laid and their location always indicated to workmen, this form of construction can be accomplished by the use of lead incasing pipes, provided only the lead be protected from the action of organic acids in the soil by means of a heavy coating of asphaltum held in place by a thick wrapping or braiding, but in public roads and through city streets such a method of wire installation would not be permissible, since the lead coating is not mechanically strong enough to resist even a slight amount of mechanical injury, and where independently protected cables are to be buried directly in the ground a heavier iron sheeting is then necessary.

This form of protection is accomplished in the Edison system by the use of iron pipes, and in the Siemens-Halske system by a double wrapping of iron tape. The Edison system of "built-in" conduits is especially adaptable to an extensive house-to-house distribution, on account of the fact that the lines are constructed in such short lengths as cast or wrought iron pipes may be made—namely, lengths not exceeding 25 feet. The form of conductor, insulation and protection here used is perhaps the cheapest that can be accomplished in any method, but as frequent joints must be made in the conductors and pipes, the final cost of the system is not low, unless from each joint there is a necessity for carrying away service wires, which is the condition encountered in a house-to-house distribution. The conductors used in this system are solid copper rods, either circular or semicircular in section, the circular conductors being used almost exclusively for the common three-wire Edison distribution systems. These copper rods are loosely wound with jute rope and slipped dry into the iron pipes, which are then filled with a hot compound of petroleum residuum and asphaltum, the filling being accomplished at a temperature sufficient to drive away most of the moisture contained in the jute rope, which finally becomes well saturated with the compound. These lengths of pipe are connected together with spheroidal junction boxes, made in two halves, allowing sufficient room for connections between the conductors, and provided with outlets, where it is contemplated to connect service wires. At important junction points large cast iron junction boxes are used, which permit the interconnection of the different circuits and admit of the introduction of fuses, which protect the main circuit from accidents occurring to sections of the service wires, and furthermore provide ready means for testing and fault location. This method was one of the very first practical systems of underground construction, and has given great satisfaction where the potentials are not higher than those commonly used on Edison three-wire circuits, although it is doubtful whether these cables would be satisfactory for higher potentials, since the method of filling the pipes does not admit of a thorough removal of moisture from the jute wrapping, and also it has been found impossible to thoroughly protect the ends of the pipes by any economical method, so that a small amount of water will penetrate the insulating material if any construction work is done during bad weather.

For trunk mains and long feeders the Siemens-Halske system of iron-taped cables is more satisfactory, as these cables can be made in continuous lengths of 500 or 600 feet, although lengths as great as these are exceedingly difficult to handle, on account of their weight. In this system, as the iron taping is not entirely impervious to moisture, the insulated cables are lead-cased, the iron taping being applied over a bedding of jute, and further protected exteriorly by a wrapping thoroughly saturated with an asphaltum compound similar to that employed for the protection of submarine cables.

At various times other solid systems have been contemplated; underground cables being sometimes laid in wood trenches, which are subsequently filled with melted asphaltum. A few attempts have also been made at installing copper rods or pipes, insulated entirely by means of the asphaltum with which the trenches were filled, but it is found in practice that asphaltum does not resist the penetration of moisture, especially as this material has a high coefficiency of expansion with temperature, and in consequence during cold weather cracks occur, while in warm weather the material is not sufficiently strong to maintain the conductors in their proper relative position, unless they are supported in the trenches on wood balks. These balks cannot be so thoroughly saturated with any compound that they will not subsequently absorb moisture and short-circuit the system. At one time the Calender Insulated Wire Company installed a large amount of cable, insulated with a compound of rubber and asphaltum which was partially vulcanized, the cables being supported on wood balks and the trenches filled with asphaltum; but even here the conductors sank into contact with the balks and short-circuiting ultimately took place. These difficulties might be overcome by installing rubber-covered cables suspended by a jute wrapping from iron wires parallel to them and carried on insulating balks, and if the trench in which these cables were carried should be filled with asphaltum the construction would doubtless give great permanence, but the supreme difficulty with any such system is encountered when repairs or extensions are contemplated, since no cable of the system can be removed without disturbing all the cables in the trench, and in spite of the fact that such a built-in system is without doubt more economical to install than any other, this disadvantage has prevented the possibility of an entire solution of the insulation difficulties in solid systems being attempted.

Intermediate between the draw-in and draw-out systems lies a method of construction designed by David Brooks, which has been employed to a greater or less extent since its first conception, in about 1881. Brooks desired to employ oil as an insulation for cables, as he had found that wires insulated with rosin oil were exceedingly difficult to short circuit, even under the influences of high values of potential; but, of course, no pure oil could be used in the construction of a cable, even were it lead-incased, for opening the lead casing while joining would allow the escape of the oil. The method which he proposed, therefore, consisted of laying an iron pipe line over the whole distance to be traversed, in which the pipes were terminated by hermetically sealed boxes—the cables to be drawn into these pipes being lightly wrapped with jute, and, after being boiled in oil, were drawn into the iron ducts, which then remained full of oil. In order that leaks in the pipe should not admit small amounts of moisture where the pipe was laid through damp ground, Brooks proposed having the oil in the pipes under pressure from a standpipe or pump, the theory being that small leaks would allow the oil to escape and on account of the pressure behind the oil no water would enter. However, this principle was not found to be operative on account of the fact that exceedingly heavy oils were necessarily employed for obtaining the best values of insulation, and in these oils the pressure from the standpipe or pump could not be transmitted over a considerable distance when there was movement of the oil column, on account of the friction between it and the pipes with their inclosed cables.

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*Abstracted from article in "Electrical Engineering," July, 1898.

In this country there are not at present any examples of the Brooks method of construction, although at one time extensive experiments were made by the Western Union Telegraph Company and the Pennsylvania Railroad Company between Jersey City and Newark, across the marshes. But in England the system has been developed by Messrs. Johnson & Phillips, who have succeeded in obtaining a highly satisfactory system by abandoning the principle of oil under pressure and paying great attention to the details of the laying of pipes without leaks and hermetically sealing all junction boxes and pipe ends. For certain classes of work, as for electrical lines traversing private grounds, and for long trunk cables, where there is not much probability of cables ever being disturbed after they are laid, this system presents many advantages, although when the construction is satisfactorily done the cost is not materially less than with other plans which might easily be adopted in its place, but where the cables must be disturbed either for repairs, extensions or subsidiary connections this system meets with many disadvantages. In the first place, handling the cables, which have been saturated with a heavy oil, such as rosin oil, is extremely objectionable to the workmen, who are thus not able to take the same pains with their work as would be possible when working with comparatively clean hands; and furthermore, where a little oil has leaked out of the pipe after it is cut for introducing a new junction box, it is exceedingly difficult to fill the pipe again without removing the entire length of cable and refilling just as if new cable were being installed. These disadvantages, increasing the cost for repairs, cause the system to be uneconomical in operation, and to sacrifice whatever advantages of cheapness it may have in the original installation.

The largest installations of insulating ducts have been constructed on the systems of Dorset and of the Interior Conduit Company. Dorset's plan never contemplated the installation of cables entirely without insulation, although at the time it was first used it was hoped that the character of the duct system would materially reduce the cost of covering the cables themselves. This conduit consisted of blocks of asphaltic concrete moulded in lengths of about 4 feet, the cross section being 1 foot square, each block pierced from end to end by a series of duct holes 2½ inches in diameter, formed by mandrels, around which the blocks of asphalt were cast. These lines of conduit were laid with abutting ends, and, after being held in alignment by mandrels in the duct holes, were cemented together by hot pitch poured between the sections of conduit. This is a system of construction which, largely used in New York and Minneapolis, proved to be a complete failure on account of the fact that it was impossible to be sure that the pitch between the sections of conduit effected a thorough cementing, and in consequence, after construction, the blocks were found to have cracked apart and fallen out of alignment, thus not only sacrificing all the insulating properties of the conduit, but reducing the size of the ducts, on account of the holes in the different sections not being strictly in the same straight line.

General Weber, of the British Postal Telegraph, has modified this system until he has been able to construct a satisfactory cable-carrying conduit with its use, although he has never been able to render the conduit entirely impervious to moisture, and in consequence where it is used by him it has been employed without much reference to its insulating properties. Weber's modification of the Dorset system consists in laying the sections of moulded conduit with a space of 4 or 5 inches between them, into which melted material of the same constituents as that of the original conduit is poured. This melts back the moulded portions for a short distance, and produces a conduit entirely homogeneous and satisfactory as a cable-carrying conduit, [illegible] for the employment of uninsulated wires.

The system attempted by the Interior Conduit Company was installed [illegible] at Minneapolis and consisted of paper tubes thoroughly impregnated with petroleum residuum laid in a trench with paper sleeves at their joints, the whole trench being filled with asphaltic concrete composed of residuum, asphaltum and sand poured hot into the trenches and entirely covering the paper ducts. Into these paper ducts a bare copper wire was drawn, small manholes being provided at the feeding points, which consisted of double wooden boxes, sealed in compound poured between them and covered with water-tight covers. After a couple of years of fairly satisfactory work it was found necessary to abandon this construction, although it is probable that the failure was largely due to the original use of [illegible] unsatisfactory material. The paper ducts themselves were not thoroughly impervious to moisture, and being supported on wood balks to prevent their sinking through the compound with which the trench was filled, these wooden balks became saturated with moisture and short circuited the cables through the paper of the conduit tubes. Furthermore, the manhole construction was not thoroughly water-tight, and in many instances the whole duct system was found to be filled with water after heavy storms. Profiting by the experience gained in this construction, the Interior Conduit Company has proposed a similar system with a number of paper tubes, telescoped one within the other, and designed to be laid with broken joints, the exterior surface of the tubes being protected either by an iron pipe or laid as before, in asphaltic concrete, and supported on blocks made of pottery, thoroughly water-tight iron manholes being designed in place of the double wooden boxes.

The latest system of insulated ducts is that of Cummings, in which large iron pipes are employed for inclosing a number of ducts, four wooden ducts being inclosed in each pipe, the space between being filled in with an asphaltic compound. This system has found a limited use for low-pressure construction, where but a small number of cables are to be installed, and will not probably find wider application, on account of the fact that it is doubtful whether such construction is less expensive than a multiple duct system, where many cables are used and connections or repairs are frequent.

In consequence of the ease with which repairs may be effected in the "draw-in and draw-out" systems, these have come to be considered as the standard method of installation for underground lines throughout the United States. When first contemplated it was thought that the cost of the total system might be decreased by providing an insulating conduit, into which conductors lightly insulated might be drawn, or even in special cases uninsulated wires might be laid; but all attempts at such construction have resulted in failure, since, as has been said, it was found impossible to construct a conduit that would afford of itself insulation sufficiently high in value when laid under the conditions in which street work must be accomplished. Even where a good insulating material has been used for the ducts, the relative differences of temperature between the external atmosphere and that of the ducts has caused heavy condensation of moisture within the ducts themselves; and furthermore, it has been found generally impossible so thoroughly to seal the manholes as to entirely prevent the entrance of storm water. In addition no insulating duct has yet been found which can be constructed with sections of great length, and the difficulties of laying the ducts in short lengths with perfect alignment have not been overcome. In consequence, engineers have decided that an underground duct system can only be called upon to fulfill the following requirements:

First, the ducts should be internally smooth and free from projections, so that the lengths of cable may be easily introduced and at any time withdrawn.

Second, the ducts should be reasonably water and gas tight, even though no attempt at effecting an absolutely hermetically sealed duct has ever been successful.

Third, the duct construction must be sufficiently strong to withstand both the surface street traffic and accidental interference when other street work is in progress.

These conditions have been filled by ducts made of wood, iron, terra cotta and cement, a choice of the particular duct to be used depending upon the weight of the street traffic, the chances of interference from other workmen, and finally the cost per cable in the different localities. The materials used for these ducts might be divided into insulating, semi-insulating and metallic; but, as the insulating properties of ducts are not now considered of importance, such subdivision would have no significant character. For wooden ducts use has been made of planks, with semicircular grooves, so laid together that two planks make a conduit; or they have been constructed of independent pump logs, and where care is taken in thoroughly seasoning the lumber and subsequently impregnating it with an antiseptic compound, this construction is satisfactory, especially since no duct material offers less resistance to the drawing in and drawing out of the cables, and in no other form of construction can so great length of heavy cable be used. As a consequence many miles of properly prepared wood ducts are in use, giving satisfaction; but when the removal of the sap from the wood and its subsequent impregnation with a preservative compound is done imperfectly, the natural wood acids and the acids which form as the wood decays are found to be very injurious to the rubber of insulation if rubber covered wires are used or to the lead covering when lead-incased cables are employed. Indeed, in this form of duct, lead-incased cables are destroyed very rapidly, the lead being transformed, by the acetic acid from the wood and the carbonic acid which is always present in the air of a city, into lead carbonate or white lead. It was at one time thought that this action was due to the creosote commonly employed in wood preservation, but careful experiments have proved that where the wood was thoroughly dry and freed from every acid, and where the impregnation was honestly done with "dead oil" or creosote obtained from coal tar, and not with wood-tar creosote, no such action took place, and in them the cables have as long a life as in any other form of duct.

The strongest of all conduit systems is the one which is most commonly used in larger cities, where the surface traffic is heavy and street disturbance frequent. This consists of wrought iron pipes laid on a bed of concrete. The common form of 2-inch steam pipe is most commonly employed, connected by ferules with a taper thread, according to the ordinary methods of steamfitters. These pipes are laid in horizontal rows on a 4-inch bedding of cement, about 1½ inches apart, and as many tiers of pipe rows as is necessary for the duct system, laid one above the other, the concrete being well pounded in between the ducts. Over the top of the final row of pipes a 4-inch layer of concrete is laid, and the whole finally protected by a planking. This form of construction leaves nothing to be desired as regards durability, although it is necessary that great care be taken in the inspection of the pipes, that no internal burs remain from the welded seam or from cutting and laying the pipes. In cutting, the greatest care must be taken that a flange is not turned up on the end, since any internal bur would be likely to injure the insulation of the cables as they are drawn in; and, furthermore, the flange left by the pipecutter is apt to diminish the area of the duct.

This system is one which is exceedingly expensive, and in consequence various attempts have been made to produce a concrete duct without the use of iron pipe, since if a strong concrete be employed the iron pipe can be regarded simply as a former for obtaining a truly cylindrical hole. Zinc tubes were first proposed for effecting this, but it was found that in handling the zinc was apt to become dented and reduce the area of the tube. The Chenoweth system contemplates the formation of a cement tube by ramming the concrete around a mandrel wrapped with a metallic tape, which may be subsequently withdrawn by first slipping out the tapered mandrel and then withdrawing the spiral of tape; but no great success has been obtained by this system, since if the ducts be made thoroughly smooth the expense of construction is not materially less than where iron pipes are employed.

Cement-lined iron pipe, however, has been found to surmount all these difficulties.

Cement-lined iron pipe consists of sections of thin wrought iron pipe 8 feet long, with a riveted seam, lined with five-eighths inch of pure Rosendale cement, without sand, moulded within the iron pipe by placing in it a brass pipe the size of the desired duct, and pouring the cement into the surrounding annular space, the brass pipe being readily withdrawn after the cement has slightly hardened. The sections of this duct are connected by moulding in the cement an external and internal joint of spherical form, so that a considerable amount of change in direction between two sections is permitted without throwing the ducts out of alignment—the external and internal joints fitting each other on the ball-and-socket principle. This form of conduit is laid in a bed of concrete, exactly as has been described for the iron ducts, the construction being designed to take the place of the iron ducts, with the advantage that the construction is cheaper and the ducts are internally smoother, so that a greater length of cable may be drawn into the ducts at one time without an unnecessarily heavy tension being applied to the cable ends. It is also claimed for this conduit that the cement can have no effect upon the insulation or the lead of cables drawn in, but use has not indicated that the system has any advantage in these respects over an iron pipe, since whatever effect of corrosion may take place on the insulation or the lead of the cable covering is due rather to corrosive principles present in the water, which may filter in or condense within the ducts themselves, and protection from this effect is now so well understood that such corrosion is not to be feared in any satisfactory system of duct construction.

The telephone companies throughout the country employ a very large amount of conduit made with terra cotta ducts. The first system of this kind was that of the Lake conduit, originally used in Washington, D. C. The Lake conduit is made of glazed earthenware about 1 inch thick, with two or four rectangular ducts, each 3 by 4 inches, the lengths of the sections of conduit being not over 4 feet. These lengths are laid with abutting ends and served with wrapping or burlaps, which is then impregnated with hot asphaltum, care being taken that the temperature of the asphaltum is not so great as to destroy the strength of the burlaps. These ducts are then laid upon a bedding of concrete and protected at the sides and over the top by concrete, liquid cement being poured in between the various parallel sections of conduit, in order to cement the whole into a solid mass. This makes a duct which is internally very smooth, and into which cables may readily be drawn, although on account of the large size of the ducts it is uneconomical to lay but one cable in a duct, which at times necessarily interferes with the ready withdrawal of single cables for repairs. In this construction the McRoy conduit has succeeded the Lake, being constructed of better materials and more carefully, so that it is stronger, smoother and more impervious to water.

The most recent improvement in this system consists in the use of a single duct of terra cotta or hollow tile. These hollow tiles are made of earthenware, square in cross section, from 18 inches to 2 feet long, pierced by a duct about 2½ inches in diameter, with an internal and external shoulder at the opposite ends for joining the different pieces of tile and keeping them in perfect alignment. This system is laid on a bed of concrete, the separate tiles being laid up in cement, making a solid tiling wall, and the construction is found to have the great advantage of internal smoothness, together with the advantage of having a separate duct for each cable, which is not possessed by the Lake construction, although for the same number of cables it is slightly more expensive than the rectangular earthenware pipe. In any system where terra cotta is used it is necessary to avoid easily fusible materials containing a large proportion of sodium, since such materials are readily decomposed by escaping currents producing metallic sodium, which may cause gas explosions in the ducts.

It has been already stated that while attention might be paid to the relative insulating properties of these various conduits, at the same time this property does not determine the character of the cable to be employed. It has, however, been found that this insulating property must be considered in all service, for when a metallic duct is used and a cable is defective at any point, the cable is immediately grounded where it is defective; but where ducts of cement, terra cotta or wood are employed the cable is not well grounded in every part, and in consequence difficulties are sometimes encountered with lead-incased cables grounding on each other, rather than through the ducts, causing the destruction of good cables where they touch defective cables, unless care is taken to solidly connect the lead sheathing of each cable with some form of ground at frequent intervals.

In all underground systems it is necessary to provide boxes or vaults for the making of connections between cables and for the attachment of feeders. Even trunk cables cannot be handled in lengths greater than 1000 feet, drawn into the duct 500 feet in either direction from a centre, and in consequence all duct systems must be made accessible at distances not greater than 500 feet apart. These frequent points of accessibility are not absolutely necessary in the built-in construction, although it is difficult to handle lead-incased cables in lengths much greater than 1000 feet, except for the smallest cables, since the weights of longer lengths prove to be sufficient for the upper layers to crush the insulation of the underlying layers on shipping reels. Where solid or built-in systems are employed points of accessibility are provided in small junction boxes, containing a system of contacts which may be interconnected in any desired manner by wires or fusible strips, the junction boxes themselves being made small and thoroughly water-tight, the common form being that of iron boxes cast in a single piece, with a lid made tight by a gasket. As this form of construction contemplates only one system of cables in each junction box, the various cables of the system being interconnected merely by uninsulated conductors, there is no necessity for the junction box to be larger than will be required by the presence of the conductors—the workman making a change never being required to enter the box itself. Several forms of such junction boxes have been developed, but those systems which are most complete are the ones adapted to the Edison and Siemens-Halske underground systems.

In the draw-in and draw-out systems larger junction boxes must be provided, since in general the ducts of these systems are far below the street level, and in consequence the splicing of the cables must be done by a workman standing within the junction box itself. These are then called "splicing vaults" or "manholes." The size of a splicing vault depends largely upon the depth of the conduit. In certain localities where the ground does not freeze to a great depth during the winter and where the traffic is light, it is possible to lay the conduits at a shallow depth and near the curbs, or under the sidewalks. When this is possible, it is easily seen that the presence of workmen on the streets splicing cables is not so objectionable as where the work must be done in the centre of the streets. Accordingly, for this class of construction the splicing vaults are made small and called "handholes," as, for example, where the ducts are laid about 2 feet below the street surface, handholes 4 feet square by 4 feet deep are found to be sufficient, the workman splicing the cable sitting on the street with his legs hanging into the handhole, splicing with the cable in his lap; but where this shallow construction is not possible the splicing must be done at the bottom of the hole, and for this reason the splicing vault must be large enough for the splicer to work rapidly and without interference with neighboring cables, the size of the vault depending somewhat on the number of cables and upon their character, although a splicing vault should never be less than 4 feet square, from which size they increase to 8 feet square in some of the larger systems.

Even where but few cables are to be installed a splicing vault 4 feet square is found to be an inconvenient place in which to work, and where three or four ducts lead into the vault they are rarely made less than 5 feet square—6 feet being considered the standard size in the larger cities. The depth, of course, depends upon the depth of the ducts, although the floor of the splicing vault should always be at least 18 inches below the lowest cable ducts, on account of the convenience of the workmen, who should not be obliged to work in an exceedingly uncomfortable position, and on account of the fact that these splicing vaults form catchbasins for any water which finds its way into the conduit system, the ducts being generally laid with a grade toward the splicing vaults. If a good depth of vault below the lowest duct is provided, then any moderate amount of water accumulating within the system will lie harmlessly in the bottom of the vaults, and can easily be removed by pumping. Where the ducts are on a line with the bottom of the splicing vaults the cables will often lie in water, and the deterioration of their covering is hastened.

Cast iron splicing vaults have been proposed and are used to a limited extent where small vaults are required, but there is no special advantage in the employment of cast iron, since it is found to be very difficult to make these cast iron boxes thoroughly gas and water tight at the points where the cable ducts enter. Accordingly, the common construction consists of a brick wall laid upon a concrete floor, the brick being laid in cement and coated internally with a plaster of cement. Such a form of floor is penetrated by dampness, but a large amount of water cannot pass through the walls, nor are the walls extremely permeable to gases. In any system, therefore, the size of splicing vault should be as great as a reasonable cost of construction will allow, although an excessive size increases the cost of cable laying, for the cables cannot be carried straight across the vaults from duct to duct, but must follow the walls and be hung upon hooks set in the brickwork, in order that each cable may be readily accessible for renewals or repairs; and where very large vaults are provided there is a waste of cable, increasing resistance and cost, as the cable is carried around the walls.

At one time it was thought possible to splice all cables on the street, without reference to the depth of the ducts, the cables of different ducts being both carried up to the street level, and spliced in a bend, which was then fastened to the side wall of the ducts, but not only did this form of construction increase the length of useless cable, but also such "bends" formed convenient steps for workmen entering the splicing vaults, and where the vaults were frequently entered the cables were soon injured by being used in this improper manner. Often where the cables are carried around the side walls there is a great temptation for workmen to use them in entering and leaving the vaults, unless they are so located that they are inconvenient for this purpose, and in consequence they should be so placed where it is possible, the manhole for entering the vault being on one side of smaller vaults, or in the center of larger vaults, so that a man cannot readily let himself down through the manhole and rest his feet on the cables.

The two great difficulties found in underground construction arise from the presence of water and gas within the ducts. Water may enter either from condensation of moisture from air which is admitted whenever the construction is opened, or from overflowing of the streets where the manhole covers are not thoroughly tight. Gas penetrates the conduits through the walls of the splicing vaults, and even through the ducts themselves when there are gas leaks in the neighborhood. In the oldest cities such gas leaks are almost always present, and it has been found to be practically impossible to keep the ducts entirely free from its presence. There is a difference of opinion among engineers as to the best methods of removing these difficulties. In New York, where both water and gas have given a great deal of trouble, it has been found necessary to connect splicing vaults throughout the territory where gas leaks are plentiful by 6-inch pipes, through which a current of air is continually blown. Storm water is kept out by the use of perfectly tight manhole covers, and as it is impracticable to securely fasten the covers on the street level, where they are continually subjected to vibrations by the traffic passing over them, double manhole covers are employed, the inner cover being seated on a gasket and screwed tightly in place, while the outer cover is held down simply by its own weight, which in these cases amounts to 300 or 400 pounds.

When a tight conduit construction of this kind is employed and an air pressure kept on the inside of the ducts by blowing through the 6-inch pipe, gas does not seriously enter, nor is there trouble from storm water, while the water of condensation is continually removed by the blast of air, which serves the double purpose of keeping the ducts free from gas and moisture; but as this entails a considerable expense, both for the original laying of the ventilating pipe and for the operation of the blowing system, it cannot be contemplated except where a large number of ducts are laid and where the difficulties from water and gas are serious. Small amounts of gas are readily removed, either by ventilation through the manhole covers themselves, or by means of auxiliary pipes, led up to the tops of neighboring buildings. Such pipes have sometimes been attached to neighboring arc light poles, but this is at the present time considered to be a source of danger, for the gas within the duct may be ignited by the arc whenever an explosive compound flows out through the ventilating pipe.

In Chicago it is found that single heavy manhole covers, pierced with holes, afford ventilation and prevent the presence in the ducts of an excessive amount of gas, although many engineers hold that this is again a source of danger, on account of the possibility of gas coming out through the covers and being ignited by means of lighted cigars falling upon the covers. Indeed, no form of a ventilated duct seems to free the construction so completely from gas that it is safe for workmen to enter the splicing vaults until the gas has been well pumped out by means of a hand blower, and in such ducts it is generally necessary to continually force into the vault a supply of fresh air for the workmen whenever there is a likelihood of a large amount of gas being present.

On account of the great expense of construction of the splicing vaults in the draw-in and draw-out systems, auxiliary cable ducts must be laid for house-to-house feeding systems. These auxiliary duct systems contain only a few ducts, and are provided with handholes at every alternate house; the form of conduit construction which has been found to be most satisfactory for this purpose being a cast iron duct made in two halves, containing from six to eight separate ducts, the conduit itself being laid in sections of about 6 feet, the halves cemented together by plumbers' putty, and cast iron manholes being placed at every junction point.

In this country the only systems that have been satisfactorily employed are the solid constructions of Edison and Siemens, in which the cables are each inclosed in their own protection, and the draw-in and draw-out systems with auxiliary ducts for service; but in England and on the Continent wires have been satisfactorily laid in trenches, the attempt being to apply the principles of overhead construction in inclosed trenches underground. The most satisfactory construction of this character is that developed in England by Crompton, who provides a water-tight trench laid as near as possible to the surface of the street, the wires being supported on insulators located about 20 yards apart and made accessible by handholes. In order that spans of 20 yards can be allowed and the expense of tying the conductors to the insulators be not too great, at points about 200 yards apart the conductors are firmly held by clamps, into which they are fastened after the conductors are strained until they hang at a safe distance above the bottom of the conduit. In this system no auxiliary service conduits are necessary, since all service wires may be connected at the handholes.

On the Continent a similar construction has been adopted, but the straining of the conductors has not been attempted, and in consequence they are necessarily supported at more frequent intervals. In Crompton's construction the supports are glass insulators held in wood balks, which are set into the concrete of the trench, while the Continental system employs balks made of pottery. These have been found to give trouble from the fact that no petticoat is provided for the pottery balks, and furthermore, the character of the pottery is such that on account of the porous material used they become saturated with moisture; and it is further stated that the escape of current has in some cases formed a deposit of sodium, which ignites in the presence of moisture and causes gas explosions. Such excessive leaks and gas explosions have not been encountered in Crompton's system, which has stood the test of severe service and potentials up to 500 or 1000 volts.

In America the smaller towns have not as yet demanded underground construction where a house-to-house distribution is contemplated, merely the trunk lines and feeders being buried, which can be done cheaply with insulating cables laid in wood ducts, and in consequence the trench system has not as yet found a foothold here, but with the extension of electric lighting and power plants it certainly seems that this form of construction should be more carefully considered, as it is especially adaptable in those cities where frost does not penetrate to a great depth, and where the weight of the surface traffic is not likely to injure the trench construction, especially since in such cities it is difficult to obtain workmen who are capable of satisfactorily splicing insulated cables and making connections to surface wires. The particular form of trench construction and the insulators employed by Crompton are those which are adapted to the materials to be had in England, and in consequence the employment of the Crompton system would not always lead to the cheapest form of trench to be used in this country, since the materials available for trenches and insulators will necessarily vary with the localities, while the character of the trench itself will vary with the character of the soil in which it is laid and the difficulties to be encountered from the probable presence of other underground construction, as well as with the street traffic which must be borne.

It is seen, therefore, that we have up to the present time developed very thoroughly a satisfactory system of underground construction for the larger cities, although we have not as yet attacked the problem of underground work and house-to-house distribution in the secondary towns. These points must carefully be borne in mind in comparing the work which is considered as standard in this country with the various systems which have been satisfactorily employed abroad, and as the laying of wires underground shall proceed it is not safe to presume that we have as yet exhausted the possibilities of satisfactory service with economical construction, for it is probable that in some cases built-in systems can be developed and in others that insulated conduits may be employed, and that in some cases the best service could be obtained by the use of a form of trench.

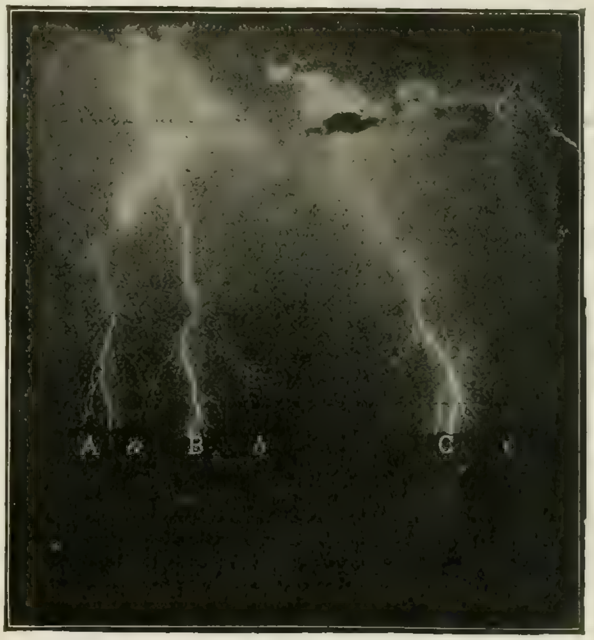
Lightning and Lightning Arresters.

BY H. E. RAYMOND.

Having had a number of communications regarding the use of an overhead barbed wire for protection against what I termed a "direct stroke," I think I may be justified in making my meaning more clear. Endeavoring to cut down the article on lightning and lightning arresters* into as small a space as possible I allowed a number of ideas to be taken for granted, and in this case seem to have incurred a general misconception.

In my experience I have known but few cases where a line was struck by a "thunder bolt." The first and second split up the poles, and in one case burned out an armature, while the third blew an arrester, installed on a pole, all to pieces, tearing down wire and a piece of the pole. It must not be imagined that by the term "direct stroke" I meant such instances. It was used more to distinguish, from inductive charges, gradual charging, etc., the effect on an electric line of a severe local discharge. If we refer to the accompanying figure it will be seen that a discharge often consists of main paths, with a large number of branch-like side flashes, while furthermore the space between is frequently affected by a brush-like or diffused electrostatic condition. Suppose our line ran in the neighborhood of A, B or C. It would then be influenced by the discharge in the main path or the direct stroke, and the severity of this influence would depend on the intensity and proximity of this stroke. If it should lie in the positions a, b or c it would be affected only by the minor flashes or the brush-like discharge. Both the action of arresters on a line, and the view of the lightning discharge show a much greater apparent volume in this direct path than in the side flashes. I have watched different forms of arresters in action on a dead line—i. e., with no dynamo current flowing. The discharge through them was by no means unvarying. While many forms acted alike at the same discharge the nature of the discharges was very variable. When the lines were affected by an induced charge the spark was small and the snap light; when a heavy discharge took place near them, the report and flash through the arresters was like that of a rifle.

A proper installation of arresters with a low striking potential will generally be reliable for protection from the discharges from the side flashes, the induced charges, the gathering of static electricity from the atmosphere, winds, etc., but it would require an enormous installation of station and line arresters to adequately protect any system from the effects of a very heavy "main path" discharge in close proximity to the line. As I opposed the idea of a large number of line arresters, on a transmission line, I advocate the use of the overhead grounded wire as an auxiliary protection from these direct strokes. The wire will not prove a complete protection in itself, but it will and does tend to lessen the "volume" of the severe discharges and thus enable the arresters to discharge from the line proper what consists, then, almost entirely of an electrostatic charge without appreciable volume. It is the apparent volume we wish to take care of.



A Simple Method of Renewing Dry Batteries.

To renew an ordinary commercial dry battery when exhausted it is only necessary to perforate the sides and bottom with a dozen or more holes, the simplest method of accomplishing this being with the aid of a steel wire nail and a hammer. The battery should then be placed in a vessel containing water, and it will be ready for almost immediate use with a new life as long or longer than that already obtained. In renewing a battery of such cells they should not, of course, be placed in the same vessel of water, as the shell of the battery is one electrode, unless all the cells are placed in multiple. In case they are in series connection they should be placed in separate vessels, and if the latter are metallic they should be insulated from each other.

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*The Electrical World, June 11 and June 25, 1898.

DIGEST OF CURRENT ELECTRICAL LITERATURE AMERICAN AND FOREIGN

By Carl Hering.

Dynamos, Motors and Transformers.

AGING OF TRANSFORMER IRON. Klinker. Lond. "Elec.," June 24.—A short note referring to Roget's recent paper (see "Digest," July 2). He confirmed the discovery that at a certain temperature the iron commences to improve after having aged. He has made an extensive series of aging tests on different kinds of iron; in one a sample of Swedish iron was placed in an oven at 90° C.; its initial hysteresis loss was 0.15 watt per pound at 2500 lines per sq. cm. and 100 cycles per second; this was the lowest figure he ever found; after twenty-six days at this temperature the hysteresis loss became 0.31 watt per pound; after seven days at 120° C. the hysteresis loss was 0.19.

EXCITATION FROM HALF THE DYNAMO VOLTAGE. Sengel. "Zeit. fuer Elek.," June 19.—A brief abstract of a paper read before the Union of German Elec. Engs. A continuous-current machine is provided with a ring contact which is connected to one point of the armature winding, and is provided with a brush for leading off the alternating current; if the field is connected between that brush and one of the other two on the commutator, then only the rectified component of this current will act on the field magnet coils to excite it; the reverse current will be negligibly small, owing to the large self-induction of the field coil; these coils are therefore excited by half the voltage of the dynamo, and this is said to have some advantages in practice.

CRANE AND ELEVATOR MOTORS.—"Elec. Eng.," June 23.—A brief, illustrated description of the Westinghouse motors for these purposes.

Lights and Lighting.

ARC LAMPS. Richard. "L'Eclairage Elec.," June 18.—Brief but well illustrated descriptions of improvements in arc lamps, taken from patent specifications.

ARC LAMP.—Lond. "Elec. Eng.," June 24.—An illustrated description of the Cotsworth lamp.

STREET ILLUMINATION. Hopkins. "Elec. Eng.," June 30.—A short, illustrated article enumerating the requirements of satisfactory lighting. In a table he shows from an actual case how many of the gas and naphtha lamps were extinguished by wind while the arc lamps kept burning. A diagram shows, in the form of circles, the relative light-producing power obtained for $100 by the arc light and by gas and naphtha burners. He recommends that the present arc lights be sub-divided into three or four smaller ones, and predicts that the tower system will soon go out of use.

Power.

POWER DISTRIBUTION PLANT NEAR PRAGUE. "Elek. Zeit.," June 23.—A long, well illustrated description of the power plant at the Government Railway Works at Laun; all the power is supplied electrically. The power machine is a three-phase alternator, and the motors connected with it are largely those which are started and stopped frequently and must have a large starting torque; a well illustrated description of this alternator is given, including curves and working drawings with dimensions. Among the applications are a traveling crane, a traveling platform for locomotives, an elevator, etc., all of which are illustrated. The machinery was designed by Kolben.

STEAM-USING PLANT.—Lond. "Elec.," June 24.—A reprint of the discussion of Jeckells' paper.

FURNACE FOR BURNING REFUSE.—"St. R'y Jour.," July.—The burning of ordinary town refuse and garbage for generating power has been employed to a considerable extent in England with satisfactory results, the fuel, of course, costing nothing. Such a furnace is described and illustrated, the chief feature consisting in the use of forced draft, provided by steam jets, in which superheated steam is used. Some tests made at Rochdale, England, show the total water evaporated from 212 Fahr. was 1 pound of water to 1.07 pounds of refuse, the steam pressure being 5 atmospheres.

POWER TRANSMISSION ON WARSHIPS. Diehl. "Cassier's Mag.," July.—A long abstract of his recent paper before the American Society of Mech. Engs., in which he compares steam, water, compressed air and electricity, favoring the latter and claiming that every function requiring power on a warship can be performed by electric motors without involving the use of anything except well known and tried mechanism.

Traction.

HALIFAX.—Lond. "Elec. Rev.," June 24.—A long, illustrated description of the municipal line which has just been started and which is said to be the first combined lighting and tramway system in that country in which the plant is controlled entirely by the municipality; work on similar lines is being carried out at Glasgow, Hull, Bradford and Plymouth. The streets appear to be extremely hilly; the single generator is driven by ropes; the lighting plant is run with alternating currents; a motor-alternator is to be added, and will consist of a continuous-current machine driven by ropes from an alternating-current motor; there is also a battery of 270 accumulators, having a discharge of 200 amperes for six hours; it is to act as a fly wheel, is to run the whole tramway during the peak of the lightning load and during the early morning hours, and by reversing the motor-alternator it will run the alternating current lights during the hours of light load; thus the alternating plant may be shut down during the night.

MONTPELLIER.—"L'Eclairage Elec.," June 18.—A brief description of the electric railway.

NO TROLLEY CARS IN LONDON.—Lond. "Elec," June 24.—A note stating that the London County Council has vetoed every proposed introduction of the trolley system within the area which it controls.

ELECTRIC TRACTION. Stewart. Lond. "Elec. Rev.," June 24.—A reprint of a short paper read before the Municipal Electrical Association. It is directed more to the managers than to the engineers. He recommends that current should be supplied from the existing lighting station; he advocates municipal ownership. A table is given for three small and three large stations, showing that they could afford to sell the required number of units at 3.48 cents per unit and make a profit of 1 cent per unit by the transaction.

ELECTRIC TRACTION. Quin. Lond. "Elec. Rev.," June 24.—A reprint of a Municipal Electrical Association paper, in which he reviews briefly the various elements in the construction of electric railways. The paper is discussed editorially in the same issue, in which it is remarked that it can hardly be said to contribute anything new to the common stock of knowledge on electric traction.

AUTOMOBILE VEHICLES. Reyval. "L'Eclairage Elec.," June 18.—A short article on the recent trials in Paris, in which eleven electric and one petroleum motor took part; a more detailed description is promised, the present being only preliminary. The vehicles operated very satisfactorily; the cost per km is about 1 cent per km for the electric vehicles at the rate of 6 cents per kw hour, at which price the electric energy may be bought in Paris; the cost is about 50 to 70 cents per carriage per day, running about 36 miles; the kw hours for the trip are also given approximately, and vary in the neighborhood of 10 to 12. The cost of fuel for the petroleum carriage was considerably greater; with a consumption of 13 liters, at a cost of 12 cents, the total cost per day was $1.56. An important item in the electric vehicles is the maintenance of the battery, concerning which no information will be given in the report; the Fulmen cells behaved well, and that company will maintain the batteries at 60 cents per day per carriage, making the total cost $1.20 per day, or about double that for the energy; this is still less than that for the petroleum vehicles. The conclusions are that the electric vehicles are practical, economical and in point of comfort are much better than those operated by horses or petroleum. A short account is also given in "Eng. News," July 7.

ELECTRIC CABS IN PARIS.—Lond. "Elec. Rev.," June 24.—Brief data from the preliminary tests. It appears that the petroleum cabs have been superseded in that city by those driven electrically.

MOTOR VAN TRIALS.—Lond. "Elec. Eng.," June 24.—A brief account of the recent trials of the Royal Agricultural Society; most of the vehicles were not electrically driven.

PROPOSED CONSTRUCTION IN NEW YORK.—"St. R'y Jour.," July.—The Third Avenue Railroad Company, of New York, will install the electric conduit system on 102 miles of track, of which 28.5 miles are now equipped with cable. The change from cable to electricity is not made to secure greater economy of operation, but to give a pleasanter service and to have a uniform system over its entire line. The present cable line was laid in 1895, and the rail used was 7 inches in height, and weighed 80 pounds per yard. The joints in this time have gone down three-eighths of an inch. It is estimated that 2,500,000 cars have gone over the line during the last five years. The company will use in its new work rails weighing from 104 pounds to 112 pounds, and will increase the carbon in its rails from 45 per cent to 55 per cent. The company will also install a large central station and distribute power by the three-phase system with eight or ten sub-stations.

BUFFALO RAILWAY COMPANY'S STORAGE BATTERY PLANT.—"St. R'y Jour.," July.—This company has recently installed a large storage battery for the purpose of regulating the fluctuating load due to the 300 or more cars in use; this is briefly described and illustrated. The station contains steam units of a capacity of 7000 horse-power, and also four 500 hp generators supplied with current from Niagara Falls. The storage battery consists of 264 cells of the chloride type, having a capacity of about 1200 horse-power; the positive terminal of the battery is connected to the positive main bar of the switchboard, and the negative terminal with a booster to the ground; the booster has a capacity of 2500 amps. at 70 volts. A diagram shows the effect of the battery in regulating the output of the station.

SCHUYLKILL VALLEY.—"St. R'y Jour.," July.—A short description of this line, about 22.5 miles in length, near Philadelphia. The average output is about 400 horse-power when thirteen cars are in operation, but during heavy traffic eighteen cars are run, with an output of about 925 horse-power. The company uses from 5½ tons to 6 tons of coal per day, costing $1.90 per ton. Employees are paid $.125 an hour and work eleven and a half hours per day. The average life of motor gears is about eighteen months, and of pinions about eight months. The trolley wheels usually run about 48,000 km.

HULL ELECTRIC RAILWAY. Armstrong. "St. R'y Jour.," July.—An illustrated description of this line, which was formerly operated by steam locomotive power, but in 1897 was equipped with electric power. Its length is about 26 miles, and considerable freight business is done. The power station contains six turbines, connected with one shaft, from which two generators of 325 kw are driven; there are two electric locomotives; one is equipped with four 80-hp motors, the other is somewhat lighter.

GORNERGRAT RAILWAY.—"Eng. News," June 30.—Some brief data concerning this electric mountain road, which has been referred to frequently in the "Digest."

MEADVILLE.—"St. R'y Jour.," July.—A short, illustrated description of this line, which comprises about 10⅝ miles of track; the power house contains two 250-hp condensing Corliss engines, each connected to a 225-kw generator.

ELECTRIC EQUIPMENT OF THE BROOKLYN ELEVATED RAILROAD.—"St. R'y Jour.," July.—On June 18 the first electric train on the Brooklyn Elevated Railroad crossed the bridge to New York. Sections are given of the track at curves and on straight work, with the third rail in place.

LARGE STREET CAR UNITS. Brill. "St. R'y Jour.," July.—A short article in which he claims that the tendency in rolling stock is toward the largest car that can be handled by two men; this is because it is found that the cost of operation depends principally upon the number of units and not on the size of the cars.

Installations, Systems and Appliances.

UNIFORMITY IN PLANT AND APPARATUS. Wordingham. Lond. "Elec.," June 24.—A reprint of his paper, with the discussion (see "Digest," last week). The subject is also discussed in the leading editorial. While it is thought that a large variety exists in the equipment of small stations, anything more than very limited standardization is not desired in the more important stations; it is thought that the importance of standardization in large stations is greatly overrated; the chief capital expenditure is under the heading of mains; the absolute standardization of boilers is an obvious impossibility.

WAKEFIELD.—Lond. "Elec." and "Elec. Eng.," June 24.—An illustrated description of this station. This city is the sixty-ninth in which the municipal authorities control the works. The high pressure alternating system, with transformer sub-stations and distribution on the three-wire system at 200 and 400 volts, is used. It has a four-cell refuse destructor, and is now in full working order; it will supply steam at the required pressure as far as possible; 100 to 200 horse power can be developed from the refuse alone.

BOOSTER.—Lond. "Elec. Eng.," June 24.—Several explanations of the working of a direct-current booster, with diagrams of the switch gear for charging a battery from continuous-current supply mains.

CENTRAL STATION ACCOUNTS.—Lond. "Elec.," June 24.—An analysis of the accounts of the Islington station.

Electro-Physics and Magnetism.

THE ARC AS A TELEPHONE. Holsten. "Elek. Zeit.," June 23.—A short communication stating that as early as 1893 he noticed a phenomenon like that recently described by Simon (see "Digest," April 9). An arc lamp made quite a noise when run with a continuous current; the noise was produced mainly when there was sparking at the commutator, even though it was only slight; it diminished with the number of the lamps in circuit, and is also affected by the length of the arc; the noise is not always produced.

POWERFUL LABORATORY ELECTROMAGNET. Weiss. "L'Eclairage Elec.," June 18.—A detailed description of a magnet which he has constructed for giving intense fields of 30,000 units, and which is more convenient and economical than those formerly described; the weight does not exceed 220 pounds, and the energy required is less than 2 horse-power. The best results can be reached with truncated cone pole pieces, the best angle for which is discussed and is shown to be 63.5 per cent.; the force exerted between the two poles is 1320 pounds; the frame is of the rectangular type and the apparatus is conveniently mounted for introducing apparatus between the poles. The diameter of the wire is 2 mm and the current 9 amperes for ten hours or 14 amperes for ten minutes, the number of ampere turns for the latter current being 50,000; the total resistance is about 9 ohms, thus requiring about 125 volts. The fields for various currents and distances between poles are given. With 11.4 amperes and a distance of 3 mm, the force is 30,500. There are supplementary coils near the pole pieces, which he claims yield an extra thousand units; the intensity in the pole pieces is 1630 units. The proper cross section of the iron is discussed, as also the construction of an apparatus of a different scale.

EXAMINATION OF COAL BY X-RAYS. Couriot. "Eng. and Min. Jour.," July 2.—A brief abstract of a French Academy paper. He states that X-rays afford an instantaneous and certain means for determining the purity of mineral fuel; coal, diamond and wood are permeable to these rays, while silica and silicates are opaque; thus the silicious ash, forming constituents of coal, obstructs the passage of the rays; owing to the great transparency of coal, it is not necessary to trim the sample, large fragments sufficing for the test; impurities are clearly shown as dark spots. A 10-inch spark coil will answer, with an exposure of about five minutes, the samples measuring 1.25 to 2 inches. A brief account is also given in "L'Eclairage Elec.," June 18.

ELECTRICAL DISCHARGE. Moore. "Amer. Jour. of Sc.," July.—The first part of an article in which he considers some notions concerning the electrical nature of electrical discharge in gases, which are almost wholly dependent on the kinetic theory of matter; these notions are not in complete agreement with the conclusions reached by some continental and English physicists.

ZEEMAN EFFECT. Ames, Earhart and Reese. "Johns Hopkins Univ. Circular," No. 135; reprinted in "Am. Jour. of Sc.," July.—A short account of their investigation of certain variations from the phenomena discovered by Zeeman.

Electro-Chemistry and Batteries.

PLATING WITH A CADMIUM AND SILVER ALLOY.—"L'Eclairage Elec.," June 18.—It is stated that an alloy of cadmium and silver, containing from 7 to 8 per cent. of cadmium, is better for coating articles; the cadmium prevents the silver from tarnishing so easily; moreover, the alloy is electropositive as compared with nickel by 0.25 volt, so that a piece of iron covered with this alloy will be less easily attacked by oxygen and the humidity of the air than when covered with nickel. The Cowper-Coles process for thus covering articles is briefly described.

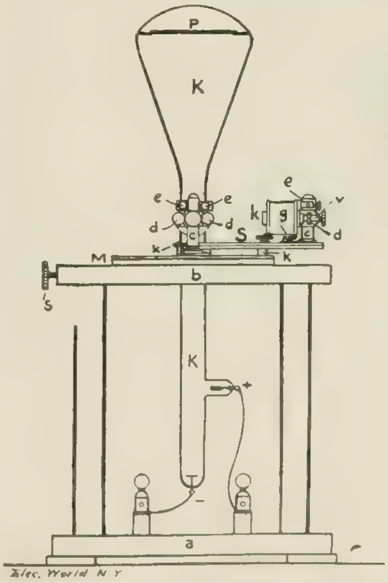
PLATING ALUMINUM.—"L'Elec.," June 25.—Various recipes patented by Lenseigne and Leblanc.

ELECTROLYTIC COPPER REFINING. Ulke. "Eng. and Min. Jour.," July 2.—An article on the progress during the past year, in which the mechanical details of this process have been improved; the article is based on what has actually been accomplished at various refineries. Not only has the quality of the product been improved, but the time required has been diminished, so that the stock of copper locked up in course of treatment is greatly reduced; copper of 100 per cent. conductivity is now an ordinary commercial product.

SIGNIFICANCE OF IONIC REACTIONS IN ELECTROCHEMISTRY. Kuester. "Am. Jour. of Sc.," July.—An abstract of his article from the "Zeit. f. Elektrochem.," August, 1897, which was noticed in the "Digest" at that time.

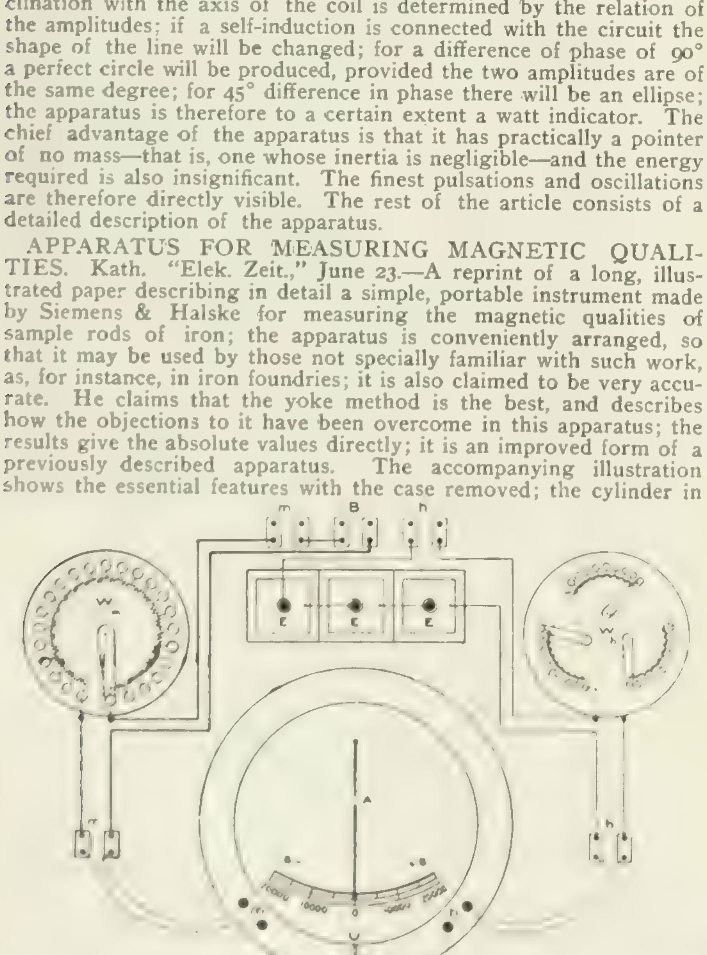
Units, Measurements and Instruments.

INDICATOR FOR ROTATING FIELDS AND ALTERNATING VOLTAGES. Ebert and Hoffmann. "Elek. Zeit.," June 23.—An illustrated description of an interesting and simple device for showing and studying varying fields and potentials. The fact that cathode rays are deflected by magnetic forces and by electric fields are the principles on which this apparatus is based; it will show an illuminated curve representing the rotary field, by a rotating cathode ray striking a phosphorescent plate and thus enabling every portion of the curve to be seen and studied. The apparatus is shown in the adjoining figure, the lower part of which is the cathode ray tube, with the aluminum cathode at the bottom; at *b* there is a diaphragm which sharply defines the beam, and above this are the various deflecting apparatus; P is the screen which for



convenience has circles and diameters drawn on it for making approximate measurements. To produce the rotating field or for combining the fields of various currents, an iron ring, not shown, is placed around the tube near the table M; this ring is wound with numerous coils, which may be variously combined. With a true rotating field a perfect circle is produced, but if there are pulsations this circle will be deformed; these deformations show in how far the rotating field varies from the true one; the direction and magnitude of the deviations are also indicated; the most important feature is that by the use of small condenser plates of negligible capacity the time variation of the voltages can be followed; moreover, the apparatus can be put in any branch of an alternating current system, provided the voltage is high enough; in the present apparatus it must be at least 500 to 800, but by means of a small transformer it could be connected to even lower voltages. The magnetic field producing the deflection need be only moderate; the deflection takes place in a plane perpendicular to the direction of the lines of force; if the field rotates the beam will describe a cone; if the screen is coated with a luminous paint a bright curve will be produced, which can be photographed. In the apparatus which he used the field had an intensity of about 0.1 lines of force per sq. cm., and this was found to be ample. If two small condenser plates insulated from each other and connected to an alternating current be placed on the two sides of the tube the beam will also be deflected, and the deflections will follow the time variations of the voltage; the deflections take place in a plane perpendicular to that of the plates. If a small magnetizing coil is placed near the tube, and if between them is placed a small insulating plate perpendicular to the axis of the coil and another plate on the other side of the tube, the plates being connected to an alternating current source, the coil will produce a deflection perpendicular to its axis and the condenser a deflection in the direction of the axis; the combination will produce diagrams like the well-known Lissajous figures, from which the various forces may be determined. For a moderate frequency the induction of the coil may be neglected and the deflection of the rays is therefore practically identical with the current variations; the current and voltage curves of an alternating current system can therefore be directly compared with each other; if they are in phase a straight line will be shown on the screen, and its inclination with the axis of the coil is determined by the relation of the amplitudes; if a self-induction is connected with the circuit the shape of the line will be changed; for a difference of phase of 90° a perfect circle will be produced, provided the two amplitudes are of the same degree; for 45° difference in phase there will be an ellipse; the apparatus is therefore to a certain extent a watt indicator. The chief advantage of the apparatus is that it has practically a pointer of no mass—that is, one whose inertia is negligible—and the energy required is also insignificant. The finest pulsations and oscillations are therefore directly visible. The rest of the article consists of a detailed description of the apparatus.

APPARATUS FOR MEASURING MAGNETIC QUALITIES. Kath. "Elek. Zeit.," June 23.—A reprint of a long, illustrated paper describing in detail a simple, portable instrument made by Siemens & Halske for measuring the magnetic qualities of sample rods of iron; the apparatus is conveniently arranged, so that it may be used by those not specially familiar with such work, as, for instance, in iron foundries; it is also claimed to be very accurate. He claims that the yoke method is the best, and describes how the objections to it have been overcome in this apparatus; the results give the absolute values directly; it is an improved form of a previously described apparatus. The accompanying illustration shows the essential features with the case removed; the cylinder in the front part is the magnetizing coil through the axis of which the sample rod is passed; the ends being clamped into the semicircular yoke piece; in the other part of this piece there is a pivoted coil like that in a d'Arsonval galvanometer, through which a constant current is passed, and the deflection of the needle will therefore indicate the strength of the field; the two small coils shown are compensating coils for correcting certain errors. The main coil is so proportioned that H in absolute units is equal to 100 times the current in amperes; the compensating coils are connected in series with the main coil, but act in the opposite direction; they are for the purpose of neutralizing the field, which the coil itself without a rod in it would have on the deflecting coil; the deflection is proportional to the number of lines of force; by using a suitable current in the deflecting coil the reading may be made to give directly for any desired cross section of the sample rod the results per sq. cm. cross section of the sample; the formula for determining this current is simply a constant given by the maker, divided by the cross section of the sample, this quotient giving the current in amperes in the movable coil. The accessory devices, consisting of switches, plugs, and resistances, are described in detail; they are so arranged that the work is greatly simplified; the resistances are so proportioned as to give 24 points of the curve; with almost no resistance and a 4-volt battery, H will equal 150, or with 8 volts 300; the field intensity is read off directly in absolute units. The apparatus must be shielded from neighboring magnetic fields or large masses of iron; the effect of the earth's field is eliminated by placing the apparatus in a certain direction marked on the case. The apparatus has been examined and tested by the Reichsanstalt, and the results are reproduced in curves. The cross section of the sample should be about one-fourth sq. cm.—that is, for round rods a diameter of about 6 mm; for sheet metal a pile of strips 5 mm in width and the same in height is used; the length of the sample is 200 to 270 mm.



UNIFORMITY IN MAGNETIZATION DIAGRAMS. Kath. "Elek. Zeit.," June 23.—A short article in which he urges uniformity in the systems of recording and showing induction and hysteresis curves; the system is the one adopted by the Siemens & Halske Company. The magnetic properties of every kind of iron are shown sufficiently well for practice by the usual induction or magnetization curve from zero up to H = 150, or for hard steel up to 300; and by a hysteresis loop between plus and minus 150, or for hard steel 300; only one-half of the hysteresis curve need be shown The scale for the induction curve should be 1 mm for every 100 C. G. S. units; the field intensity is usually represented by a scale of 2 mm for one C. G. S. unit, and for hard steel 2 mm for two units; in printing these the reduction may be one-half to one-quarter. (In another article in that same issue by the same author, abstracted above, such a sample curve is reproduced). The cross section paper should be printed in red, which will be reproduced by the usual copying processes by means of light; the lines on tracing paper or cloth will correspond well with those on thicker paper, so that the two may be superposed.

PHASE METER. Bruger. "Zeit. fuer Elek.," June 19.—A brief abstract of his recent paper read before the meeting of Union of German Elec. Engs. The apparatus is a sort of double wattmeter having one fixed and two movable coils; the two torques are opposed to each other; the deflection of one of the movable coils is proportional to the cosine of the angle; the second movable coil has a current flowing through it, which differs in phase from the current in the other movable coil by 90°, and the deflection is therefore proportional to the sine of the angle; when the angle is zero there will be only the deflection due to the cosine, while if it is 90° it will be proportional to the sine; between these two the pointer will always take a definite position.

ACCUMULATOR METER. Aron. "Zeit. fuer Elek.," June 19. —An abstract of his recent paper read at the meeting of Union of German Elec. Engs. He described one of his pendulum meters, in which the needle is moved one way by the discharge and back again by the charge; in the latter it passes the zero and has to be set at each charge; to obviate this a resistance may be used, shunting the meter so that the charging readings are about 10 per cent. lower, in which case the meter can be used when the charging and discharging is intermittent, as in the case when accumulators are connected in parallel with the dynamo. In another form of meter the charging and discharging currents are registered separately in two meters, each of which will register only in one direction.

CHANGES IN THE QUADRANT ELECTROMETER. Elster and Geitel. "Wied. Ann.," 64, p. 680; abstracted briefly with the illustration in the "Elek. Zeit.," June 23.—The principal directions of improvement are to increase the insulation in the inner part, for researches of longer duration, and to facilitate the renewal of the sulphuric acid used for damping and drying.

INTENSITY VARIOMETER. Heydweiller. "Wied. Ann.," 64, p. 735; noticed briefly in the "Elek. Zeit.," June 23.—The principle of his new instrument for measuring the earth's magnetism is that two equal declination needles are secured directly over each other with a common axis, and are perpendicular to each other, each, therefore, making with the magnetic meridian an angle of 45°; each of the four poles will then move in a nearly homogeneous magnetic field, and a change in the external force of the horizontal intensity will produce a proportionate declination.

MEASURING INCLINATION AND HORIZONTAL INTENSITY. Meyer. "Elek. Zeit.," June 23.—An abstract, with illustrations, from the Proceedings of the Natural Science Society of Freiburg, 10, No. 3. The apparatus appears to be the same as the one mentioned in the "Digest" May 28.

INSULATION INDICATOR. Kallmann. "Zeit. fuer Elek.," June 19. A brief abstract of a paper read before the Union of German Elec. Engs. He describes an apparatus which will indicate a leakage of current between any two points of a wire. At two points of a circuit there are two equal resistances and the currents through these pass through the two coils of a differential galvanometer, which will indicate the differences between the currents going through them, when there is no loss of current there will be no deflection; the well-known Thompson bridge arrangement may also be used, together with an ordinary galvanometer; from the deflection the fault in the insulation can be measured. The abstract is very brief.

INTERRUPTERS.—"Jour. de Physique," June, noticed briefly in the Lond. "Elec.," June 24.—Descriptions of several new forms of interrupters for induction coils. Ducretet and Lejeune showed a mercury interrupter worked by an electric motor; it is on the Foucault principle, but the plunger moves so as not to whip up the mercury; at 300 turns per minute for radiography the motor requires 0.6 amperes at 2 volts; for fluoroscopy, 100 turns per minute are required, which consumes 1 ampere at 4 volts. Cremieu describes another type in which he eliminates the difference between the make and break currents; there is a combination of metallic contacts attached to an oscillating lever worked by an alternating current, the current in one direction consisting of a combined make and break current, and the same in the opposite direction, so that the currents are alike in quantity and shape; (the description in the abstract is not clear). Several other forms are briefly referred to.

RESISTANCE FOR LARGE CURRENTS. Derry. "L'Elec.," June 25.—Data for some resistances which he used in testing large dynamos. They were made of bands of galvanized iron wire netting; the bands were 260 mm wide, and consisted of sixteen wires, having a section of 50 sq. mm.; the length was 60 meters; the resistance at ordinary temperatures was 0.21 ohm; with 500 amperes at 240 volts the temperature was below the fusing point of lead—that is, about 300° C. Two such bands were used to absorb 400 horsepower, and three for 660 horse-power; the current density used was 10 amperes per sq. mm., but this may be increased if finer wires are used.

FLICKER PHOTOMETER. Whitman. "Science," July 1.—A short article on this apparatus. He corroborates Rood's recent statement as to the ease with which the flicker photometer is handled by observers not accustomed to its use; it is probably more easy to use by the unskilled observer than the ordinary photometers. The method used by Rood of keeping one lamp stationary and moving the other has certain advantages, one of which is that the measurements are all made at the same absolute brightness, but the arrangement is not so sensitive as that in which both lights are stationary and the photometer itself moved, and this is therefore preferable in general when the lights are sufficiently bright. It takes longer to make a setting with the flicker photometer than with others. The essence of this photometer lies in the fact that the two fields to be compared are presented to the eye alternately, in rapid succession, and not simultaneously side by side, as in other instruments; one simply notices the disappearance of a certain recurrent sensation. The time of transition from one field to the other should be as small a portion of the whole time as possible, and he therefore prefers the rotating to the oscillating apparatus He then describes a modified form which avoids some of the difficulties of the disc form; a short, truncated cone is cut through its axis and the two parts fastened together again after one-half has been reversed in direction; this is then mounted so as to rotate about the axis, which is parallel to the bar.

MEASURING SELF AND MUTUAL INDUCTANCE AND CAPACITY. Roland and Pennimann. "Johns Hopkins Univ. Circulars," June; reprinted in the "Am. Jour of Sc.," July.—In the latter journal for December last Roland published an account of a large number of new methods for measuring and comparing self-inductances, mutual inductances and capacities (see "Digest," Dec. 18). In the present article they give examples of some measurements made by some of these methods, and which show the accuracy with which a self-induction can be determined; the values determined in various ways agree among themselves within one part in 100, even though the frequency could not be kept quite constant; the results were remarkably good and showed the accuracy of the methods. The construction of standard self-inductances that will agree with each other to within one part in 10,000 is feasible by this method.

Telegraphy, Telephony and Signals.

TELEPHONIC DELIVERY OF TELEGRAMS.—"Elek. Zeit.," June 23.—Beginning with July 1 a trial is to be made in Germany in delivering telegraphic messages at the end station by means of the telephone. The present short article gives the rules and regulations governing this. The charge for such delivery, irrespective of the number of words, is 2.5 cents. In such case the telephone number instead of the address is to be given.

SPEEDS OF ATLANTIC CABLES.—Lond. "Elec. Rev.," June 24.—An editorial discussion of some recent figures. The speed obtained on the Siemens cable is, after allowing for its higher K R, 63 per cent. greater than on the Anglo-American cable.

SEEING BY-WIRE. Smith. Lond. "Elec. Rev.," June 24.—A note stating that in such apparatus selenium as well as revolving mirrors will have to be superseded by something more sensitive and constant in action. He believes he can accomplish this with some ideas which he expects to be able to put into practice, but he does not disclose the principles.

TRANSMITTING PICTURES. Piedfort. "L'Elec.," June 25.—A note, with illustrations, showing a device which he described at a congress of scientific societies in 1894, and which he claims anticipates the recent suggestion of Dussaud.

WILMINGTON. Clausen. "West. Elec.," July 2.—A brief, illustrated description of the central office of the Delmarvia Telephone Company, which is claimed to be one of the most complete exchange systems of the independent companies.

INDEPENDENT MOVEMENT IN INDIANA. Beers. "West. Elec.," July 2.—A short article on the independent telephone movement in that State, in which there are now 137 exchanges, with about 20,000 subscribers and 5,000 miles of interurban lines.

Miscellaneous.

LIGHTNING.—"Elek. Zeit.," June 23.—An editorial discussion of a recent report by Kassner, giving statistics for Saxony and Anhalt for the eleven years ending 1897; the report is accompanied by a chart (which is not reproduced). The districts are indicated by the density of the buildings. It shows that in general the number of bolts of lightning which were observed is somewhat greater in the denser districts than in the more sparsely settled, but this is only approximately true; he also endeavored to find in how far the frequency of the bolts depends on the condition of the soil, and what the effect of water in the neighborhood is; in general the bolts are less frequent the greater the distance from running water, but it does not follow that there is greater danger nearer the water; in general the number of bolts increases with an increased extent of water. It may be considered as demonstrated that at least in that district the presence of forests has no apparent effect on the number of bolts. The number of bolts per square mile (presumably German miles) varies greatly in the different districts, from 1.2 to 10.4 (this apparently refers to the whole period of eleven years). Buildings on flat land are struck more frequently than those in a city; the number of bolts which produce ignition is greater on flat lands than in the cities; for 1633 "cold" bolts on the flat land there were 458 which produced ignition, which is about 28 per cent., while in the cities the numbers were 464 and 60, or 12.9 per cent. The number of observed bolts in those eleven years has increased, it being 33.7 per cent. greater in the last five than in the first five years, the increase being greater on the flat lands; formerly the bolts which did not produce ignition increased more than those which did, but this relation is now reversed; comparing the periods of five years with each other, the number of igniting bolts on the flat lands increased 45.7 per cent., and those which did not ignite 32.7 per cent.; while in the cities these proportions are 42.9 per cent. and 25.5 per cent. The maximum number of bolts on one day was 99 and on another 96; the worst month was May, 1890, when there were twenty-five days on which there was lightning; the number of bolts per day on which there was lightning varies from one in December to 5.8 in June, the mean for the whole year being 4.3; the distribution over the different hours of the day is also shown.

MUNICIPAL ELECTRICAL ASSOCIATION.—Lond. "Elec.," June 17.—A running account of the proceedings of the recent meeting. A brief running account is given in the Lond. "Elec. Rev." and in Lond. "Engineering," June 17. Lond. "Lightning," June 16, describes the various excursions of the Society and begins the publication of the papers. An account of the excursion to the shops of Willans & Robinson is published in the Lond. "Elec. Eng.," June 17.

STANDARD DIAGRAMS. Jamieson. Lond. "Elec. Rev.," June 24.—A discussion of some of the conventional diagrams which were recently proposed by the committee of the Chicago Electric Association. Side by side with a number of these he shows suggested improved forms; he has himself read a paper on this subject a number of years ago. The figures for series, shunt and compound dynamos and motors have the objection that the field is represented by zig-zag lines, which have been universally adopted to represent non-inductive resistances, which the field coils certainly are not; the diagrams are unnecessarily complicated by drawing the leads from each brush with two right lines, whereas in the usual diagrams, which he shows, the leads come straight away from the brushes. To distinguish a storage cell from a primary battery he thinks the letters S and B placed beneath the usually accepted sign is sufficient. He does not see any necessity for complicating the figure of a constantly driven magneto by representing a belt, when a mere arrow will suffice. He offers some slight improvements in the symbols for ammeters, voltmeters, etc., representing them all alike with a small letter A, V, etc., at the side. He omits the iron core in the inductive resistance, as he thinks it is unnecessary. For ground he uses the old-fashioned arrow-marked earth. The well-known symbol for non-inductive resistance is used for a transformer, and to this he objects. Several other suggestions are made. He urges the need of coming to an early state of uniformity.

ELECTRIC REGULATOR.—"L'Eclairage Elec.," June 18.—An illustrated description of the Maquaire regulator, which can be applied to various purposes, as, for instance, to the regulation of the pressure of the gas. A membrane on which this pressure acts closes one of two opposite contacts, when it moves in either direction; the contact lever is connected to a third brush on a small motor, which is placed midway between the other two brushes; when either of the contacts are closed the current circulates between that brush and one of the two others, turning the motor in either of two directions, which, by means of gearing, operates a valve or other regulating device.

ENAMELS FOR HEATING APPARATUS.—"L'Eclairage Elec.," June 18.—A brief account of the researches of Damour, in which he endeavored to find an enamel which has a high expansion coefficient to be used for imbedding wires used in electrical heating apparatus. The principal ingredient seems to be the natural borate of calcium; various compositions are given, with their coefficients, which are very nearly equal to those of platinum, iron or nickel.

ALUMINUM FURNACE.—Lond. "Elec.," June 24.—A brief account of the researches of Goldschmidt, which were referred to in the "Digest" May 28 and June 4.

A Large Warehouse and Repair Shop.

In facilitating its relations with that large class of its customers located in the Middle and Northwestern States, and dealing directly with its Chicago sales office, the General Electric Company has found the large warehouse and repair shop which it has established in that city of the greatest value.

The warehouse and repair shop occupy a commodious and well-lighted six-story and basement building, abutting on the main lines of three railroads; also on the Belt line, which connects with all the other railroads radiating from Chicago. From these, into a special spur by the side of the warehouse, the cars of any of the roads may be switched.

Wire Cable and Original Packing Room.

The top, or sixth floor, is devoted to the storage of unbroken packages of arc lamps, porcelain and glass insulators, insulator pins and cross arms, armatures of the older types of machines, etc. On the fifth floor is stored a stock of incandescent lamps in original packages ready for immediate shipment, fan motors, arc-lamp globes in broken lots, arc-lamp carbons, etc. At the time of writing this the incandescent lamps of various candle-powers, voltages, etc., in stock numbered roughly about 500,000, which number is kept constantly on [illegible] Edison Lamp Works, at Harrison, N. J.

The fourth and third floors are laid out in floor bins and wall cupboards, the latter divided into pigeonholes of various sizes. Each bin and each pigeonhole bears the catalogue number of the device or part it contains. On the fourth floor are the larger wiring supplies and parts, arc lamps single and double carbon series and open and enclosed arcs for direct or alternating circuits; car resistances, and meters and type "H" transformers of all sizes in the original factory boxes ready for re-shipment at the shortest notice. In the bins on the third floor are the smaller wiring supplies and parts: Fuses, sockets, switches, cut-outs, lightning arresters, arc-lamp parts, dynamo-motor parts, brushes, both copper and carbon, line material of all kinds, controller parts, rheostats, assembled commutators and a full stock of the new C. A. [illegible]

[illegible] equipped with lathes, plan-

[illegible]

[illegible]

above this floor and out over both railroad tracks and the street and greatly facilitates the shipment or reception of the cases of supplies or apparatus. The basement contains the power plant, consisting of two 80-hp boilers and two horizontal engines, one of 100 horse-power, used for dynamo testing purposes, the other a 50-hp engine, belted to a direct-current machine, from which the lighting and power current used in the building is supplied, and to a 20-kw alternator used for meter and other testing purposes. The basement also contains a boiler feed pump, a water heater, a large fire pump, four large steam-heated ovens for baking armatures and dynamo field coils, and a switchboard divided into three sections equipped for testing high-tension series arc machines, direct-current low-tension machines and alternating testing work. Beneath the sidewalk is kept a large stock of insulating oil for transformers. The different floors are connected by a 4-ton elevator.

Electric Power in New Bridge Manufacturing Shops.

The shops of the Youngstown Bridge Company, Youngstown, Ohio, which were destroyed by fire in September of last year, have been entirely rebuilt on a much larger scale. The electric power plant comprises a Buckeye engine, Style B, of 150 horse-power, which drives a six-pole compound-wound Edison dynamo of [illegible]-kw capacity, running at a speed of 550 revolutions. The voltage of the dynamo is 250 to 275. It is arranged to furnish current to three circuits, one for power, one for arc lights and the third for incandescent lights. The switchboard is provided with one 500-ampere L-circuit breaker, Weston voltmeter and ammeter, one double-pole main switch and four double-pole feeder switches. The rheostat is mounted on the back of the board.

Meter and Lamp Testing Department.

There are in the works twenty-five 2000-cp arc lamps, 100 16-cp 250-volt lamps and four motors, all of which are supplied with current from the one generator. One of the four motors is of 35 horse-power, running at 600 r. p. m. at a pressure of 250 volts. This motor operates a group of eight machines, consisting of punches, angle shear, plate shear and Sturtevant blower. A second 35-hp motor operates another group of machines, seven in all, including drill presses, rotary planers, bending rolls and rivet header. A 10-hp slow-speed motor, running at 850 r. p. m., operates a straightening machine, cold saw, radial drills and a large emery grinder. The fourth motor, which is also a slow-speed motor of 5-hp, runs at 1000 r. p. m. This motor drives a circular saw and a wood-boring machine.

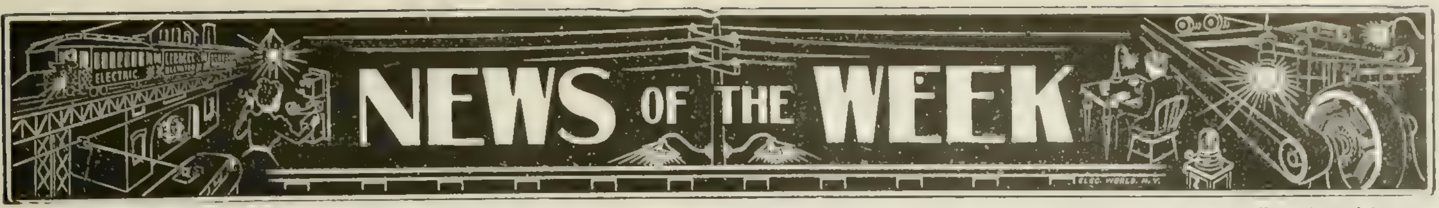
In addition to this equipment the company also has ten 1-hp electric hoists. When all the machines are in operation, and all the lights in use, the greatest amount of current used is [illegible] amperes.

The steam generating plant includes two 100-hp and one 75-hp boilers, which supply steam, not only to the main engine, but also to a steam hammer, several air compressors and a steam riveter. The several motors referred to above

Electric Power in Bridge Manufacturing Shop.

[illegible] directly [illegible] building, an interior [illegible] of the [illegible] feet apart, and are [illegible] tons to 10 tons [illegible] the shop.

The company [illegible] bridges for [illegible] steam and electric railways and [illegible] buildings [illegible] electric power stations, etc., and general structural work.



NEWS OF THE WEEK

Financial Intelligence.

BRYANT ELECTRIC COMPANY, Bridgeport, Conn., has increased its capital stock from $75,000 to $100,000.

GENERAL ELECTRIC COMPANY'S AFFAIRS.—It is stated that at a meeting in Boston of the General Electric Preferred Stock Committee the proposal of the directors to reduce the stocks of the company, both preferred and common, 40 per cent., to $60 par value, was considered. A majority of the committee decided not to recommend this proposition to the preferred stockholders.

Special Correspondence.

NEW YORK NOTE.

Office of THE ELECTRICAL WORLD,
9 Murray St., NEW YORK, July 11, 1898.

THE A. I. E. E.—At the meeting of the Executive Committee of the American Institute of Electrical Engineers, June 24, Mr. C. O. Mailloux, of New York, was elected a vice-president of the Institute to fill the vacancy caused by the election of Dr. A. E. Kennelly to the presidency. Mr. Robert N. Baylis was also appointed a member of the Board of Examiners, succeeding the late Dr. Charles E. Emery. The following associate members were elected: Walter Cummings Allen, inspector of electric lighting, Government of District of Columbia, Washington, D. C.; Albert H. Armstrong, electrical engineer, General Electric Company, Schenectady, N. Y.; George A. Damon, with B. J. Arnold, electrical engineer, Chicago, Ill.; Frank H. Dexter, student Cornell University, Ithaca, N. Y.; P. M. Downing, superintendent electrical department Blue Lakes Water Company, Blue Lakes City, Cal.; Joseph Lyons, patent solicitor, with Gustav Bissing, Washington, D. C.; Alfred A. Thresher, electrical engineer and proprietor Thresher Electric Company, Dayton, Ohio; William B. Jackson, New York and Staten Island Electric Company, West New Brighton, N. Y.; Paul M. Lincoln, electrical superintendent Cataract Construction Company, Niagara Falls, N. Y.; Thoburn Reid, consulting electrical engineer, New York City; Philip Green Gossler, electrical engineer, Royal Electric Company, Montreal, P. Q.; Theodore E. Theberath, Pacific Coast engineer, Stanley Electric Company, San Francisco, Cal.; Frederick M. Pedersen, assistant electrical engineer, Crocker-Wheeler Electric Company, New York City; Will K. Dunlap, electrical engineer, Westinghouse E. & M. Company, Niagara Falls, N. Y.

NEW ENGLAND NOTES.

Branch Office of THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., July 9, 1898.

MR. CHARLES E. NEWTON, secretary of the Jewell Belting Company, Hartford, Conn., has our sympathy, also the sympathy of the entire electrical field, over his recent bereavement through the death of his estimable wife, Mrs. Alice Huntington Newton. Mrs. Newton was the daughter of Prof. Charles W. Huntington.

MESSRS. WILLIAM J. MURDOCK & CO., Boston, report a good demand and sale for the "M" telephone receiver, which is the pony type, high grade, bi-polar, with hard rubber case, plate-binding posts, double-pole magnet of the best magnet steel, weighs 12 ounces and will operate any standard switch. The magnet is supported near the diaphragm, so that the change in temperature does not affect adjustment.

THE BIBBER-WHITE COMPANY, Boston, has recently acquired by purchase all rights, title and interest in the stock, tools, factory and good will of the American Electric Company, Boston, manufacturer of burners and fittings. The Bibber-White Company will continue to produce such goods as were manufactured by the American Electric Company, including the "New Era" and "Victor" burners, keeping a large stock constantly on hand from which shipment can be made.

THE BOARDMAN-TUCKER COMPANY, Boston, Mass., manufacturers of telephones and specialties, reports a very nice business. Its common battery system is attracting favorable recognition from the trade, as is also its transmitters and new receiver, which possesses important features, and is sold separately or in connection with its combination sets. Mr. Boardman, electrician of this company, is well and favorably known to the telephone industry, and Mr. F. S. Tucker, his associate, is possessed of admirable practical knowledge and experience regarding the manufacture of telephones.

MR. T. W. NESS, of the Holtzer-Cabot Electric Company, Boston, has just returned from an extended Western trip, during which he visited telephone exchanges. He reports the outlook as very encouraging for the independent telephone business, old and cheap apparatus being rapidly discarded for better and more efficient, and as the Holtzer-Cabot apparatus is prominent in the latter classification, particularly the new automatic switch and intercommunicating system, Mr. Ness was able to book quite a number of good orders. His trip was successful beyond even sanguine expectations.

MR. F. A. SWAN, well known in electrical circles in Boston, has recently purchased the business of the old Boston electrical establishment of Charles L. Bly, 37 Pearl Street, in business since 1864, and in which Mr. Swan served his apprenticeship some twenty years ago. Mr. Swan will continue the business at the old address, largely increasing the facilities. It is quite safe to say that the excellent business which this old firm has always commanded will not only be held by Mr. Swan, but that it will be materially enlarged because of his wide acquaintance and intimate knowledge of electrical construction and the manufacture of electrical specialties.

TRAVELERS on the New York, New Haven & Hartford Railroad, as they pass through Jamaica Plain, near Boston, Mass., now look out on the large manufacturing establishment of the B. F. Sturtevant Company, and wonder at the disappearance of the tall boiler chimney, which previously stood as an evidence of so much invested capital. It had, however, outlived its usefulness, and its value was measured only by the possible utilization of its bricks, for a substitute had been installed in the shape of a Stutevant fan for providing the draft. The invisible products of combustion are now discharged through a small stack extending such a short distance above the boiler house roof as to be hardly noticeable. Thus does the new and efficient method push out that which is old and wasteful. No longer is a manufacturing plant to be identified by the existence of a tall chimney, for the time is at hand when the progressive engineer will seek for a more convenient and efficient substitute. The boiler plant is of about 300 horse-power, and is effectually served by a fan having a wheel 54 inches in diameter, driven by a direct connected upright engine whose speed is so regulated that it increases as the steam pressure falls, and thus maintains practically constant steam pressure. A mixture of half and half Cumberland coal and yard screenings is used with absolute smokelessness, and in a recent test the Orsat apparatus gave no evidence of the presence of any carbonic oxide in the gases. An efficiency of 11.05 pounds of water evaporated into dry steam per pound of combustible was shown at a combustion rate of 16.45 pounds per square foot of grate. With the plant of sufficient size to warrant the introduction of an economizer, the otherwise wasted heat of the gases (although their temperature is only about 450 degrees) could be readily utilized.

PHILADELPHIA NOTES.

Branch Office of THE ELECTRICAL WORLD,
929 Chestnut Street,
PHILADELPHIA, Pa., July 9, 1898.

THE STANDARD CONDUIT manufactured by the Standard Fireproofing Company, Perth Amboy, N. J., is reported to be meeting with great favor in Philadelphia, and is rapidly coming to the front. The company reports that it will lay about 200,000 feet of its conduit within the next few months. The company's exhibit at the Philadelphia Exhibition attracted the attention of those interested in that particular line, and Mr. M. J. Harrington, who had charge of the exhibit, did some good missionary work on behalf of his company.

MOORE VACUUM TUBE LIGHTING AT THE EXHIBITION.—One of the most popular features at the Electrical Exhibition at Philadelphia was the vacuum tube exhibit of Mr. D. McFarlan Moore. This system of illumination was very attractively exemplified in the lighting of a Turkish smoking room luxuriously furnished in true Oriental style. On the walls of the apartment near the ceiling were curved glass tubes about 2 inches in diameter, set off with highly polished brass fixtures. From each corner to the centre of the vault there is an arch span of glass, which, with those along the walls, gave out the characteristic light of vacuum tubes. The room was wired on the Moore three-wire system; that is, the tubes were connected in parallel between two wires. These wires entered the top of a small polished oak cabinet, which contained all the apparatus necessary to operate the tubes. The power was taken from the street railway mains of the Edison Company, and high tension was obtained by induction coils in the "rotator vacuum brake," which has already been described in the columns of THE ELECTRICAL WORLD.

THE FRANKLIN ELECTRIC SUPPLY HOUSE has been established by Mr. H. P. Feister at 506-508 North Street, near Fifth and Arch Streets. Mr. Feister was owner and proprietor of the Franklin Machine Works, Philadelphia, which he successfully carried on for many years. As a business man, financier and manager he is successful, and his abilities in these directions bespeak for the new enterprise success from the start. He has secured agencies for the following named concerns: The Commercial Electric Company, dynamos and motors; the Highland Electro-Chemical Manufacturing Company, Highland soldering paste; the W. S. Hill Electric Company, switches and switchboards; the Ohio Electric Specialty Manufacturing Company, automatic motor starters, commutator lubricant, Perfection brushes, woven-wire brushes and leaf copper brushes; McNamara Brothers, slate and marble for all purposes; Riley Brothers, magic lanterns, stereopticons, kineoptoscopes; Schmidt & Bruckner, "Twentieth Century" telephones; Prismatic Electric Sign Company, "Prismatic" electric signs; Oshkosh Logging Tool Company, electric construction tools; John Rauscher, push buttons; the Franklin incandescent lamp; American burners; Crefeld wire and cables.

WASHINGTON NOTES.

WASHINGTON, D. C., July 9, 1898.

A DEED OF TRUST upon the plant and stock of the Potomac Electric Power Company for $750,000 has been filed. The capital stock of the company will be increased from $500,000 to $1,000,000.

TELEPHONE RATES.—A bill making appropriations for the District of Columbia for the fiscal year 1898-99 contains the following clause: "That from and after the passage of this act it shall be unlawful for any person or any telephone company doing business in the District of Columbia to charge or receive more than $50 per annum for the use of a telephone on a separate wire; $40 for each telephone, there being not more than two on a wire; $30 for each telephone, there being not more than three on a wire, and $25 for each telephone, there being four or more on the same wire." It is stated that the enactment of this provision was brought about after an active campaign by the local telephone users and consideration of the subject by both Houses of Congress. It is highly probable that the Chesapeake & Potomac Telephone Company will use all the means at its command to thwart the efforts of those who desire to see the law upheld, but there sems to be a very general and decided inclination among users of telephones to compel it to obey. This sentiment, it is thought, will undoubtedly lead to organized action by telephone users. The plan now being considered includes a purpose on their part to decline to pay a larger sum for telephones than the law permits, taking the ground that by so doing they will violate the law. In case the company should attempt to remove the instruments from the premises of those refusing to pay more than the legal tariff, the latter will secure injunctions from the courts and thus the question would be brought up for final settlement.

BUFFALO AND NIAGARA FALLS NOTES.

BUFFALO, N. Y., July 9, 1898.

THE NIAGARA GORGE RAILWAY, a trolley system, is now a part of the through line from Lake Erie to Lake Ontario, an arrangement having been made with the New York Central Railroad.

THE BUFFALO POLICE DEPARTMENT has learned that for three times the annual rental of the Bell telephone plant it can buy a system of its own, and steps have been taken to put the discovery into practice. Contracts for 155 receivers have been awarded to the Wilhelm Telephone Company, of Buffalo, on its bid of $2.25 each, and for as many receivers to the Pennsylvania Electric Company, on its bid of $3.77 each. Several bids are in for cables, but no awards have been made.

THE FIGHT between North Tonawanda and the Ely Trolley Company over the location of the tracks of the company's new line from Buffalo to Lockport is over, the town appearing to come out best, as a 3-cent rate, with transfer privileges, was secured to laboring men in the corporation, and a 25-cent rate to Buffalo and return, all day, to anyone. In return the city granted Mr. Ely all the privileges now enjoyed by his Niagara Falls line. The next fight is likely to be with the steam roads for a right to cross their lines at North Buffalo.

THE CATARACT POWER & CONDUIT COMPANY is about to establish a new distributing station near the city line where the power cable comes in from Niagara Falls, and bought a piece of land for the purpose. It is not on the present line, but the line of conduits that are now being laid will pass through the building, which is to be the point of union of the two methods of transmitting the current. It seems not to be settled whether to put any transformers in the station at present or not, but this will not be done probably till there is a demand for power in that vicinity.

PITTSBURG NOTE.

PITTSBURG, Pa., July 8, 1898.

TROLLEY CAR EXPRESS SERVICE.—The Consolidated Traction Company has had introduced into councils an ordinance giving it the privilege of running express cars on three of its lines. If the ordinance is passed the company proposes to establish a regular express service between the city and East Liberty. The success of the mail cars now in operation indicates, according to President C. L. Magee, that it is feasible to operate express cars, and the introduction of them will materially reduce the number of delivery wagons on the streets. It is proposed to establish distributing stations at intervals along the lines, where light wagons can call for and leave packages, thus avoiding the necessity of long hauls by horse-power.

CHICAGO NOTES.

Branch Office of THE ELECTRICAL WORLD,
936 Monadnock Building,
CHICAGO, Ill., July 9, 1898.

MR. W. D. SARGENT, president of the International Brake Shoe Company, Chicago, sailed for Europe last week to make arrangements for the manufacture of the Diamond "S" shoe in several European countries, including Russia. The success of this shoe since its introduction last fall has been little short of phenomenal, and it is doubtful if any railway device of recent invention has been so thoroughly and consistently pushed on all occasions as this brake shoe has been.

A CONFERENCE was held a few days ago between the superintendents of the Chicago Edison Company, the Chicago Telephone Company, the Postal Telegraph Company and the Western Union Telegraph Company and Commissioner [illegible] to consider the subject of manhole explosions. Means for preventing the recurring occurrence of these accidents was considered, and the companies agreed to put in new and improved ventilating apparatus. It is expected that fewer accidents of the kind will result from the installation of the improved devices.

MILWAUKEE NOTES.

MILWAUKEE, Wis., July 8, 1898.

JUDGE [illegible] of the United States Circuit Court, has handed down his opinion in the suit of the [illegible] Company against the American [illegible] Company [illegible] of Milwaukee in favor of the petitioner. The [illegible] to prevent the defendant company from further manufacturing of certain types of [illegible] and [illegible] the court deciding that the defendant has been infringing the patent of the complainant.

MAYOR [illegible]

that the conditions are vastly different now, that the company stands in a better position to grant a 4-cent fare than it did in 1896, this contention is denied. The company is not in the least alarmed at what the city proposes to do.

ST. LOUIS NOTES.

ST. LOUIS, MO., July 8, 1898.

MUNICIPAL WIRES TO BE BURIED.—The Council has decided that the city's wires should go underground. A motion that the Council appropriate the $53,000 necessary was made. The amounts allowed the various departments will be cut in order to find the money.

THE PRESIDENT of the Terminal Railroad Company says that after a thorough search he has failed to find any practical plan by which the steam engine now used in the tunnel and railroad yards can be satisfactorily substituted by electric motors. The large number of trains hauled by the company on the St. Louis and East St. Louis yards and through the tunnel could not be properly cared for with the electric engines now obtainable, he says.

THE PROMOTERS of the electric railway which is to connect St. Louis, Alton, Collinsville, Edwardsville, Venice, East St. Louis and other towns in Madison County, met at Edwardsville this week and elected the following officers: Charles E. Carroll, president; John A. Mehling, vice-president, and August Holthaus, secretary and treasurer. Application has been made for incorporation papers, and as soon as they are received the work of securing franchises will be begun.

THE STRIKE OF ELECTRICAL WORKERS.—A conference was held last week between members of the Electrical Exchange and the secretary of the Building Trades Council, who represented the Electrical Workers' Union, and an agreement between the electricians and their employees was reached. The members of the Exchange agreed to pay the wage scale asked for by the union, which is $3 per day, for a period of three years. It was also stipulated that the men can only work for the firms which are members of the exchange, and in case they work for outside parties they lose their standing in the Building Trades Council. It was also agreed that all firms not members of the exchange should join at once.

COLORADO NOTES.

DENVER, Colo., July 7, 1898.

LARGE LIGHT AND POWER PLANT.—The Rocky Mountain Power Company has just been incorporated to build a large light and power plant in Lafayette, Col. It is the purpose of the company to furnish current to the coal and metalliferous mines that are located at and near Lafayette.

GOLDFIELD POWER PLANT.—It is announced that the large electric power plant at Goldfield, Col., will be completed in three months. The plant is being built by the Smith-Moffat syndicate, of Denver, and it will supply power to supplant steam in mines in the Cripple Creek district. One of the local papers says that "another year will find a large percentage of the mines in the Cripple Creek district operated by electric power. Steam will be to a large extent superseded as a motive power for hoisting and air-compressing, and will be used only for pumping."

INSURANCE CASE.—The Denver Consolidated Electric Company was victorious in the suit brought against it by a score of insurance companies. The suit grew out of the destruction by fire of the Denver Union depot in 1894. After the insurance companies had paid over $60,000 in fire losses they came to the conclusion that the fire was due to the crossed wires of the electric light company, and action was brought to recover the amount paid out as fire loss. When the case came on for trial in the district court Judge Johnson granted a non-suit on the ground that no negligence or responsibility had been proved against the electric company.

RECEIVERSHIP FOR CABLE COMPANY.—Edward C. Baggs has been appointed receiver for the Denver City Railroad Company, which operates the cable system of Denver. The appointment of a receiver was made upon application of the bondholders of the road, who have failed to receive their interest. The failure of the company is due to the fact that the cable system is so expensive a means of operation. The company has long realized the truth of this assertion, and, as has been noted in this correspondence, has made application to the city government for the privilege of introducing the trolley system. It is thought not unlikely that if the application had been promptly granted the receivership might have been averted. The ordinance giving the company a franchise to change its motive power has been adopted by the Board of Aldermen, but it hung up in the Board of Supervisors. Opposition has been made to the grant on the ground that the company does not offer to pay a high enough price. It agrees to pay $2500 per annum for twenty years, but a certain class of persons makes a demand that it pay a percentage on its gross receipts, which would amount to a sum considerably in excess of what the company is willing or probably would be able to pay. It is believed that when a scheme for the reorganization of the company is agreed upon it will proceed on the theory that the trolley system shall be introduced. The company has been in financial difficulties since 1894, when G. E. Randolph was appointed receiver. He held the position for three years until a reorganization was effected. At that time [illegible] in bonds were issued, and no interest has been paid.

PACIFIC COAST NOTES.

SAN FRANCISCO, Cal., July 3, 1898.

THE ELECTRIC LIGHTING PLANT in Dayton, Ore., may be purchased by the town authorities and operated as a municipal plant.

THE MARKET STREET RAILWAY COMPANY, San Francisco, recently declared dividend No. [illegible], of [illegible] cents a share, on its issued capital stock, for the quarter ending June [illegible].

THE SAN FRANCISCO ELECTRICAL COMPANY, H. P. Thayer, manager, now occupies new salesrooms at 31 Second Street, with a large stock of telephone and other electric supplies.

THE NEW FORTIFICATIONS at Magnolia Bluffs, near Seattle, Wash., will be well lighted by electricity, the War Department having increased the appropriation to $84,000. The contracts for lighting and heating have been let.

THE COMMERCIAL LIGHT & POWER COMPANY, San Francisco, is erecting a brick central power station on Battery Street, near Pacific. A Stanley two-phase electric equipment will be operated by McIntosh & Seymour compound engines.

THE CALIFORNIA AUTOMATIC TELEPHONE COMPANY, San Francisco, recently gave a press reception, which was attended by many representatives of the daily and technical press. The working of the improved switchboard was thoroughly demonstrated.

THE STANDARD ELECTRIC COMPANY, of California, recently made application for a franchise for the erection of a transmission line from Lake Chabot, via Haywards, into Oakland, Cal. This application is for the last section of the projected line from Blue Lakes, in Amador County, to San Francisco Bay. Franchises and rights of way through private lands have already been secured through Amador, Calaveras, San Joaquin and Contra Costra Counties by L. C. Bullock, who is associated with Prince Andre Poniatowski in the project of transmitting power 110 miles to San Francisco.

MR. WYNN MEREDITH, who has been acting as construction engineer for Hasson & Hunt, consulting electrical engineers, for several years past, has gone to Unalaska, where he will do electric work for the Alaska Commercial Company. A number of steamboats has been built in the vicinity of Unalaska, which are to be equipped with electric lighting plants. Mr. Meredith was a constructing engineer at the World's Fair and assistant electrical engineer at the California Mid-Winter Fair. He has done important work at the Folsom plant, Nevada County plant, Los Angeles street railway plant and, lately, on the new water-power electric plant, near Victoria, B. C.

CANADIAN NOTES.

MONTREAL, Que., July 6, 1898.

THE RATEPAYERS of Thorold, Ont., will be asked to sanction a loan of $7000 to extend the electric light plant.

AN ELECTRIC LIGHT PLANT will likely be installed to furnish public and private lighting at Maniwaki, Que.

THE LOCAL electric company at Wallaceburg, Ont., has agreed to install an incandescent plant within eight months.

THE TELEGRAPH and electric light companies at Lindsay, Ont., will probably be asked to lay their wires underground.

A JOINT STOCK COMPANY is being formed for the purpose of constructing electric light and waterworks systems at Shawville, Ont.

THE CITY COUNCIL of Brantford, Ont., has decided to dispense with gas for lighting purposes, and will call for tenders for electric light; also for installing an electric light plant, to be controlled by the city.

ORILLIA, ONT.—Tenders are invited by the town for a street lighting plant, an incandescent lighting plant, power service and steam plant. Particulars can be obtained from the town clerk or R. J. Clarke, consulting engineer, Toronto.

DR. SHAW, Lucan, Ont., is making arrangements to construct telephone lines to some of the neighboring villages. We understand a line is to be built first to Southgate, in London township, and after to Saintbury and Mooresville.

THE RAILWAY COMMITTEE of the Privy Council at Ottawa considered the bills for electric railways in the neighborhood of Montreal. The North Shore Electric Railway was granted a charter. This company proposes to build a road from Three Rivers along the northern shore of the St. Lawrence. The Montreal & Southern Counties Railway Company was given power to extend its operations to the counties of Beauharnois, Chateauguay, Huntingdon and Napierville. The promoter of both of these undertakings is Mr. A. J. Corriveau.

FRENCH NOTES.

(From Our Own Correspondent.)

PARIS, June 23, 1898.

ELECTRIC LIGHT IN ALGERIA.—The Municipal Council of Oran is considering the proposition made by the gas company to supply electric light to private consumers at a maximum price of 15 centimes (3 cents) per 100 watts, with a reduction of 20 per cent. in the price to the town. The company asks for a franchise to enable it to string wires in the territory of the municipality, and the lease of a strip of land for eighty years, on which to erect a power station.

THE PAYEN ACCUMULATOR.—This system of accumulator plate, the invention of M. Clement Payen, consists of porous crystallized lead, arranged so as to give great strength without sacrificing simplicity of construction. The small porous crystalline lead plug constitutes the active material, and is supported in a square of conducting material arranged so as to assure at all times good contact between the plug and the grid and at the same time allow for the expansion of the lead. The whole arrangement makes it possible to secure good contact and to keep the plates from changing shape or buckling.

ELECTRIC CARRIAGES.—On June 15 the exhibition of electric carriages opened at the Tuileries Gardens. Among them are the many different forms of hacks and cabs which the companies will try to introduce for carriage service in Paris. Some of the more remarkable ones are the following: A coupé, built by Doré; a coupé and a victoria, by Krieger; a coupé and a victoria of the General Electric Carriage Company, and also one of the French Automobile Carriage Company. They have already been put through a preliminary trial over a measured course, and have been subjected to various tests on the expenditure of power required on a level, on a hill, at starting and at various speeds, etc. It is intended also to determine for each carriage the cost of operation per day, the reliability in service and the relative comfort of passengers. The jury has twelve members, six of whom are appointed by the commission for the cabs exhibition and the other six by the exhibitors. At present the compiling of the results has not been entirely completed.

THE MICROPHONE IN WAR TIME.—A new microphone has been exhibited before the Academy of Sciences. It detects at a great distance the approach of a ship, whether an armored vessel or a torpedo boat, and gives its warning with great clearness. It is to be subjected to tests at Cherbourg. Some years ago Commander Banare proposed an instrument which he called a hydrophone, and with which he was able to hear at a distance of a mile or a mile and a half the vibration produced by the screw of a torpedo boat, or the more regular beat of the screw of a large battle ship. It consisted of a water-tight box, the vibratory plate being inside to prevent the pressure of the water from acting on it too directly. The wires from the transmitter were carried first to a float to make sure that the transmitter would be continuously immersed; from the float the wires were carried to a receiver on a ship or on shore. Thus with 2 or 3 miles of wire it becomes possible to receive a warning of the approach of a vessel from 4 to 5 miles distant.

General News.

THE TELEGRAPH AND TELEPHONE.

CURRIE, MINN.—Currie has been connected by telephone with Tracy, Canby, Balaton, Walnut Grove, and the line is to be extended to Avoca, Fulda, St. Paul and Minneapolis.

PORTERVILLE, CAL.—The Mt. Whitney Telephone & Power Company has been sold to J. H. McFarland. It is said to be Mr. McFarland's intention to put the plant in thorough working order.

EVANSVILLE, IND.—A telephone company composed of Evansville capitalists has been organized. The company proposes to construct a line into the counties west of here to connect with the city.

BOONE, IA.—The Boone County Telephone Company has placed an order with the Sterling Electric Company, of Chicago, for a toll board, which, it is stated, will be the finest of its size in the State.

BELLAIRE, OHIO.—Mr. G. M. Daniels has been awarded the contract to build a telephone line from Bellaire to Barnesville, Ohio, a distance of 24 miles. He expects to begin the work of construction at once.

ST. PAUL, MINN.—The Northwestern Telephone Exchange Company has decided to increase its capital stock $1,000,000. It is understood that the toll line system will be extended to the principal points in Minnesota and the Dakotas.

BOSTON, MASS.—It is stated that the local telephone companies, operating under the American Bell patents, will spend in extensions during the year 1898 $12,000,000, increasing the wire mileage at least 150,000 miles and their subscribers 60,000.

ST. JOHN, MICH.—The National Telephone Company has completed its long-distance line to Owosso, connecting at that point with 200 subscribers of the Owosso Telephone Company, also connecting with the long-distance lines of the new State Telephone Company.

BOSTON, MASS.—Mr. Charles Webster, vice-president and general manager of the Western Electric Telephone Company, who was in Boston a few days ago, gave out some interesting facts regarding the independent telephone movement in the West. According to a Boston financial paper, Mr. Webster states that his company's system is composed of 3000 miles of toll lines in operation in Minnesota, Iowa and North and South Dakota. Copper metallic circuits have been built on all the trunk lines, and his company is now erecting a line from St. Paul to Duluth, Sioux Falls, Lacrosse and other places, 1000 miles in length. By January 1, 1899, the company expects to have 5000 miles of wire in operation. The system is composed of the Union Electric Telephone Company, with a capital of $100,000; the Minnesota Central Telephone Company, capital $100,000; the Western Electric Telephone Company, $100,000; the Western Minnesota Telephone Company, $30,000, and the Southern Minnesota Telephone Company, $30,000. After a year's fight the independent companies have obtained franchises in St. Paul and Minneapolis. In Minneapolis, the Minnesota Mutual Telephone & Telegraph Company has been organized with a capital of $300,000, and the company, Mr. Webster states, has already between 5000 and 6000 subscribers on five-year contracts on the basis of $48 per year for long-distance instruments. The new company will not start for a year at least. It is now putting its wires underground. His company, Mr. Webster states, has the largest independent system in the country, although the oldest of the six companies is but three years old. The Northwestern Telephone Exchange Company, which operates in St. Paul and Minneapolis, has recently increased its capital stock $1,000,000 for the purpose of extending its lines.

ELECTRIC LIGHT AND POWER.

BUNKER HILL, ILL.—An electric light plant to be owned by the city will be established at a cost not to exceed $10,000. For $6900 of this amount 5 per cent. fifteen-year bonds will be issued.

LOS ANGELES, CAL.—The Southern California Power Company has let contracts for new electrical machinery to cost $100,000. This new apparatus will be installed at the power house in the Santa Ana Canyon and the distributing points at Los Angeles and Pasadena, at which places the power is to be used.

LANCASTER, PA.—Messrs. F. E. Bailey & Co., representing the Manheim Electric Light Company, have received a contract for lighting the borough of Mt. Joy with electric lights. It has not yet been decided whether to erect a plant in Mt. Joy or to obtain current from the Manheim plant, which is some miles distant.

FAIRMOUNT, W. VA.—The Fairmount Electric Light & Power Company has just secured a five-year contract with the town for 35 2000-cp street arcs at $84 per year, and 30 32-cp incandescents at $15. The company will immediately increase its incandescent plant by about 150 kilowatts in new machines, and 200 horsepower in engines. Mr. Smith Hood is manager and E. S. Aldrich is electrician.

JAMAICA, L. I., N. Y.—The Queens Borough Electric Light & Power Company, recently incorporated, has absorbed the Citizens' Lighting Company, of Far Rockaway. The Queens Borough Company has executed a mortgage to the Colonial Trust Company, of Manhattan, and has issued bonds for $250,000 at 5 per cent., maturing in 1928. The principal stockholders of the new organization are: R. C. Peabody, Van Wyck Rossiter, Joseph C. Biglin, Frank MacGovern, Isaac M. Sutton and T. S. Williams.

OBITUARY NOTE.

DR. CORNELIUS HERZ, who in late years became notorious through his connection with the Panama Canal scandal, died at London, England, on July 6. Dr. Herz was some years ago interested to a large extent in various electrical enterprises in this country and in France. He was born in Besancon, France, in September, 1849, and was three years old when his family settled in America. He was given a university education, and obtained a physician's degree. He joined the French army during the Franco-Prussian war, and at the end of the war returned to the United States. In San Francisco he established an important electric works, and did much toward developing electrical industries on the Pacific coast. Some years after that he returned to Paris, where he founded the paper "La Lumière Electrique," and was among the first to develop the electric light in that city. He became deeply interested in projects for electric railways, and conducted experiments on cables and telegraph lines in France for many months, perfecting his theories, afterward put into practice. Since the Panama Canal scandal in Paris, Dr. Herz has been practically banished from France, residing in England. He was quite wealthy, having made considerable money in promoting electrical enterprises about the time of the first Paris Exposition in 1881. It is thought by some that he was not technically strong, his chief abilities being as a business man and promoter. His property in France was confiscated, and as an American citizen he filed a claim for $5,000,000 against the French Government in the State Department at Washington, which has recently been under advisement.

DR. CORNELIUS HERZ.

PERSONAL NOTES.

CAPT. WILLARD L. CANDEE, managing director of the Okonite Company, sailed for Europe on the Cunard line steamer "Etruria" on July 9.

MR. MAX LOWENTHAL has been added to the staff of "The Electrical Engineer" in the capacity of associate editor. Mr. Lowenthal's training especially qualifies him to occupy a position of this character.

MR. GEORGE C. EWING, of the firm of Huntress & Ewing, Boston, Mass., manufacturers of the National electric headlight, is sergeant in Company F of the First Regiment of Volunteer Engineers, U. S. A. Mr. Ewing's regiment is [illegible] N. Y. [illegible]

MR. E. DYSTERUD, superintendente de la Compania de Luz Electrica y Fuerza Motriz, Monterey, Mexicó, is in the United States visiting important electrical plants and manufacturing establishments. The company is extending its business, particularly in the way of power transmission.

MR. JAMES MITCHELL, of Rio de Janeiro, Brazil, was in New York during the past week. It is Mr. Mitchell's intention to spend the summer in the Adirondacks, returning to his home in South America during the fall. Mr. Mitchell deals exclusively in electrical machinery of American manufacture, and [illegible] Brazil [illegible] trade.

MR. WILLIAM S. BRAYTON, of the New York office of the General [illegible] Mr. Brayton is a graduate of Cornell, and passed through the works at Schenectady [illegible]

LEGAL NOTES.

[illegible]

[illegible]

move laterally to engage with one of the branch conductors. 20. In an electric railway, the combination, with an overhead switch plate having depending ribs, but open at its extremities, of main and branch conductors extending from its two extremities, respectively, a vehicle, an upwardly pressed contact arm attached to the vehicle and tending to move laterally therewith, and a track switch for the vehicle located so as to operate in advance of the conductor switch." "23. The combination, with branching overhead conductors, of a vehicle having a laterally swinging contact arm pressed upward to engage the conductors, and a switch plate at the branching point having depending sides, but open at its extremities, the interior width of the plate between the sides being greater than the thickness of the contact wheel, whereby the wheel is free to move laterally with relation to the main conductor and engage one of the branching conductors." "25. In a branching electric railway, the combination of a track switch, an overhead conductor switch, and a vehicle having a rearwardly extending contact arm, whereby the track switch will operate in advance of the conductor switch. 26. In a branching electric railway, the combination, with a vehicle, of a track switch, an overhead conductor switch, and a contact arm extending upward from the vehicle to the conductor, and so located relatively to the length of the vehicle and the two switches that the lateral movement of the vehicle will give a corresponding movement of the contact device on the conductor switch. 27. In a branching electric railway, the combination, with a vehicle, of a track switch, a contact device consisting of a trailing spring pressed arm having a grooved contact piece embracing the conductor and guided thereby, the said arm being jointed to the car and tending to move laterally therewith, and an overhead conductor switch adapted to engage the contact piece, and whereby the extremity of the arm is flexibly guided from main to branch conductor."

Trade and Industrial Notes.

THE WESTERN ELECTRIC COMPANY, Chicago, has recently mailed to the trade copies of its tool catalogue No. 3. If any of our readers failed to receive a copy one will be sent upon application.

THE E. W. BLISS COMPANY, Brooklyn, N. Y., has placed Mr. W. S. Smith in charge of its Western branch at Chicago. Mr. Smith has been connected with the Bliss Company for a number of years and is a Westerner by birth.

MESSRS. PASS & SEYMOUR, Syracuse, N. Y., have just made a shipment of 16,000 porcelain pieces, aggregating nearly 2 tons, to Mexico. The popularity of the goods of this company is making tremendous strides, not only at home, but in the foreign markets.

A MEETING of the shareholders of the Phœnix Carbon Manufacturing Company will be held at the office of the company, St. Louis, Mo., on August 31, for the purpose of considering and acting upon a proposition to increase the capital stock of the company from $160,000 to $500,000; and also to consider and act upon any other matters which may be brought before the meeting.

EXTENSIVE ADDITIONS.—The Walker Company, on account of rush of work and consequent need of additional space, has found it necessary to add to the large machine shops it already possesses at the Cleveland works. These machine shops alone consist of three bays, each 400 feet long, and the addition will consist of a fourth bay. Work is being rapidly pushed, and the new bay will be shortly completed and ready to receive the large machine tools which are to be placed there.

THOMAS & BETTS.—Robert McKean Thomas, formerly assistant chief inspector in the New York City Electrical Bureau, and Hobart D. Betts, who was connected with the inspection bureau of the Edison Electric Illuminating Company, have formed a partnership, the firm being known as Thomas & Betts. Both are well and favorably known to all interested in electrical work in this city. Their offices are at 141 Broadway, Washington Life Building, where they will engage in electrical engineering. They are agents for Loricated Conduit, manufactured by the Safety Conduit Company, Rankin Station, Pa.; the Helios arc lamp, made by the Helios Electric Company, Philadelphia, Pa., as well as for the refrigerating apparatus of the Hygienic Refrigeration Company, whose factory is at Bridgeport, Conn.

THE BERLIN IRON BRIDGE COMPANY, of East Berlin, Conn., is furnishing and erecting for the People's Light & Power Company, Jersey City, N. J., a new boiler house in connection with its electric plant. The building is a modern structure in every respect. It is 60 feet wide and about 90 feet long, contains ample space for large upright boilers, and has an arrangement for the storage of coal in the steel bunker inside the building, so that the fuel can be easily taken direct to the boilers. The tracks are arranged so that railroad cars will run into the building and discharge the coal directly into the bunker. It is of fireproof construction throughout, with steel frame, brick side walls and iron-roof covering, well lighted and ventilated. Sandford & Stillman, of Jersey City, have the contract for the building.

[illegible] C. STERLING & SON, Monroe, Mich., report an excellent [illegible] the spring and summer. They [illegible] demand for their stock, and have their poles piled and [illegible] shipment, for which they are noted. This firm has catered to the electrical construction trade almost from [illegible] one of the oldest cedar firms in the [illegible] many hundreds of thou[illegible] that they dispose [illegible] without putting a repre[illegible] the best [illegible] telephone companies.

THE [illegible] COMPANY [illegible] from the Union Carbide Company [illegible] of the alternating type for the [illegible] Sault Ste. Marie. The order calls for twenty 500-hp alternating current generators, single phase, sixty cycles, to de[illegible] there will be five [illegible] and a complete switchboard. The [illegible] rights of manufacture of [illegible] in the United States, and [illegible] its main works at Sault

Ste. Marie. The output of the Soo plant will be about 100 tons per day. The works are to be built for the accommodation of forty generators and forty electric furnaces. This contract, which is the initial order for the apparatus for this plant, is said to be the largest ever placed at one time for alternating machinery.

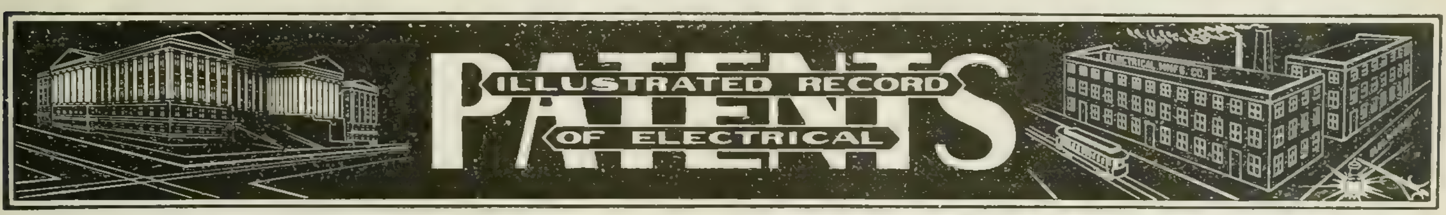
THE BABCOCK & WILCOX COMPANY, of New York, manufacturer of the water-tube boiler of that name, has just gotten out the thirteenth (1898) edition of its magnificent book, "Steam, Its Generation and Use," together with its catalogue. This edition, like all previous editions, is one of the handsomest volumes of its kind ever gotten out, and treats in a most practical and interesting way of the boiler, its uses and misuses, its history, practical conditions and problems which have had to be met with, and showing the gradual and careful steps in the evolution of the Babcock & Wilcox water-tube boiler. The book is beautifully illustrated, not only with cuts of the Babcock & Wilcox boiler, but also with interesting scenes from all over the world, showing the prominent buildings and structures, the operation of which is dependent upon this boiler, which is so widely distributed. It is a book that no central station manager or manager of an isolated plant, architect or engineer should be without. Judging from the enormous editions gotten out from year to year, it is certainly not the fault of the Babcock & Wilcox Company if everyone interested is now provided with a copy. It is a most valuable addition to anyone's library.

THE NON-POLARIZING DRY BATTERY COMPANY, 625 Broadway, New York, is meeting with success with its non-polarizing dry battery. This battery is known as the "O. K." dry battery, and the fields for its use and the demand for it in these fields are rapidly increasing. The fact that the company is supplying the largest independent telephone companies and leading railways for signal work, and also that the battery has been adopted by the United States Government, whose standard everyone knows is of the highest, is certainly proof of the excellent qualities it possesses. The battery is always instantly ready for use, and can be placed anywhere. The company claims that it is not affected by heat or cold. Its use in conection with bell work, telephones, medical batteries, cataphoric boxes, bicycle bells, etc., is increasing every day. The battery has remarkable recuperative power after severe work. The batteries are made in five sizes, and can be furnished either square or cylindrical in shape. It is claimed that it will do the work of an ordinary wet battery of four times its size. The Non-Polarizing Dry Battery Company is publishing some very interesting circulars in regard to the O. K. battery, which will be cheerfully sent on application

THE E. G. BERNARD COMPANY, Troy, N. Y., has completed its contract for finishing the electrical work in the state capitol at Albany, N. Y. The company contracted to do this work in thirty working days, but finished it five days ahead of time. It was thought by the authorities in charge to be a physical impossibility to do the work in less than sixty days, at the least. All the other competitors, it is stated, required eighty-five to ninety days. The company installed about 7000 lights, including switchboards, mains, feeders, branches, etc. This contract is thought to be one of the most difficult of the kind ever undertaken and accomplished in such a short time. There were about sixty granite newel posts, in which a vertical hole 9 to 17 feet long and 2 inches in diameter had to be drilled. These vertical holes had to be met by horizontal holes, running from 4 to 8 feet long. In drilling the horizontal holes, the men were obliged to lie in trenches about 18 x 20 inches. All the wire used was special, and special dies had to be made in order to get the right size of lead covering. The alloy of this wire was also special and different from the standard. All switchboards, cabinet boxes and floor boxes were especially designed. About seventy-five men were employed on the work. The accomplishment of this difficult piece of work is certainly very creditable to the Bernard Company, and shows the ability and facilities of the company for rapidly installing large and special work in its line.

Business Notice.

THE ILLUSTRATIONS in this issue were made by the Photo-Engraving Company, 9-15 Murray Street, New York City.



UNITED STATES PATENTS ISSUED JULY 5, 1898.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

11,676. STORAGE OR SECONDARY BATTERY; R. Ashley, of Port Republic, N. J. App. filed April 9, 1898. An electrode for a storage or other battery consisting of the horizontal, straight and corrugated metal strips alternating with each other, and the spacing pieces between the ends thereof and soldered thereto.

606,646. RHEOSTAT; H. B. Cutter, of Philadelphia, Pa. App. filed June 22, 1897. The combination of a rheostat, an automatic magnet circuit breaker, adjustable with respect to the normal flow of current necessary for its actuation and means for preventing the closing of the circuit breaker when the rheostat arm is in certain positions.

606,658. MACHINE FOR PUNCHING TELEGRAPHIC PAPER; G. M. Gibson, of Chulmleigh, England. App. filed July 26, 1897. The combination of three rows of punches, cross bars fixed to the punches of the middle row, collars on the other punches bearing on the cross bars, and means for operating the punches of the two outer rows.

606,663. ELECTRIC RAILWAY; J. C. Henry, of Denver, Col. App. filed March 28, 1898. An electric controller, comprising an insulating cylinder, a series of contacts mounted thereon, a plurality of annular magnets surrounding and mounted on said cylinder, and having extensions projecting into proximity with such contacts. ·

606,664. ELECTRIC RAILWAY; J. C. Henry, of Denver, Col. App. filed April 7, 1898. The combination with two electric motors having their field magnets connected in circuit by connections independent of their armatures, of controlling devices for changing the said field magnets from series to parallel relation.

606,693. AUTOLUMINOUS COMPOSITION; A. Syssoyeff and L. Braly, of Lyons, France. App. filed Dec. 14, 1897. An autoluminous composition formed of a mixture, in suitable proportions, of the soluble sals of rhodium and ruthenium freed from elements foreign to their group or family, and the soluble salts of cerium and vanadium, in suitable proportions.

606,711. TROLLEY HEAD; C. Grover, of Kansas City, Mo. App. filed Nov. 13, 1897. In a trolley head, the combination with a fork of a tubular spindle mounted therein, a trolley wheel mounted to rotate upon said spindle, said spindle provided with an opening through the wall thereof, and a contact plug arranged with said tubular spindle and projecting through said opening and into contact with said wheel.

606,726. INCANDESCENT LIGHTING SUBSTANCE; William Mahler, of New York, N. Y. App. filed July 31, 1897. A mantle or hood for incandescent lighting, composed of a large percentage of thorium oxid, a small percentage of cerium oxid considerably smaller than the percentage of cerium oxid.

606,716. ELECTRIC LIGHT SWITCH; F. L. Temple, of St. John, Canada App. filed Oct. 7, 1897. In an electric-light switch, the shears-like levers or members, having their upper portions or jaws adapted to readily receive between them the inner end of the door key, and the spring metal electric conductors, with their lower ends adapted to be connected to electric wires, and having upper end engaging contact points, said levers or members also having insulated projections or studs adapted to engage said spring conductors and hold said contact points in engagement with the aid of the door key.

606,761. METHOD OF AND APPARATUS FOR GENERATING ALTERNATING CURRENTS; M. Hutin and M. Leblanc, of Paris, France. App. filed March 13, 1894. The method of generating alternating electric currents by causing electrical alternations of the desired frequency and reinforcing the same to the desired volume.

606,762. ALTERNATING CURRENT DYNAMO; M. Hutin and M. Leblanc, of Paris, France. App. filed April 19, 1895. The method of generating alternating electric currents, by rotating an armature circuit or circuits closed upon themselves, within inductive proximity to a resonant circuit traversing an alternating magnetic field or fields, with a speed exceeding the frequency of electrical oscillations in the resonant circuit, divided by half the number of poles of the field.

606,764. TELEPHONE EXCHANGE; F. A. Lundquist, of Chicago, Ill. App. filed May 19, 1897. In a circuit closing device, a crank, a pitman connected thereto, a mercury receptacle into which said pitman is thrust by said crank, means for causing said crank to stop at a fixed position, and connections for permitting said crank to be rotated by the hand.

606,769. ELECTRIC HEATER OR RHEOSTAT; D. Van Rensselaer Sill, of New York. App. filed May 29, 1897. An electric heater or rheostat, consisting of an outer shell and a resistance filling therein in the form of a spiral layer or comminuted material with the convolutions in contact.

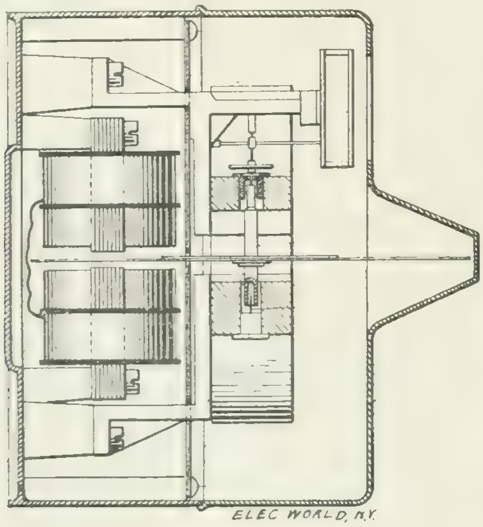
606,771. FUSE BOX; J. B. Smith, of Manchester, New Hampshire. App. filed Feb. 23, 1897. In a fusible cut-out, the combination, with a box provided with partitions, the upper edge of each of which is provided with a notch, and the inner edges of the walls of the box is recessed or provided with a shoulder even with the top of the partitions, the notches being out of alignment with each other and the central partition being provided with a shouldered opening extending from the bottom of the box to the top of the partition, and each end wall of the box being provided with an opening, a cover for the box provided a series of openings, the central one of which registers with the openings in the middle partition, and each of the other openings registers with the compartment between two partitions, a bolt through the box and the cover, the head of which fits within the larger portion of the opening in the partition and the point projects above the cover, a spring between head of the bolt and the shoulder of the opening, a nut upon the bolt above the cover, a binder in each end compartment, and a fusible connector secured at its ends to the binders and having its intermediate portion passed through the notches in the partitions.

606,792. ELECTRIC RADIATOR; F. W. Quidas, of Mount Washington, Md. App. filed July 22, 1897. The combination in an electric heater, of a resistance, a casing surrounding the same, a block of poor heat conducting material inclosing the back of the casing and in contact with it and having a portion of said material extending along the edges of the front to hold said casing in the block.

606,795. ELECTRIC METER; W. Stanley, of Pittsfield, and F. Darlington, of Great Barrington, Mass. App. filed Jan. 13, 1898. In an electric meter, a magnetic brake consisting of a rotating disc mounted upon the shaft to be retarded, and a permanent magnetic system having a permanent magnet provided with a soft-iron pole piece and adjustable projections engaging with said soft-iron pole piece.

[illegible] TELEPHONE SYSTEM; B. R. Dodge, of Post Mill Village, Vt. App. filed June 17, 1897. A party-line telephone system, having two main metallic leads and a plurality of stations, each station comprising a talking circuit, a signaling circuit and a telephone switch, alternately closing the circuits, the signaling circuit having a ground tap and the signaling circuit also having a signaling bell, a generator and a resistance, the resistance being in parallel with the generator and in series with the bell, and the talking circuit also having a switch for normally holding the resistance in the closed circuit and capable of throwing the bell into such circuit to the exclusion of the resistance.

606,819. CONTACT DEVICE FOR ELECTRICALLY PROPELLED VEHICLES; H. P. Davis, of Pittsburg, Pa. App. filed April 6, 1896. A locking head comprising two plates separated by an intervening space, a pair of dogs pivoted in said space and projecting inwardly toward each other, and a spring holding said dogs yieldingly in normal position.



No. 606,795.—Electric Meter.

606,825. CONTACT DEVICE FOR ELECTRIC RAILWAYS; C. A. Terry, of New York, and H. P. Davis, of Pittsburg, Pa. App. filed March 2, 1896. In a contact device for electric railways, a cylindrical roller, bearings therefor, a shaft carrying the roller, a fork receiving the respective ends of the shaft, slots formed in the arms of the fork through which said shaft is inserted and wearing pieces covering said slots.

606,826. CURRENT COLLECTING APPARATUS FOR ELECTRIC RAILWAYS; C. A. Terry, of New York, and H. P. Davis, of Pittsburg, Pa. App. filed April 6, 1896. In a current collector for railway vehicles mounted to turn upon a vertical axis, a locking device normally acting to prevent such turning movement and means actuated by the downward movement of [illegible] the locking device.

606,827. OVERHEAD CONSTRUCTION FOR ELECTRIC RAILWAYS; C. A. Terry, of New York, and H. P. Davis, of Pittsburg, Pa. App. filed June 10, 1896. An overhead supply conductor for electric railways having [illegible] conductor extending at an angle to said first-named conductor, and a casting having arms extending in the direction of the crossing conductors and [illegible]

[illegible] ELECTRIC RAILWAYS; [illegible]

No. [illegible]—Contact Device for Electrically Propelled Vehicles.

[illegible]

[illegible]

lating material arranged to fit into the cap and be free to move in and out, but prevented from turning therein, and means for securing the insulator to a support.

606,852. TELEPHONIC TRANSMITTER; T. F. Ahern, of Detroit, Mich. App. filed June 19, 1897. An electric telephone transmitter or analogous device to be operated by varying electric currents, consisting of two substantially triangular carbon electrodes placed in frictional contact, the area of which is varied by the sound vibrations of the diaphragm carrying one of the electrodes.

606,863. ALTERNATING CURRENT DYNAMO; L. Guttman, of Peoria, Ill. App. filed Dec. 4, 1897. In an iron-clad inductor alternator, the combination with one or more stationary annular armature cores and windings for the same, of a stationary field winding, a field core for said winding, in three solid and separate structures, and a removable shaft for said field magnet core.

606,865. POLICE PATROL SYSTEM; O. W. Hart, of Fall River, Mass. App. filed Aug. 3, 1897. A telephone transmitter, consisting of a case, a mouthpiece on the front of the case, a diaphragm at the rear of the case, a plurality of electrodes extending from the diaphragm toward the mouthpiece and provided thereat with a rigid support and with means of adjustment.

606,884. ELECTRIC SNAP SWITCH; A. F. Wood, of Philadelphia, Pa. App. filed Oct. 8, 1897. An electric snap switch, consisting of a suitable casing, a disc journaled therein, a lever pivoted concentric with the disc, a spring connected between said disc and said lever, two dogs pivoted to the lever, a locking plate with which the noses of the dogs are adapted to engage, a spring drawing said dogs together and means for oscillating said disc.

606,887. ELECTRIC EXTRACTION OF POISONS; J. B. Campbell, of Cincinnati, Ohio. App. filed Oct. 5, 1896. The herein described method of extracting poisons from the human body, consisting in providing the negative electrode of an electric battery with interchangeable receivers of animal, vegetable or mineral substance, to extract a poison from the body of a nature or kind corresponding with or to the negative electrode employed.

606,912. MEANS FOR PREVENTING DISTURBANCES IN TELEPHONIC CIRCUITS; A. T. Blathy and K. De Kando, of Buda-Pesth, Austria-Hungary. App. filed April 27, 1897. Monophase or polyphase alternating current plants which have one of the conductors grounded, with alternating currents of a frequency less than twenty complete periods per second, in combination with monophase or polyphase alternating current motors with slantwise slots, for preventing disturbing influence on telephone apparatus.

606,917. ELECTRIC BRAKE; H. P. Davis, of Pittsburg, Pa. App. filed Oct. 22, 1897. In an electric braking apparatus, a plurality of electric motors arranged in parallel in a local circuit to be driven by generators, in combination with a plurality of brake magnets, one in each branch of such circuit.

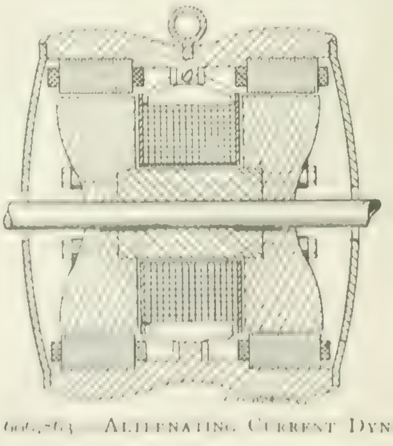
606,921. COMPOSITION OF MATTER FOR ELECTRIC HEATERS; G. B. Fraley, of Philadelphia, Pa. App. filed Aug. 12, 1897. A composition of matter consisting of talc, silicate of soda, carbonate of soda and water.

606,939. SWITCH FOR ARC LAMPS; C. A. Pfluger, of Chicago, Ill. App. filed Dec. 21, 1896. A switch for electric circuits, comprising four terminals divided into pairs, an arm associated with each pair of terminals and adapted to connect the terminals of the respective pairs together, a conducting controlling arm located between the pairs of terminals and adapted to become part of the circuit at predetermined times, said controlling arm adapted to operatively engage said arms when in a predetermined position, and move them both into and out of contact with their opposed terminals.

606,954. LIGHTNING ARRESTER; W. E. Athearn, of Brooklyn, N. Y. App. filed Aug. 9, 1897. A lightning arrester, comprising a porcelain block, having a spiral moulded on its middle portion to receive a coil of wire, one end of the block provided with a connector to receive one end of the coil and one end of the line, the other end of the block having two connectors, one for the coil terminal and one for the other end of the line, the two connectors being connected together by a fusible wire, the whole mounted on a base with a ground plate contiguous to the coil.

606,990. ELECTRIC RAILWAY; J. C. Henry, of Denver, Col. App. filed April 18, 1898. The method of changing the armatures of a two-motor car equipment from series to parallel connection, which consists in closing a short around one of the armatures of such resistance as to substantially [illegible] current from the armature without the production of a short [illegible] current through the armature.

[illegible] ELECTRIC RAILWAY; J. C. Henry, of Denver, Col. App. filed [illegible]. The combination [illegible] motors having their field [illegible] and a controller for regulating [illegible] of a supplemental switch arranged [illegible] field magnet circuit.



No. 606,863.—Alternating Current Dynamo.

The Electrical World.

Vol. XXXII. NEW YORK, JULY 23, 1898. No. 4.

PUBLISHED EVERY SATURDAY BY

The W. J. JOHNSTON COMPANY,

9 Murray Street, New York.

Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York.

New England Office, 620 Atlantic Ave., Boston.
Western Office, 936 Monadnock Block, Chicago.
Philadelphia Office, 929 Chestnut Street.

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THE ELECTRICAL WORLD,

9 Murray Street, New York.

Vol. XXXII. NEW YORK, JULY 23, 1898. No. 4.

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POWER FROM BLAST FURNACES.

Great interest has been awakened in Europe by the results of recent experiments in the utilization of blast furnace gases in gas engines. For a long time a part or all of the waste gases, which are rich in carbonic oxide and other combustible ingredients, has been used as fuel under boilers at many furnaces, but generally in a wasteful way and without any attempt to recover the enormous energy that it contains. The results obtained in the recent experiments are of great significance. It has been demonstrated that these gases afford a source of power readily utilized, and that they can be consumed to great advantage in gas engines.

The main difficulty in the use of these gases in internal combustion engines seems to have been due to the dust with which they are laden. Means for washing the gases and freeing them of this undesirable constituent have been perfected. After going through several coke "scrubbers" and being washed by a spray of water the gases contain less than one grain of impalpable dust to the cubic foot, and this is said not to produce any ill effect in the cylinders. As many as 2000 horse-power hours can be actually developed from the gases resulting from the smelting of one ton of pig iron. What this means in this country is hardly yet understood, but a few figures will show what an important source of power is wasted, and what a fortune goes up annually in smoke.

In May, 1898, there were 194 furnaces in blast in the United States. The weekly productive capacity of these furnaces was at that time 243,163 tons. Assuming that by electrical means 50 per cent. of the mechanical energy obtainable from their waste gases could be delivered to points of utilization, a continual delivery of very nearly 1,500,000 horse-power could be obtained. If this enormous amount of power could be marketed at $5 per horse-power year, over and above the cost of operation and fixed charges of the systems necessary, there is obviously an annual waste of $7,500,000.

Blast furnaces, unlike waterfalls, are situated as a general thing in or near centres of industry where the market for power is ready made. The figures given above make one of the best arguments for energetic and careful work upon the perfection of large gas engines yet presented.

A COMPARISON OF THE TWO SYSTEMS OF MULTIPLE RATE METERING.

The perplexing question of how to divide the charges of a central station between the different consumers somewhere nearly in proportion to the cost of the consumers' loads, and of encouraging the use of electrical energy with conditions under which it can be cheaply generated and discouraging its use at times or under circumstances when it is expensive, has brought out two more or less satisfactory attempts at solution, both involving the use of separate rates which the consumer must pay according to the conditions of his demand. Theoretically, of course, an infinite number of rates should be charged, the rate being raised step by step with every step of increased cost, but it has been found in practice that more than two rates complicate matters unwarrantably with either system.

The whole problem is due to the fact that the customer's demand is more or less intermittent, invariably greater at certain hours of the day than at others. Sufficient machinery must, therefore, be provided to carry the load at this time when it is greatest, and more or less of this machinery is non-productive of revenue, but a continual source of expense at other times. Of the two multiple rate systems, that which is known as the Wright demand system has come into the wider use in this country. In this system, by means of some measuring device, the maximum load of the customer's installation for any given period is recorded, the total number of watt hours for the same period being recorded by another instrument. A lower rate is given on all of the load over and above a certain amount proportional to the indication of the instrument recording the maximum load. The result of this method of fixing the charges is to give to those consumers with steadiest loads the lowest rates and, vice versa, to those with the most unsteady loads rising to high values at times and falling far below these at other times the highest rates. A further result is, of course, if the consumer comprehends the action of the system, to render him more anxious to steady his load, or rather to reduce his maximum. How great this effect is it is hard to state, but it is probable that at the time of the maximum the consumer does not realize it, is engrossed with other things, and the effect is slight. The principle on which this system is founded is that the central station must be provided with an equipment of boilers, engines, generators, etc., sufficient to carry his maximum load, and that in proportion as this maximum load is much greater than the average, this machinery is idle the greater part of the time, hence the consumer with the greatest ratio of maximum to average load should pay more for the power he uses. Obviously, this is not quite true, unless the maxima of all consumers occur at the same time; for example, if the maximum of one new consumer's load curve occurred during the forenoon, while another occurred at the time of the peak of the station load curve, the latter would require the addition of sufficient machinery to carry that consumer's maximum load, while the former would require only sufficient to carry the load added at the time of the peak of the station load curve. The two consumers would by the Wright demand system be charged the same rate. In so far, however, as the individual maxima occur together the system may be made to properly divide the charges.

The other system of multiple rate metering is based on the time of day at which the current is taken, a higher rate being charged for that used during certain hours when the station is heavily loaded, and when, therefore, any addition to the load necessitates a corresponding increase of the equipment, which increased equipment is idle and non-productive at other times. To be consistent a large number of rates should be charged, the rates increasing from minute to minute as the station load curve runs up, since the incremental apparatus required at or near the very peak of the load are idle a far greater proportion of the time than those required further down the load curve. The Wright demand system obviously accomplishes this sliding scale of charges by the simple means of varying the proportion of the load paid for at a higher rate according to the height of the peak. The two rate system has, however, the [illegible] that it is readily comprehended by the consumer. If the price is said to be [illegible] per hour a month for burning a lamp [illegible] at any other time of the day, he [illegible] understand it than if told that he [illegible] to the [illegible]. He is then much more likely to take care to [illegible] by watching his lights during the high rate hours [illegible] than at other times of the day, thus tending to [illegible] load curve.

On the other hand, the two rate system does not properly differentiate between consumers, one of whom, to take a concrete case, is very irregular in the use of light, while the other keeps his lights burning comparatively steadily, other conditions remaining the same. To illustrate this point, let us suppose one load is a theatre load, requiring an enormous supply of current for a few hours each day and nothing the rest of the twenty-four hours; while another load, consuming exactly the same number of watt hours per month, is perfectly steady in its demand. If the same percentage of each is consumed during the hours when the higher rate is charged, the amount charged the two consumers will be the same, while the cost to the central station of the intermittent load may be three or four times that of the other.

What is needed is a combination of the elements of the two systems, but no means of accomplishing this with simple mechanism and possessing the essential requirement of easy comprehension on the part of the consumer has so far been devised. A maximum demand meter so arranged as to record only at the time of the maximum load at the switchboard would come much nearer a proper solution than does the demand meter as now used, since it would show the exact proportion of the station equipment necessary to carry the load to which it is attached and would therefore give the data for a proper division of the fixed charges; a thing the Wright demand meter by itself does not do unless the maximum it records occurs simultaneously with the station maximum.

BRUSH HOLDERS.

In the pioneer days of dynamo construction no attention was paid to the design of the brush holders, their details being left largely to the mechanics' fancy when the time arrived for their construction. By far the most frequent troubles with direct-current machines occur at the commutator and poor brush holders are often the cause. In general it may be said of any machinery that the most trouble may be expected with the small, apparently insignificant parts, and practically the only small mechanism attached to dynamos is the brush holder. Care with this detail is, therefore, imperative. Interesting descriptions of various designs of brush holders will be found in another column.

DISRUPTIVE DISCHARGES AND SPARK GAPS.

It is usually considered that the connection of an ohmic resistance in series with a discharge gap does not affect the breaking down strength or voltage of the latter. Experiments described by Mr. A. J. Wurts in another column quite disprove this theory. The connection of 120 ohms in series with a double spark gap aggregating 1-16-inch air space so increased the resistance to the passage of the discharges that they preferred to jump a much wider gap placed in shunt around the test gap and its resistance. It would certainly seem as though the charges gathering on the terminals as the potential difference rises would not be affected by ohmic resistance, and that the breaking down point of the shorter air space would be the sooner reached. It is difficult to see why the variation of other gaps in the circuit affects this as it does, since the electrostatic stress should distribute itself over all the gaps in the line. This is a point where experiment does not meet theory and the theory will have to be changed. It would be interesting to know how various lightning arresters would act under experimental conditions more nearly imitating service conditions; for example, connected in secondary circuits indirectly affected by disruptive discharges in their primaries.

Some Modern Brush Holders.

The electrical show in New York City brought together a number of electrical machines with such interesting designs of brush holders that a brief description of the varieties there shown may be of interest. The most conspicuous feature of the tendency in the present use of brushes on direct-current machinery is the widespread adoption of what is known as the reaction brush. As this type is of such recent design that its properties may not be generally understood, a description of its peculiarities may be relevant at this time.

A characteristic example of this holder may be seen in Fig. 1, which shows the form of it generally adopted for all apparatus manufactured by the Walker Company, with the exception of street railway motors. As may be seen in this figure, the holder is extremely simple, consisting of one main casting with but one surface necessarily finished, namely, that against which bear the sides of the carbon brushes. A finger or follower forces or wedges the beveled back end of each carbon brush between the commutator and the bearing surface of the holder, the finger in turn being pressed against the brush by the action of a torsional spring, the end of which can be hooked by hand in any one of a number of notches in a segment of the follower casting, thus adjusting the pressure according to the notch in which the spring is caught. A tooth on the follower prevents the end of the latter from falling on the commutator when the brush is removed.

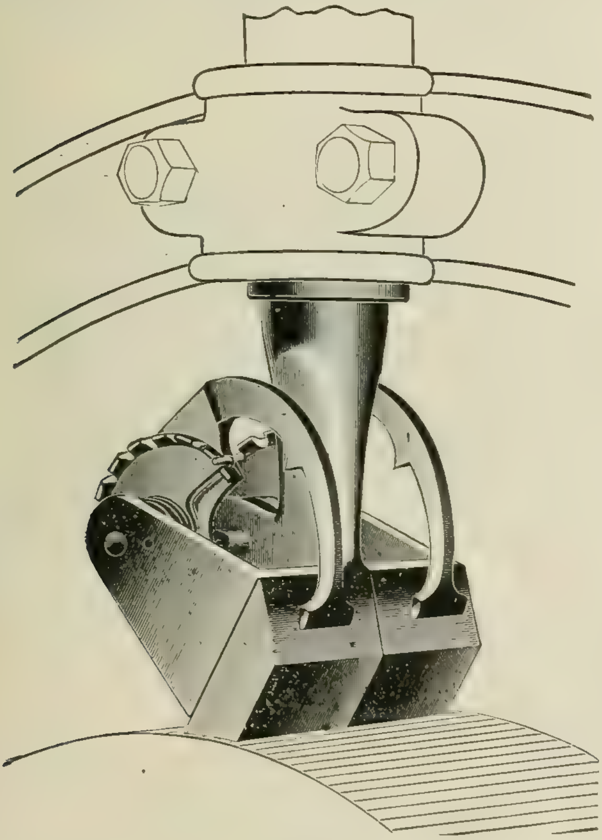

FIG. 1.

The advantages claimed for this type of brush holder are, in the first place, the freedom of the brush to follow all ordinary irregularities in the surface of the commutator, and to follow them, not by oscillating about an axis and thereby destroying the parallelism of the face of the brush, but by moving in a straight line toward or from the commutator. It is obvious that this gives a much more continuous contact of the whole face of the brush against the commutator bars than if the former rocks around a stud whereby it is tilted up until only its inner edge makes contact on high parts, and tilted down until its outer edge makes contact on low parts of the commutator if the latter is at all out of true. To follow narrow irregularities promptly the brush and other moving parts must be of small inertia, and it is obvious that this requirement is fulfilled in this type, the brush itself being quite small and the follower a very light brass finger. Another peculiarity is the closeness with which the metal parts of the holder may be brought to the face of the commutator, the metal parts being stationary and no margin, therefore, being necessary for wear. This shortens the distance which the current must travel through carbon and also increases the rigidity of the brush at the commutator surface, preventing chattering. Another advantage is the facility of removal, the brush being easily lifted out with two fingers at any time, even when the machine is running, no clamping devices or screws being disturbed and no adjustment being lost, the brush settling exactly into the same place when restored.

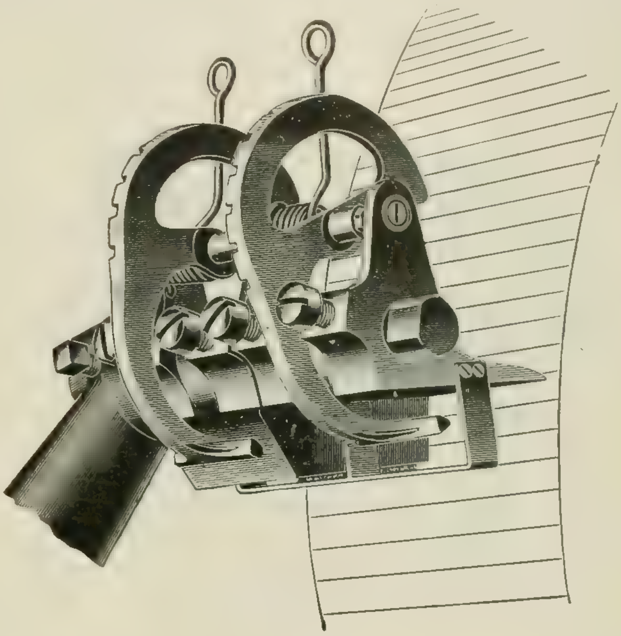

FIG. 2.

Another advantage of this holder is the fact that no box or frame is used around each brush, hence the brushes may be in actual contact with one another side to side, and the whole face of the commutator with a slight margin at each end may be made use of. This increases the available area of contact with a given thickness of brush and face of commutator about 10 per cent. over other forms.

As there is no tightly bound or clamped contact to carry the current from the brush to the holder, the surface lying against the holder being alone depended on for this purpose, it is essential that the brush be well plated, and that this one side of it at least be flat and true. For this reason sawed or ground carbons are preferred to moulded carbons for this holder. In case moulded carbons are used care should be exercised that this side of the carbon is not rounded. For very high-current capacities the brushes are fitted with copper sheets covering the side which bears against the holder and bending over the top angle of the brush, also covering the beveled side against which bears the follower. These sheets are soldered to the brush, and, if ground, the surface of the holder being milled, a very satisfactory contact is obtained. A remarkably light pressure against the commutator surface is used, this being possible owing to the ease with which the brush adjusts itself to irregularities. On this account the wear of both commutator and brush is greatly reduced, good, fine grain carbons running for years without renewal. The area of contact of the brushes on the commutator is figured at about the same value as that with other types, namely, 30 amperes per square inch, the contact between the brush and the holder being as a rule about twice this area, or 15 amperes per square inch.

The brushes are said to work equally well whatever the direction of rotation may be, but it is customary to run the commutator toward the brush from the holder side, that is to say, right-handedly, as shown in Fig. 1. This would appear to give a tendency to trip the brush, but no ordinary irregularity or high bar is found to do so in practice. Nothing short of a segment rising perhaps one-sixteenth of an inch above the adjacent surface acts to throw the brush out of position. The angles used by different makers vary, but the standard set by the original designer of this type of brush holder is 60 degrees between the bearing surface of the holder and the face of the commutator and 45 degrees between the surface of the holder and the top bevel of the brush against which bears the follower.

A modification of this holder in which these angles are not exactly followed, but in which the face of the holder is almost radial, is shown in Fig. 2, this being the arrangement used by the C & C

Electric Company. Another peculiarity used on the machines of this make is the strap or band around the brush preventing its falling out, this being necessary with the peculiar angle used, since the follower does not tend in this case to wedge the brush, so to speak, between the commutator and the face of the holder. It is to be noticed that here also the holders, one for each brush, are mounted on a stud in the ordinary manner instead of being all cast together with a supporting post as in the Walker design. The stud of the C & C machine is flattened, as shown, to give all of the holders the same rake when the brush holders are fastened with their set screws on the flat of the stud.

Still another modification of this is that shown in Fig. 3, and used by the Eddy Electric Manufacturing Company. Here it will be no- [illegible]

range of capacities. In fact, but two sizes of brush holder are necessary for a line of machines, ranging in capacity from 1 to 2000 kilowatts.

Fig. 4 shows the arrangement used by the Bullock Electric Manufacturing Company, the holders proper being of the most simple construction mounted on studs swung in trunnions, by which the angular position of the different groups of brushes may be relatively adjusted. There is provided for use with this holder a brass gauge shown in the upper part of the figure by which the proper angle between the face of the holder and the tangent of the commutator may be obtained.

A modification of this holder differing greatly from those already described, is shown in Fig. 5. Here the torsional spring with its simple adjusting hook is replaced by a helical spring shielded by the walls of the holder and adjusted by a screw and nut, the tension of the spring being depended on to prevent the screw working under vibration. The follower here is pivoted on the main brush holder stud, and the surface of the brush bearing against the holder is not depended upon for conductivity, a flexible braid being used, attached at one end to a copper strip riveted to the brush and at the other end fastened under a screw in the holder. The advantage of increased conductivity is offset against the disadvantage of greater difficulty in removal and replacement. This modification is that used by the Onondaga Dynamo Company.

The reaction brush is the invention of Mr. R. N. Baylis, and was patented by him September [illegible], No. [illegible]. Beside the companies mentioned above which use it as licensees under this patent

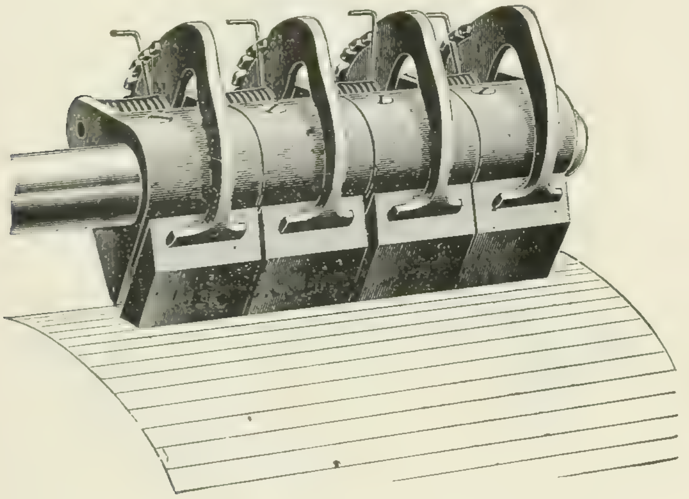

Fig. 3.

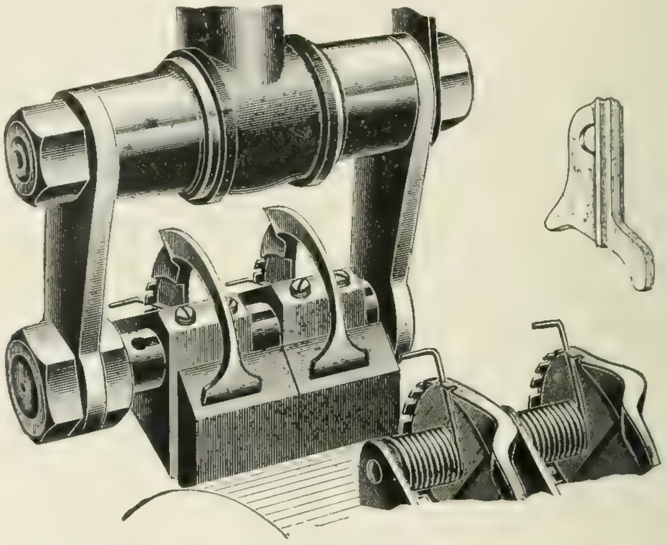

Fig. 4

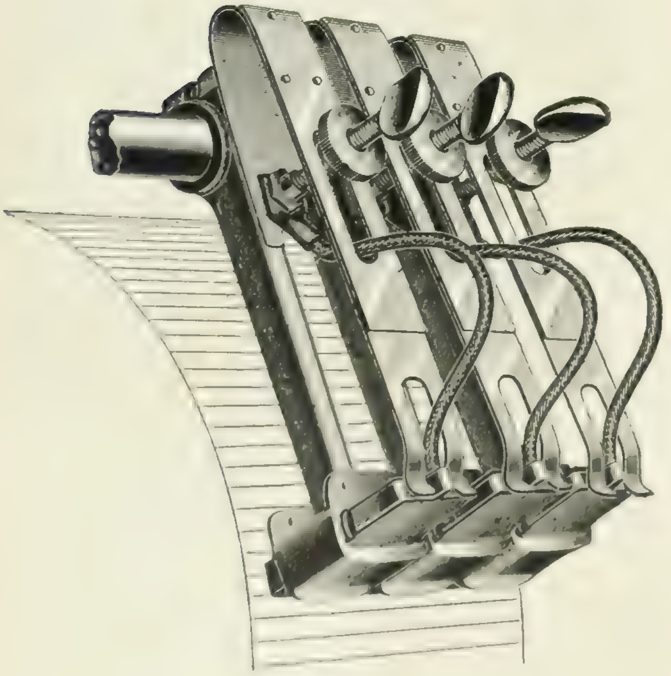

Fig. 6.

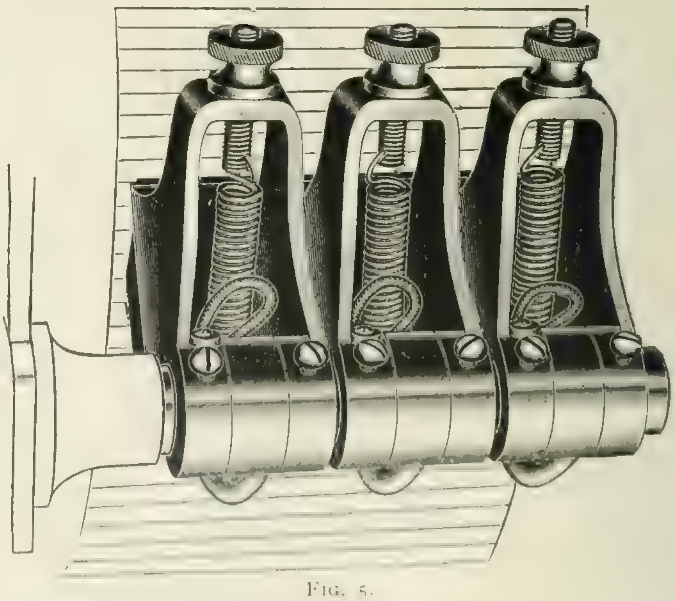

Fig. 5.

are the following: The E. G. Bernard Company, the Keystone Electric Company and the Triumph Electric Company. The Baylis Company also manufactures these holders in its own shops.

To allow the drawing of a contrast with the reaction type brushes described above some of the other brushes in use on machines exhibited at the New York show are illustrated herewith. One of these is a new type brought out by the General Electric Company and shown in Fig. 6. In this the carbon brush fits loosely, and is free to slide radially in a frame, a number of which are clamped rigidly to the brush holding stud. Fastened into a copper strap, which is soldered to the top of the brush, is a flexible copper braid, which conducts the current to a lug which is bound under a thumb screw to the rigid part of the holder. Tension is applied by means of a flat reinforced leaf spring, and is adjusted by means of a knurled nut on the thumb screw mentioned above. The under side of this nut is squared, and sets into the slot in the leaf spring, so that it not only cannot work loose by vibration, but the unscrewing of the thumb nut to remove the copper braid and the brush does not disturb the adjustment of the spring. There is also obviously no possible means of disturbing the position of the brushes or getting the various brushes of one group out of line with each other.

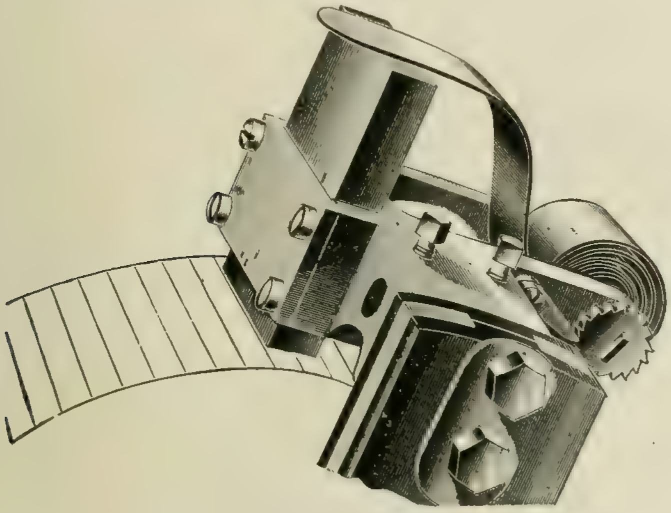
FIG. 7.

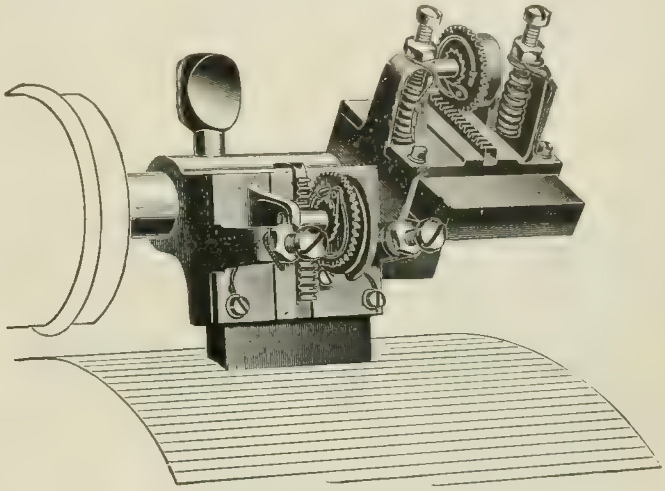
FIG. 8.

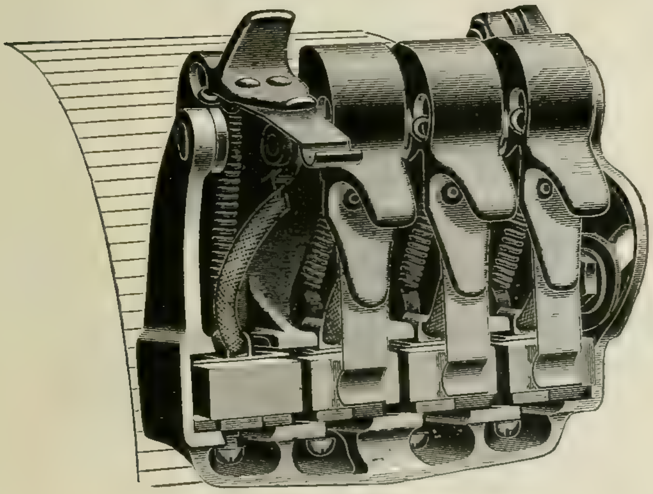
FIG. 9.

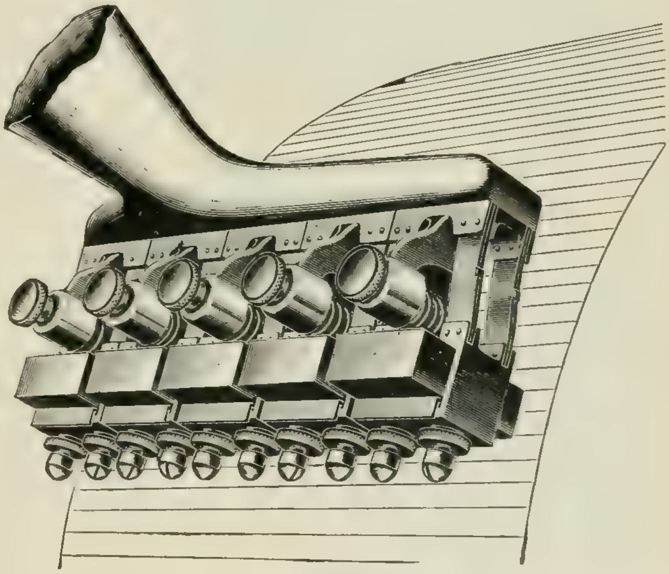
FIG. 10

Another holder of interest is that shown in Fig. 7, and used on machines manufactured by the Card Electric Company. The carbon brush here also slides loosely in its holder and is forced against the commutator by a long leaf spring bearing directly against the top end of the brush. This spring is coiled up spirally, its inner end being attached to a drum fitted with a ratchet wheel and ratchet by which the tension can be adjusted, and fixed in such a way that it will not shake loose. An elongated rectangular nut on the face of the ratchet wheel is arranged to take a wrench when it is desired to adjust the tension. The current obviously has two paths to the holder, one through the box in which the brush slides and the other through the spring. The simple H-shaped insulating clamp, by which the holder is attached to the brush supporting spider and the hole and set screws for the conducting lead, are also shown in the illustration.

Another device interesting because of its peculiarities is that used by the American Engine Company, and illustrated in Fig. 8, where one of the two brushes is raised to show more clearly the operating mechanism. The holders are clamped by a thumb nut to the stud, and the brushes slide radially in a box frame, and are forced down by a lug engaging the top of the brush, and attached to a rack, which is actuated by a gear, to which a tendency to rotate is given by a spirally wound flat spring, very much like a clock spring. This also is retained in any position to which it may be adjusted by means of a ratchet and pawl, the ratchet in this case being held up by another spring. Two other helically wound springs press the cover of the box against the brush, screws and lock nuts being provided to adjust the pressure. A reduced resistance is sought by means of small flexible copper leads from the box cover to the frame. The American Engine Company also uses the reaction type of brush, which is obviously quite different from the one just described.

A holder particularly designed and adapted for the abuses and rough handling of street railway motor work is that used by the Walker Company on all its railway motors and shown in Fig. 9. In this the carbon blocks are clamped in copper frames, which in turn are connected by flexible copper braids to the body of the holder. Strong arms, the left hand one of which is shown raised, bear against the top of the carbons, and by means of helical springs force the carbons down against the commutator. When raised, the line of action of the springs crosses the pivot, so that the springs hold the arms up as well as down. These arms shelter the copper braids and springs beneath them to a certain extent from blows from above.

A brush holder lately brought out by the Crocker-Wheeler Electric Company, and most admirably combining the good qualities of perfect flexibility radially with rigidity in all other directions and no sliding surfaces in the electric circuit, is shown in Fig. 10. Here the carbons are clamped by screws and lock nuts in separate boxes or frames, each of which is attached to the main casting of the holder by four parallel motion links made up of copper leaves. In the illustration it appears as though each link were made up of two strips, but in reality each link consists of many thin strips all riveted together, and to the base at one end and to the box at the other. These serve the purpose of giving flexibility in one direction, rigidity in the others, and carrying the current by low-[illegible] from the live parts base of the holder. Pressure is supplied by means of the helical springs shown with adjusting screws with knurled heads, a separate spring being provided for each brush.

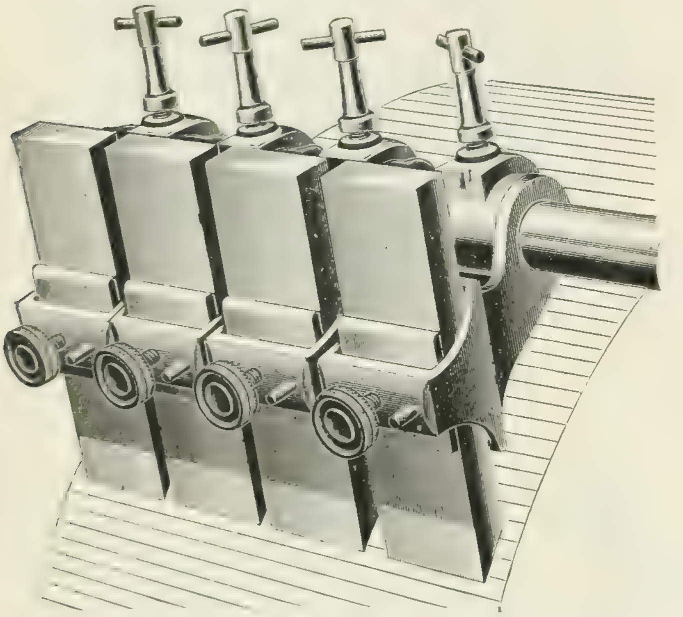
Fig. 12.

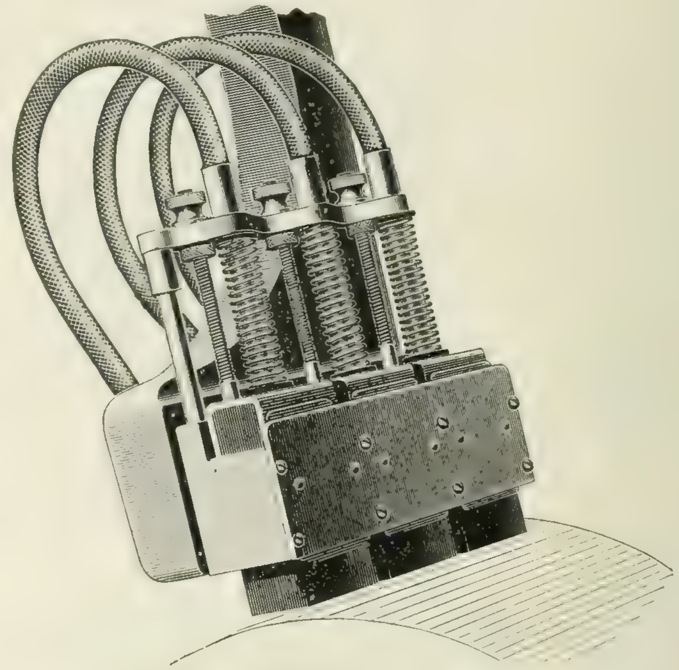
Fig. 14.

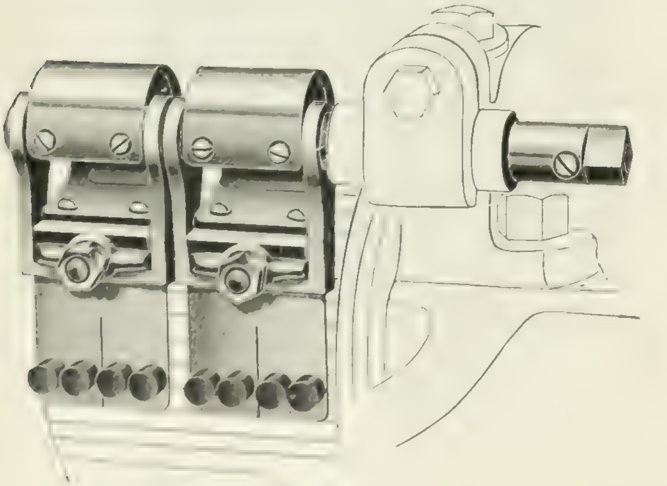
Fig. 13.

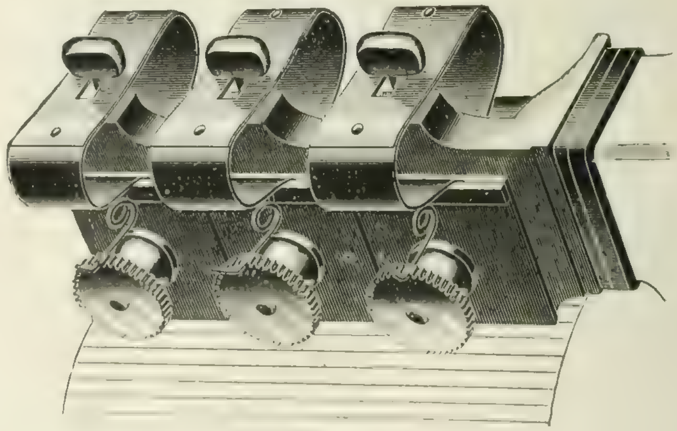
Fig. 15.

The old brush holder used on the [illegible] motors exhibited by [illegible] Brothers & Co. is shown in Fig. 13. These holders consist of copper plates [illegible] carried on the stud and further [illegible] to the stud by [illegible] steel flat springs, which give the proper pressure. Each contact plate [illegible] passing through a [illegible] without [illegible] the bushing. The copper plates [illegible] to give the parts [illegible] individual flexibility.

The usual arrangement of the more [illegible] and copper brush [illegible] at the slotted end that is put on the Fort Wayne machines and shown in Fig. 12. The holder is free to turn about the stud, and pressure is applied by a spring connecting it with a collar fixed on the stud by a set screw. The pressure can of course be adjusted by loosening this and rotating the collar one way or the other.

A type of holder in which the best results have been sought regardless of care and expense is that designed by Mr. A. Churchward and used on the machines manufactured by the Excelsior Electric Company. This is shown in Fig. 14. Here the brushes slide radially in a loose fitting box, and, to make sure of their free action, each brush is bound in a copper strap, which is riveted to it and finished. Projecting from the back end of the brush and attached to this strap is a long stud into which there is fastened a generously proportioned copper braid or "pig tail" by which the current is carried to the main casting of the holder. Surrounding this stud is a helical spring, the several springs of all the brushes in one holder being forced down by a frame with screw adjustment. To absolutely prevent heating of the springs and the reduction of their temper, fibre washers are inserted between them and the frame, so that no current can by any possibility pass through them. The construction of this holder is very substantial and the parts are finished with no little care, so that its action is very perfect, but it obviously cannot compare in point of first cost with some of the types mentioned above.

A peculiar holder is that shown in Fig. 15, and used on the motors of Sprague screw type elevators. Here no provision is made whatever for any following of the irregularities or eccentricities of the commutator surface, except the slight flexibility of the holder arm. The brushes are forced down against the commutator by the springs shown at the top of the illustration, which can be released by turning the thumb nuts a quarter turn and allowing them to slip through the springs. Once forced down the brushes are fastened firmly in place by clamps, which are locked against working loose by wire springs engaging the knurled heads of the clamping nuts. The question of commutator irregularities is intended to be solved by the simple means of keeping the commutator true, and it should be stated that this odd method appears to work very satisfactorily in practice.

The Two-Rate Meter System in Brooklyn.

Brooklyn, N. Y., July 18, 1898.

To the Editor of The Electrical World:

Sir:—In reply to your inquiry as to why we have given the preference in Brooklyn to a test of the two-rate system in place of the Wright demand, I would answer as follows:

The Wright demand system is a difficult one to explain to the ordinary customer, and the fact that periodic adjustment of bills is made somewhat complicates matters for the company. In submitting the matter to several of our leading customers, and taking into account their comments, we decided that from the point of simplicity the two-rate system would have the advantage. We experienced no trouble at all in explaining to a customer that we can afford to make a cheaper rate during the period when the greater part of our machinery is not in use, since then we are not obliged to expend extra capital to supply the requirements; in other words, we are trying to keep our idle machinery in operation continuously, the same as are the Western Union Telegraph Company, the Long Distance Telephone Company, etc., etc.

Outside of the question of explanation to the customer, and taking the matter up from the standpoint of the company, there is a striking comparison between the actual two-rate system and those systems, such as the demand system, which are dependent for their rate modification upon the indication of the individual maximum load. Nothing can better express this than a letter which I have just received from a gentleman standing high in the electrical profession, and who has given a life-time thought to the question of meters and metering. He says:

"In those systems which depend for their modification of the rate of charge upon the ratio between the maximum current used at any one time, and the total record for any given period, we meet a system which is aimed primarily to discourage the use of large quantities of energy for short periods; and, secondarily, to encourage the use of small quantities for long periods. The prime tendency of this system is to discourage all load peaks and to encourage all who use small quantities for long periods. It is obvious that any system of this kind must be largely dependent upon the occurrence of local peaks coincidently with the station peak for its success.

"At first glance it might very reasonably appear that these theoretic conditions were the actual existent ones, but you have doubtless already ascertained by an analysis of your system that this is not the case. I have found as a rule that station peaks are primarily caused by a comparatively few large local peaks which are coincident, being superimposed upon a heavy load of fairly long continuance.

"In the two-rate system, on the other hand, we find the same tendency to beat down all peaks, provided they occur at a time when you do not want them; that is, you beat down or discourage all peaks which are coincident with your station peaks, and these are the only peaks which are objectionable to you.

"The two-rate system, therefore, beats down your station peak, but it does something else which is vastly more important. It directly encourages and stimulates all peaks which are not coincident with your local peak. It puts a premium on heavy burning at times when your station is lightly loaded, and it therefore not only beats down your station peak, but by the introduction of a lot of local peaks non-coincident with your station peak, it also tends to build up your average station line, accomplishing this by the introduction of a series of local peaks."

The General Electric Company has recently placed upon the market a double rate mechanical meter, in which the counting of the time of the single motor is transferred from one dial to the other. This transfer is made at predetermined times by a self-winding clock inclosed in the meter and kept in operation by the main current. We have now several of these in Brooklyn, and are adding others as fast as we receive them, connecting them to those customers presenting the worst cases, so as to give the system a thoroughly hard test at the outset. We have thus far received very gratifying results.

W. S. Barstow,

General Manager Edison Electric Illuminating Company of Brooklyn.

Disruptive Discharges, Leakage and Ohmic Resistance.

BY ALEX. JAY WURTS

In an editorial of The Electrical World for June 11 it is stated that the use of better materials has undoubtedly increased trouble from lightning, that a poorly insulated circuit offers opportunities for static charges to leak to ground; and in an editorial for June 25 there appears the following: "It must be remembered that such discharges are as a rule oscillatory, and that the impedance of, for example, a pencil lead with thousands of ohms resistance may be to such discharges less than that of a 1,000,000 cm cable 10 feet long. Very high ohmic resistances are nothing to discharges backed up by millions of volts, but the self-induction of a straight wire a few feet long may offer a great obstruction to their flow."

As my experience with disruptive discharges has led me to form entirely different opinions to those expressed in the editorials of The Electrical World, the following observations and experiments may be of interest.

Referring to the leakage of static charges from overhead wires, it hardly seems to me that the facts in actual practice warrant any such assumption. For example, in the early days of electric lighting and street railway work, when shellacked cotton insulation was used on surface-wound armatures, an immense amount of trouble was experienced by static discharges puncturing the insulation during thunder storms. With the better grades of insulation now used trouble from lightning has been enormously decreased; in fact, plants that used to shut down regularly in the early days now think nothing of running through thunder storms, although it must be admitted there is an occasional loss of a converter or an armature. But the impossibility of running poorly insulated apparatus through thunder storms in the early days indicates to my mind that this poor insulation did not leak the static charge. Furthermore, if it were possible to leak this charge, how is it that trolley wires and their feeders, when permanently connected to earth as they are, at many points, not only through the heavy copper conductors of motors and generators, but also through the non-inductive resistances of the lamp circuits, still give disruptive discharges, making it necessary to use spark gap lightning arresters? Why do not these wires leak their charge to earth?

A theoretical consideration of the subject may be of some assistance. We are accustomed to think of the atmosphere as being charged with static electricity during thunder storms, and that overhead wires become charged by this atmosphere; or, in other words, become electrically a part of it. To be a little more technical, the charged atmosphere is really an electrostatic field, and any conductors lying in this field, whether connected with the ground or not, will become charged by static induction, and will remain thus charged until the static field is removed. For example, if we have two parallel wires, say 50 feet apart, one of which is dead and the other charged with, let us say, 1,000,000 volts, a static field will be established around the first wire, which will itself then become statically charged and will remain in that condition until the static field has been removed, and if this static field be removed suddenly—that is, if the 1,000,000 volts potential be instantaneously removed from the second wire—the first will tend to discharge disruptively and will give off sparks to neighboring conductors. If the statically charged wire be of considerable length, and if one end be connected to earth, a portion of the charge will pass to earth through this connection, but the parts of the wire distant from the earth connection will still tend to discharge disruptively to neighboring conductors. And so it is, I think, with overhead wires during thunder storms. These wires are suspended in an electrostatic field; they are charged and remain charged until this field is removed, and this occurs only with the lightning flash. With every lightning flash, therefore, we may expect a disruptive discharge to occur from overhead wires. It seems to me that this theoretical consideration, as well as the facts which have been accumulated, disprove any possibility of leakage through weak insulation.

Now, as regards ohmic resistance, I desire to call attention to the following experiments:

Referring to the diagram, Fig. 1, resistance to the passage of disruptive discharges has been measured in the following manner: A static machine driven by an electric motor at a constant speed has been used to charge a battery of Leyden jars, the latter discharging across an initial spark gap B and then through two paths connected in shunt to each other, one of these being the resistance or object whose resistance it is desired to measure, and the other an adjustable spark gap A. When the disruptive discharges pass over B, and then indifferently through the object to be measured and the variable spark gap A, the length of the A gap may be taken as a measure of the resistance which the object under test offers to the passage of disruptive discharges. For example, in the diagram there is shown what is known as a double pole, "short gap" lightning arrester, which consists of two spark gaps in series, with a non-inductive resistance amounting to 120 ohms. With disruptive discharges passing at B at intervals of about ten seconds, the A gap being closed, the disruptive discharges naturally pass through the closed A gap, but as this A gap is opened wider and wider a point is reached at which the disruptive discharges pass indifferently through the lightning arrester or through the A gap. The two paths are then said to be balanced, and the length of the A gap may be taken as a measure of the resistance which this lightning arrester offers to the passage of these particular disruptive discharges.

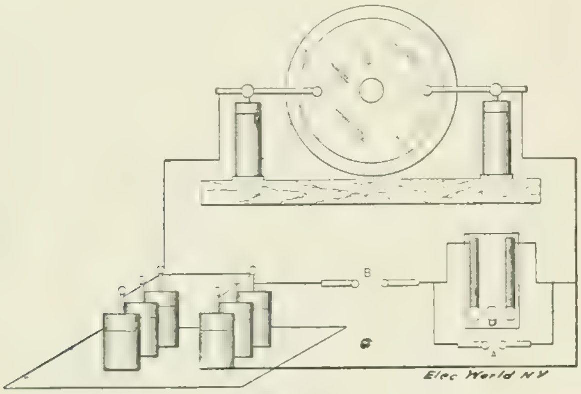

Fig. 1.

In the following experiments the lengths of A and B are measured in thirty-seconds of an inch. First, with a value of B equal to 12, comparative measurements were made between a short-gap lightning arrester having 120 ohms resistance and two gaps aggregating one-sixteenth inch air space, and a series of six spark gaps, aggregating eleven-sixty-fourths inch air space, forming the standard non-arcing metal lightning arrester. With the former the A gap, or equivalent gap, as it is often called, was found to have a value of 9, and with the latter the A gap was found to be only 2¾, thus showing experimentally that a non-inductive resistance of 120 ohms in series with two spark gaps offered about three times the resistance to the passage of disruptive discharges that six gaps offered without resistance in series. The above test was then verified by finding that three non-arcing metal arresters connected in series, making a total of eighteen spark gaps, would just balance a single short-gap lightning arrester.

Furthermore, it was noticed that the discharges which passed over the short-gap lightning arrester made a relatively small spark and a quite significant snap, compared with the larger sparks and loud reports which accompanied the passage of these discharges across the non-arcing metal lightning arrester. This observation seemed to me to be in line with the experiments above described, and indicated that the discharge was not complete, that the resistance did not allow the battery of Leyden jars to entirely discharge its contents; in other words, that the path consisting of two spark gaps in series with a resistance was in some way a restricted path, whereas, the observations made on the arrester with six spark gaps gave one the [illegible]

To verify this conclusion regarding the restricted path and the free path the following experiment was made: The A gap being re- [illegible]

[illegible]

discharge for the short gap arrester was considerably greater than for the non-arcing metal arrester, and it seems to me that the reason for this may be found in the high resistance which the 120 ohms offers to the passage of these disruptive discharges. In other words, this resistance does not allow complete discharge of the Leyden jars; consequently, it requires less time to re-charge the jars, and the discharges, therefore, occur more frequently; but the quantity of the static charge which passes through the arrester is relatively small. In service this feature is liable to cause a splitting of the discharge, one passing through the arrester and the other through the insulation of the system.

It will be noticed that the three times greater resistance of one arrester over the other, the difference in the size of the spark, the difference in the sound of the spark, the difference in the rate of discharge through the two arresters, all these observations support each other and indicate that ohmic resistance does greatly impede the passage of disruptive discharges.

May not the explanation be this? Allowing that the discharges are oscillatory, then each oscillation has to meet and overcome any ohmic resistance in its path, but with simple spark gaps the work which has to be done by disruptive discharges is simply to push aside the air in the spark gaps, and this being done by the first oscillation the passage is free for the succeeding oscillations. To help the imagination, I would liken the simple spark gap lightning arrester, which I have called a "free path" lightning arrester, to an empty water pipe having in it a glass diaphragm. With the first sudden on-rush of water the glass diaphragm is instantly shattered and the passage is free for all the water which may follow. On the other hand, the lightning arrester, consisting of a spark gap with resistance in series, may be likened to an empty water pipe having a glass diaphragm as before, but in front of it a strong steel diaphragm with a small hole in it. The first on-rush of water will break the glass diaphragm, but the resistance offered by the perforated steel diaphragm will still remain for all the water which may follow; and a further idea may here be added, namely, that the greater the amount of water the greater difficulty will there be in discharging the pipe through the small hole; and this seems to be the case with the restricted path lightning arrester, as is shown in the following experiment: Referring to diagram Fig. 1, it will be observed that any variation in the value of B will cause a corresponding variation in the volume of the discharge from the battery of Leyden jars. That is,

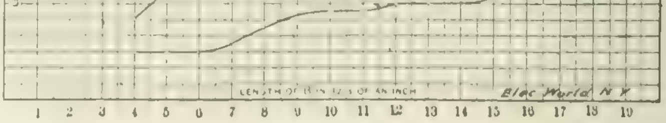

Fig. 2.

if B equals 12, the discharge will be much greater than if B is equal to [illegible]. Therefore, by varying the value of B the corresponding values of A may be determined for any lightning arrester. These values for the short gap and the non-arcing metal lightning arresters have been determined, and will be found plotted in diagram Fig. 2. Attention is called to the rapid increase in the value of A for the short-gap lightning arrester as compared with the slight increase in value of A for the non-arcing arrester as the value of B is increased; and as the discharges obtained from overhead wires during thunder storms are assumed to be of considerably greater volume than anything which can be obtained from a laboratory static machine, it will not require much stretch of the imagination to see that a lightning arrester consisting of spark gaps in series with a [illegible] resistance will offer great impedance to the passage of [illegible] when compared with the free path or simple [illegible] lightning arrester.

The Chemistry of High Temperatures.*

The researches conducted by M. Henri Moissan, with the aid of his electrical furnaces, extend over a period of about five years, and have won for this distinguished chemist an additional title to take rank with the foremost exponents of scientific inquiry at the close of this century of science, so auspiciously inaugurated by the great discoveries of Gay Lussac and Sir Humphry Davy.

The application of the high temperatures attainable by means of the electric arc, for the purpose of producing physical and chemical effects, is by no means of recent date. Many important observations on the effects of electric heat were made already by Van Marum, at the close of the last century, and by Humphry Davy, the discoverer of the arc, at the beginning of the present one. In 1849 Despretz utilized the intense heat of the arc in various scientific investigations, and later Pichon, Siemens and Huntingdon, Cowles, Heroult, Grabau, Borchers, Acheson, Willson and many others either suggested or realized the employment of the electric furnace for various industrial purposes.

In all these cases, however, the materials subjected to the arc were directly exposed to and permeated by it. But, while this may not be objectionable in many industrial processes, the presence in the arc of vapors of carbon and other substances emanating from the electrodes, and the attendant electrolytic action, constitute a set of disturbing influences which will generally complicate the results, and render them liable to lead to erroneous conclusions.

Guided by these considerations, M. Moissan endeavored to devise a furnace which would subject bodies to the highest temperatures of the electric arc under simple and controllable conditions. He has constructed five modifications of such a furnace, which are characterized by the following features:

(1) A furnace consisting of a block of lime, hollowed out, and provided with electrodes in such a manner as to maintain the arc above the substance. The cavity is lined with suitable materials.

(2) A furnace of fine-grained limestone lined with alternate layers of carbon and magnesia, the former on the inside. This construction permits the use of higher temperatures than the preceding one, and is well adapted for receiving crucibles.

(3) A furnace provided with a tube of refractory material, passing horizontally through the cavity. This arrangement affords a heated space, which is accessible from without, and protected from the action of any gases existing within the furnace. When desired, currents of gases or vapors can be passed through the tube while it is being heated.

(4) A furnace in which the tube is given an inclined position, which permits a continuous operation; the charge is introduced at the upper mouth, while the products are removed or flow from the lower one.

This model was employed for preparing large quantities of pure products in a short time.

(5) A furnace with a larger number of electrodes and arcs.

By this means a considerable space can be evenly heated, and large amounts of material treated in one operation.

By thus excluding electrolytic action, M. Moissan was enabled to investigate the simple heating effect of the current. The temperature ranged from 2000° to beyond 3800° C. While it is not possible to give exact figures for the highest temperature attained, an idea of the conditions may be formed from the description of some of the experiments. The currents employed varied from 35 amperes at 55 volts to about 1600 amperes at 110 volts.

The results obtained by means of the electric furnace may be considered comprehensively under the following heads:

I. A series of researches on the fusion and volatilization of refractory bodies.

Various compounds and elements which are either infusible or non-volatile at the highest temperatures attainable by combustion were melted or vaporized when subjected in the furnace, Model 1, to an arc consuming 30 to 40 horse-power of energy.

Thus lime, magnesia, molybdenum, tungsten, vanadium and zirconium were readily fused, and lime, silica, copper, platinum, aluminum, boron, carbon and other refractory bodies volatilized.

II. In a second series of experiments a number of reactions, which can be effected at the highest temperatures only, were made the subject of investigation.

The carbonates of barium and strontium were without difficulty resolved into carbonic acid and the oxides. Those oxides which had withstood the de-oxidizing action of carbon at the highest temperature of ordinary furnaces were readily reduced by that element in the electric furnace; others, whose reduction by carbon in the wind furnace is difficult or incomplete, readily yielded their oxygen to the carbon under the action of the arc.

III. The study of the three allotropic modifications of carbon constituted a third extended series of experiments.

The most important, perhaps, and the one which has become universally known, is that ordinary charcoal may, by means of the electrical furnace, be converted into diamond.

When molten iron at 3500° is saturated with carbon and the mass then suddenly chilled on the outside, the enormous pressure produced in the interior will cause part of the carbon which separates to crystallize in the form of diamond. Both the transparent and the black (carbonado) varieties were thus obtained—the former in octahedra and cubes, as well as in fragments; the specific gravity of 3.5, the hardness and all characteristics corresponded to those of the native stone.

It is further shown that, at about 3000°, under ordinary pressure, all the modifications of carbon are converted into graphite, and various varieties of this (the ultimately stable form of carbon) were recognized and studied.

The reason for the infusibility of carbon under ordinary pressures was established to be due to the fact that it passes directly from the solid into the gaseous condition. Carbon was actually sublimed and the reactions of its vapor studied.

IV. There yet remains to consider the investigation of several new series of crystallized compounds belonging to the classes of borides, silicides and carbides.

M. Moissan has shown that these compounds, as a rule, have very simple compositions, and that, at the highest attainable temperatures, carbon, silicon and boron generally form but one compound with another element.

The silicides, like Acheson's carborundum, possess extraordinary hardness; some, as those of boron and titanium, appear to be even harder than the diamond.

Of the metals, some do not combine with carbon; others while dissolving it at very high temperatures deposit it as graphite before they solidify. A very large number of metals, however, form definite, crystallized carbides.

These M. Moissan divides in two classes; those which decompose water at ordinary temperatures, as, for example, the carbides of the metals of the alkalies and alkaline earths, of aluminum, cerium, etc.; and those which do not react in this manner, and which include the carbides of chromium and titanium.

It appears that M. Moissan was the first to produce the crystallized calcium carbide in the electric furnace. He has also exhaustively studied the action of the various carbides on water.

The Franklin Institute therefore awards the Elliott Cresson Medal to M. Henri Moissan, of Paris, France, for his work on the chemistry of high temperatures.

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*The report of the Franklin Institute, through its Committee on Science and the Arts, on the investigations of M. Henri Moissan, with the electric furnace. Abstracted.

Telephones and Liquid Air.

Mr. Henry Norman, the well-known English journalist, in a recent article entitled "America Revisited in War Time," in the July issue of "McClure's Magazine," speaks as follows regarding the use of the telephone here and in England:

"The observant visitor to America must be impressed first with the remarkable development of what may be called applied intelligence. Not only is there an extraordinary fertility of invention, but also, what is perhaps more striking still, there is apparently an instant readiness on everybody's part to make use of the things invented. * * *

"From visit to visit, for example, I have observed a constant improvement in the telephone. The instrument has grown smaller, neater, more graceful, simpler, and easier to use. As it stands on an American desk to-day, it might be a flower-holder. In some of the best and most expensive parts of London to-day you cannot have a telephone put in your house at all. When you do, it is the ugly box arrangement of ten years ago. I call upon a journalist friend in New York. Upon his desk stands an elegant little apparatus through which he converses every afternoon with Washington and Chicago. In a London newspaper office you might as well look for a machine for making liquid air."

DIGEST OF CURRENT ELECTRICAL LITERATURE AMERICAN AND FOREIGN

By Carl Hering.

Dynamos, Motors and Transformers.

ELECTRIC GENERATORS. Parshall and Hobart. Lond. "Engineering," July 1.—In this continuation of their serial (see "Digest," June 18) they discuss Foucault currents and hysteresis losses in cores. In smooth core armatures there may be considerable loss from Foucault currents in wires, and it cannot be accurately predetermined; the loss can be greatly diminished by subdividing the wire, which is illustrated by an example in which there were four wires in parallel, each 0.165 inches in diameter, and when these were replaced by nineteen strands of cable having the same cross-section of copper the total armature loss was diminished by one-third. In slotted armatures the conductors are more or less protected, depending on the magnetic density in the teeth, but even where this is low stranded conductors must sometimes be used; stranded conductors are open to the objections of increased first cost and of having 15 to 20 per cent. higher resistance for given outside dimensions; no oxidation or other coating of the surface of the individual wires is necessary in such stranded cables, as the contact resistance suffices. Eddy currents will also be found throughout all solid parts of the magnetic circuit, and it is therefore preferable to laminate them; in continuous current machines the disturbances are mainly local, but the losses near the pole faces may be large, depending chiefly on the depth of the gap as compared with the width of the slot opening; an increase of the gap from one-eighth to one-quarter inch in a certain case greatly modified the magnitude of the pole face losses; straight-sided armature slots produce greater losses in pole faces than those with overhanging projections, whereas, if they are completely closed, the loss is practically eliminated. In the neighborhood of conductors and coils where there is a high magnetic force all solid supports should be avoided unless of a high-resisting, nonmagnetic material such as manganese steel; spool flanges could well be made of this material. Eddy current losses in the armature sheets depend on the square of the density of the flux, the square of the periodicity, and the square of the thickness of the sheets; also on the care with which the laminations are insulated; owing to the smaller amount of machine work smooth-core armatures are more apt to be free from parasitic currents in the core; the plates should be assembled without milling or filling, if possible; in one case the milling of the armature slots increased the core loss three times; tests of the core losses of a railway motor at various stages of manufacture are referred to by curves published in a previous installment. The hysteresis loss in the cores is then discussed, and some curves for railway motors are referred to; this loss in transformers will receive special consideration later; this loss may be from 1.5 to 2 times the theoretical value, owing, probably, to the flux taking a transverse path. In addition to considering the heating with reference to the radiating surface. it is sometimes useful to consider it on the basis of rate of generation of heat in watts per pound of material; the two following tables will assist in this; these should also be used in calculating [illegible] at high densities; [illegible] armatures can be run at higher current densities than [illegible] The following table gives [illegible] figures of current densities used in [illegible] in small transformers the current density can be very much higher; large, properly designed transformers have a better regulation than is necessary; a rise of no more than 60° C. should be aimed at, even with large transformers. Insulating substances have a very large negative temperature coefficient; in a case in which the insulation was mica and cloth with the transformer immersed in oil, the average temperature coefficient between 20 and 80° C. was —0.8—that is, the insulation resistance increased 80 per cent. per degree C. decrease of temperature; the resistance to disruptive effects is, however, practically unimpaired, and the two should be carefully distinguished. Railway motors have an efficiency curve which quickly reaches its maximum and then falls off, and they can, therefore, not be used for long periods at full power without excessive heating. Arc dynamos have to be designed with a very low current density, but their efficiencies are very low; they recommend throwing them all out and installing well-designed apparatus. In constant potential dynamos the aim should be to have the electromagnetic and the thermal limits coincide; 40 or 50° C. rise in temperature during continuous running is generally considered entirely satisfactory.

COPPER.

Current Density in Amperes per Square Inch.	Rate of Generation of Heat by Ohmic Resistance. Watts per Pound.					
	[illegible] Degrees Cent.	[illegible] Degrees Cent.	[illegible] Degrees Cent.	[illegible] Degrees Cent.	[illegible] Degrees Cent.	[illegible] Degrees Cent.
[illegible]	.50	[illegible]	[illegible]	.62	[illegible]	.71
[illegible]	[illegible]	2.15	[illegible]	[illegible]	2.68	2.84
[illegible]	[illegible]	4.[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	9.1	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

SHEET IRON.

Flux Density (Kilolines per Square Inch).	Rate of Generation of Heat by Hysteresis, [illegible] Watts per Pound.			
	[illegible] Cycles.	60 Cycles.	100 Cycles.	125 Cycles.
[illegible]	[illegible]	[illegible]	.44	[illegible]
[illegible]	.27	[illegible]	[illegible]	[illegible]
[illegible]	.56	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

	Amperes per Square Inch.
Small, high-speed armatures	2500 to 3500
Large " "	1500 " 2500
Small, low-speed armatures	1500 " 2000
Large, " "	1100 " 1600
Transformers with forced circulation of oil or air	800 " 1500
Large transformers immersed in oil or air	500 " 900
Small transformers immersed in oil or air	500 " 1100

COMMUTATION OF CONTINUOUS CURRENT DYNAMOS. Girault. "Bul. Soc. Int. des Elec.," May.—The reprint of a very long mathematical paper read before that society It is usually assumed that the current in the short-circuited coil should be equal in amount and direction to that which the coil must carry after it leaves the brush, but he claims that a more careful examination shows that this is far from being the correct and satisfactory condition, the true phenomena being extremely complicated He then discusses this at great length, and in considerable detail; no general conclusions are given.

This appears to be the same article which has been reprinted in "L'Ind. Elec.," and referred to in the "Digest," June 18; it is continued and concluded in that journal May 25, June 10 and June 25.

MAGNETIC LEAKAGE IN DYNAMOS. Osnos. "Elek. Zeit.," June 30.—A criticism of the recent article by Rothert (see "Digest," June 18). The latter claimed that the density of the lines of force is inversely proportional to the magnetic resistance of its path; this Osnos shows is not correct, and that one cannot speak of such a single density, as the number of lines of force and also the cross section are different in different parts. He furthermore objects to considering two independent leakage fields, as there is always only one, which is the resultant field.

RANGE OF MOTOR SPEEDS.—Lond. "Elec. Eng.," July 1.—A short answer to a request to state the range of speed between no load and full load, with a 1-hp and a 5-hp shunt motor The speeds are calculated and a variation of 9 per cent. is shown. Practically constant speed may be obtained by adding a compounding coil in opposition to the shunt coils, the number of series turns bearing to the number of shunt turns the same ratio as the resistance of armature and series coils bear to the resistance of the shunt coils.

MOTOR STARTING SWITCH.—Lond. "Elec. Rev.," July 1.—A brief, illustrated description of one made by King & Co.

ARMATURE WINDINGS. Rice. "Amer. Elec.," July.—Brief descriptions, with clear illustrations, of what he calls forced windings; he describes how to wind an armature which was designed for a multiple path winding so that it shall have a two-circuit winding.

INDUCTION MOTOR. Wiener. "Amer. Elec.," July.—A short article giving some tables and data for the construction of induction motors.

DYNAMO AND MOTOR TESTING. Radcliffe. "Amer. Elec.," July.—A short, illustrated article giving practical hints concerning the mounting, connecting and handling of dynamos and motors for the various tests made by the constructor.

Lights and Lighting.

NEW CARBON FOR ARC LAMPS.—Lond. "Elec. Rev.," July 1.—A note stating that [illegible] has patented in Russia a carbon formed of 90 per cent. of very pure carbon and 10 per cent. of [illegible] reduced to very fine powder and agglomerated with pitch. He claims a saving in current of [illegible] per cent. and a light of [illegible] tint and greater intensity; the duration is 300 hours, which he hopes to increase to 1,000. (This does not seem to have been confirmed yet.)

REGULATING MAGNETS IN ARC LAMPS. Weil. "Elek. Zeit.," June 30.—A reprint of a long paper in which he describes and discusses mathematically the action of the regulating magnets in a certain arc lamp.

INCLOSED ARC LIGHTING. Hallberg. "Elec. Eng.," July 14.—A short article on the proper handling of such lamps; he shows that much trouble which is experienced could be avoided if those who sell and use such lamps knew more about their operation and details. He shows how a properly designed lamp may be completely ruined by too strong a current or by the arc being too close to the neck of the inner globe, this being the most frequent cause of trouble; he describes how the lamp will appear when this has been the case, and how it can be repaired, although he recommends sending it back to the makers.

VACUUM TUBE LIGHTING.—"Prog. Age," July 1.—An illustrated description of the Moore system as exhibited in a recent exhibition in New York.

ILLUMINATION OF THE TRANS-MISSISSIPPI EXPOSITION.—"West. Elec.," July 9.—A number of illustrations, with a brief description, showing the lighting effects.

Power.

DYNAMOS DRIVEN BY GAS ENGINES.—Lond. "Elec. Rev.," July 1.—Referring to a recent editorial in the "Elec. World," stating that in America producer gas is used very little, it is shown that in England this gas is used very much; the record is 650 watt hours at the switchboard per pound of coal, as compared with 150 to 300 in America. It is thought that direct driving with a flexible coupling, allowing a variation of 180°, is required; there should be a fly wheel on each side of this coupling; a strong helical spring is thought to be better than a flat spirally wound spring of the clock type; the objections to irregularities in the speed lose much of their force when more than one engine is at work; the engine should not be fully loaded, so as to have numerous idle strokes; roller bearings are recommended.

POWER STATION AT PORT DUNDAS.—Lond. "Engineering," June 24.—An illustrated description of this new power house which is being erected by the municipality.

STEAM-USING PLANT.—Lond. "Elec. Rev.," July 1, and Lond. "Lighting," June 30.—A reprint (begun in the latter) in full of his recent Muncipal Elec. Ass'n. paper, containing numerous tables of data.

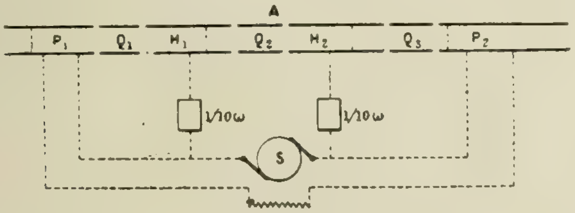
INCLINED ELEVATOR.—"Elec. Eng.," July 7.—An illustrated description of one which has recently been introduced in a large store in New York city.

BLAST FURNACE GAS FOR MOTIVE POWER. Greiner. "Prog. Age," July 1.—A reprint of a paper referred to in the "Digest" June 4 and 18.

SIZE AND PITCH OF SMALL PROPELLERS.—"Amer. Elec.," July.—Some tables and data for determining the power, diameter and pitch of the propellers for small boats.

Traction.

RAIL RETURN LOSSES. Vigneron. "L'Eclairage Elec.," June 25.—A description and discussion of a new method which he proposes for confining the return currents to the rails. The object is to keep the loss of voltage in the rails below 5 volts; the theory of the loss is discussed analytically, and he shows that if boosters are placed at certain points along the line, which will raise the voltage a certain amount proportional to the current, then this result will be accomplished; the rails are cut at these places and the booster inserted, driven by a shunt motor from the line circuit. Referring to the adjoining cut, P_1 and P_2 represent the ends of the cut rails at one of these places; Q_1, Q_2 and Q_3 are short, insulated sections having a length less than the distance between the axles of the cars; H_1 and H_2 are sections having a length greater than the distance between the extreme axles of the longest train; S is the booster for raising the voltage, the brushes being connected as shown, and a resistance of 0.1 ohm being inserted in the branches leading to H_1 and H_2; the exciting current is obtained from the rails as shown, and the booster is run on the rising part of its characteristic. A numerical example is worked out.



MECHANICAL TRACTION IN PARIS.—"L'Ind. Elec.," June 25.—The Omnibus Company, in Paris, has decided to use mechanical traction on about a third of its lines. On one of these air compressed to 80 kg per sq. cm. will be used, while the other will be run with rapidly charged accumulators, of the Tudor and of the Blot types.

FRANKFORT-o-M.—"Elek. Anz.," June 19 and 27.—A reprint of a description of the electric railway system in that city in Germany, to which other references have already been given. The trolley system is used outside of the city, while inside accumulators are used. The current is obtained from the alternating current lighting station after transformation into a direct current at substations.

BUDAPEST.—Lond. "Elec. Eng.," July 1.—A note stating that this city, with 600,000 inhabitants, is now the only one in Europe where animal traction, "over lined way," has been entirely given up.

ACCUMULATOR TRACTION. Hauswald. "L'Eclairage Elec.," June 25.—A French translation of the German paper noticed in the "Digest" February 12.

ELECTRIC VEHICLE.—"L'Ind. Eec.," June 25.—An illustrated description of the Elieson carriage, made in England.

OVERHEAD LINE FOR RAILWAYS. Pepper. "Jour. Frank. Inst.," July.—A reprint of a recent paper read before that Institute, in which he gives general instructions and data for the overhead line construction of electric railway systems.

WATERLOO AND CITY UNDERGROUND RAILWAY.—"Railway World" (London), reprinted in "Elec. Eng.," July 14.—A short, illustrated article on this short underground electric railway in London, which has just been completed; it runs in a deep tunnel, which passes under the river Thames, connecting the Waterloo station with the Mansion House.

ARGENTINA. Wardlaw. "St. Ry. Jour." (Int. Edit.), July.—A short, illustrated article on the electric railway development in that country; a list of the principal lines, with the number of passengers carried last year, is given. The electrical business is more active there now than at any previous time, and there are projects to equip all the street railway lines in Buenos Ayres with electric power.

Installations, Systems and Appliances.

METERS WITH VARYING CONSTANTS. Lux. "Zeit. fuer Beleucht.," June 20.—A short, illustrated article describing a method which he suggests by means of which the registering of the meters is so varied that their readings will be directly proportional to the load on the station at each moment; thus the charge per unit becomes a variable one, depending on the time when the current is used. The principle is independent of the construction of the meter and the connections are illustrated for three different kinds of meters. The illustrations show a shunt circuit tapped from the mains and in this circuit is an ampere meter and an adjustable resistance; in this shunt circuit is claimed that there will always be flowing a certain definite fraction of the current in the main circuit; this small current is led in series through all the meters, or at least through those branching from one main branch. (This does not seem to be correct, for on a constant potential system a constant current will flow through that circuit, which is independent of the main current; to give what he desires this auxiliary circuit should be branched from two points of one of the two mains or feeders, between which no current is led off; his arrangement seems, therefore, to be merely a suggestion.) This shunted current is then passed around the coils of the meter, thus changing its constant. The advantages claimed are that this current regulates itself, and is not adjusted or under the control of the central station.

HIGH VOLTAGE INCANDESCENT LAMP SYSTEMS. Passavant. "Elek. Zeit.," June 30.—A brief abstract of a recent paper. The advantages of raising the voltages to 200 or 250 are that the doubling of the voltage will increase the capacity of the distribution system fourfold; that it may be extended over greater distances; that the installations in dwellings are cheapened and simplified, one for an installment of 100 lamps, for instance, being reduced 30 per cent. in cost; that the reliability of the whole installation is increased, and that the lighting dynamos, being coupled two in series, may then be used for railway purposes. It would cheapen the cost of the electric light, and therefore extend it; it is not thought to be more dangerous, but on the contrary, even safer, because the higher voltage will require that the work be more carefully done, as every fault will soon make itself known; it is much safer than gas, which it is claimed should no longer be used in dwellings and factories.

STANDARDIZATION OF APPARATUS. Modulus. Lond. "Elec.," July 1.—A short correspondence on the recent suggestions of Wordingham (see "Digest," July 9). It is claimed that the latter did not consider the subject from the dynamo builders' standpoint; he thinks that the latter's suggestion to standardize in terms of the output is at present impossible, and will probably never be obtained; the steam plant completely controls this, and uniformity in the latter is not likely to to be reached, as the conditions are different according to the location. He urges making the specifications more elastic and considering alternative tenders more favorably.

MORLEY.—Lond. "Elec." and "Elec. Eng.," July 1.—An illustrated description of this 2000-volt alternating current station, having about 3000 lamps of 8 candle-power attached.

CENTRAL STATION ACCOUNTS.—Lond. "Elec.," July 1.—An analysis of the accounts of the St. James station in London.

METER TESTS. Ennis. "Elec. Eng.," July 7.—A short article on his recent tests of the meters of a station about which there was great complaint. The testing table, with all the connections, is shown, the results are described, and some of them given, showing that many of the meters were badly in need of attention and recalibration; the chief cause for trouble was the unintelligent care which had been given them, while some of it was due to the meters themselves. As a result of his investigations he recommends that all meters should be tested and adjusted if necessary when purchased, each meter should be kept securely sealed, it should be tested on several loads, more attention should be given to the fusing of the meters, periodic cleaning should be insisted upon, and every meter should be tested at least once a year. The average results were calculated as follows: The error for each load was multiplied by the number of lamps composing that load, and the sum of these products were divided by the sum of the separate loads; the average error of all the adjusted meters was 0.22 per cent. slow.

THREE-WIRE VS. HIGH POTENTIAL SYSTEM. Wagner. "Elec. Rev.," July 9.—A very short article suggesting a combination of the two systems. There is not much difference in first cost between the mains for the three-wire low-potential system and the transformers and high-potential distributing mains; the Edison feeders for the same distance, however, cost 31 times as much as for the alternating current at 1100 volts, 125 times as much 2200, or 500 for 4400 volts. He therefore suggests using a high potential alternating current in the feeders and transforming it down for the mains.

BALTIMORE. Fairchild. "Elec. Eng.," July 7.—In the present installment of this long serial he gives brief descriptions of some of the lighting plants.

PARIS. Bayly. "Elec. Rev.," July 9.—A brief description of the Edison central station in that city.

Wires, Wiring and Conduits.

HIGH VOLTAGE ACCESSORIES.—Lond. "Elec. Eng.," July 1.—Well-illustrated descriptions of some new accessories made in England, for 200-volt systems.

Electro-Physics and Magnetism.

CATHODE AND ROENTGEN RADIATIONS. Swinton. Lond. "Elec.," July 1.—The conclusion of the long abstract of his Royal Institution lecture (see "Digest," July 9). He discusses the causes of the effects exhibited in a tube in which both the anode and the cathode can be altered independently in position; a curve shows the voltages required to cause a discharge to pass through the tube with varying positions of the anti-cathode; with a forward movement there is at first a gradual increase in the length of the alternative spark, which is followed by a very sudden increase and then by a more gradual one; another curve shows the same thing for the movable cathode, and in this case the less the distance the less is the length of the alternative spark; but the distance is not the determining factor, as it is more than counterbalanced by a very important factor, the position of the cathode relatively to the glass walls of the tube. The greater the resistance of the X-ray tube the greater the velocity of the atoms from the cathode rays, and the more penetrative are the Röntgen rays; furthermore, the supply of atoms appears to be of great importance, for if penetrative Röntgen rays are desired the access of atoms to the cathode must be restricted; if only a few atoms can get to the cathode they are projected with great velocity. The area of the anti-cathode plate was investigated by means of pin-hole photography, and several results are shown for different distances between the cathode and the anti-cathode. He shows that the photographic effect of Röntgen rays is relatively very feeble; he compared the X-rays, screened with black paper, with the light from a standard candle, and found that with the tube he used, which was a very good one, there was less than one-sixtieth of the photographic power of one standard candle. The true nature of the Röntgen rays is briefly discussed; it is now becoming more and more certain that cathode rays consist of negatively charged atoms traveling at an enormous velocity. Calculations show that the rise of temperature due to the impact on the anti-cathode plate is 50,000,000,000° C., but this is based on the probably erroneous assumption that the specific heat remains constant; there is, however, a sufficient margin to say that the temperature is enormously higher than that of the arc; it is thought that Röntgen rays are produced in some way by the sudden removal of velocity from the atoms which form the cathode rays.

POLARIZATION OF ROENTGEN RAYS. Graetz. "Wied. Ann.," No. 6; abstracted briefly in Lond. "Elec.," July 1.—He endeavored to produce polarized X-rays by letting the cathode rays impinge on crystals, but found that even with this most powerful means polarized X-rays could not be produced.

INTERFERENCE AND ELECTROSTATIC DEFLECTION OF CATHODE RAYS. Jauman. "Wied. Ann.," February; abstracted at some length in "L'Eclairage Elec.," June 25.—He repeated and completed his experiments, showing interferences in the [illegible]

[illegible]

[illegible]

[illegible]

ment illustrating the conductivity of glass. Two electrodes terminating in glass rods, connected to a high-tension transformer and heated in a Bunsen burner, will have an arc formed between them; the arc keeps the rods at the conducting point; if the electrodes are separated a spark discharge sets in and on further separation there will be a brush discharge.

RESISTANCE OF STEELS. Le Chatelier. "L'Eclairage Elec.," June 25.—A reprint of an Academy paper in which he gives the results of a systematic investigation of the effect which different ingredients in the steel have on its resistance; the samples used were the same as those investigated by Mme. Curie in her recent researches on the magnetic properties of steel. The specific resistances are given for a number of samples, having different proportions of carbon, manganese and silicon. The resistance increases quite appreciably with the percentage of carbon, the increase averaging 7 microhms for 1 per cent. of carbon in weight, or 1.5 microhms per 1 per cent. of the carbon atoms per 100 atoms of iron and carbon. The mean increase was 14 microhms per 1 per cent. of silicon in weight or 7 microhms for one atom of silicon per 100 atoms of the alloy, the increase, therefore, being much greater than for carbon; he infers that this element is therefore combined with the iron chemically. For manganese the increase is considerable, but, as with the magnetic properties, the resistances of the same sample may be very different; there is a general increase of about 5 microhms for 1 per cent. in weight or in atoms. Nickel also increases the resistance quite appreciably, and, as with manganese steels, there are two varieties, having different magnetic and resisting properties; the increase in resistance is extremely variable; for quantities less than 5 per cent. the increase varies from 3 to 7 microhms. The effect of chromium, tungsten and molybdenum is very slight, and could scarcely be measured for amounts less than 3 per cent.; he believes these do not form definite combinations with the iron.

ZEEMAN EFFECT. Corbino. 'L'Eclairage Elec.," June 25.—A translation in abstract from the Italian of an article on Cornu's interpretation of this phenomenon.

MAGNETIC SUSCEPTIBILITY OF LIQUID OXYGEN. Fleming and Dewar. Lond. "Elec.," July 1.—The first part of a reprint of a Royal Society paper giving the results of measurements made to determine whether oxygen had a constant susceptibility or whether this is altered when subjected to different magnetizing forces, as in the case of ferro-magnetic substances. The method they use was based on the fact that if a body is placed in a variable magnetic field it is subject to a mechanical force tending to displace it in the direction in which the field varies most rapidly; they obtained the difference in the susceptibilities of liquid oxygen and air; some of the results of the observations, but no conclusions, are given.

Electro-Chemistry and Batteries.

REGENERATIVE ZINCING PROCESS.—Lond. "Elec. Rev.," July 1, reprinted without the illustration in "El'ty" (N. Y.), July 13.—A brief, illustrated description of the Cowper-Coles process. The chief difficulty in electro-zincing is to keep the electrolyte in working order, as less zinc is dissolved than is extracted; this he overcomes with the use of zinc dust, which is mixed with coke or sand, through which the liquid is made to filter by means of pumps, and in this way the free acid is neutralized and the bath is kept free from impurities, which latter were one of the chief causes leading to the formation of zinc sponge. The electrolyte consists of 40 oz. of zinc sulphate per gallon of water, and has a specific gravity of 1.1770; the current density is 17 amperes per sq. ft., and the E. M. Fs. 6 volts.

CHROMIUM STEEL. Placet. "L'Ind. Electrochimique," abstracted briefly in "L'Eclairage Elec.," June 25.—A brief description of his process in which he deposits chromium electrolytically on the iron and steel objects, which are then submitted to a process of cementation by which the surface so treated becomes extremely hard, while the internal parts retain their previous qualities; the deposits are made of alternate layers of iron and chromium. This is all the information that is given in the abstract.

ALUMINUM INDUSTRY.—Lond. "Engineering," July 1.—A short article on this industry, giving data regarding the production and describing the various uses.

CALCIUM CARBIDE AND ACETYLENE.—Lond. "Elec. Rev.," July 1.—A brief abstract of a recent lecture by Lewes and some notes on patents.

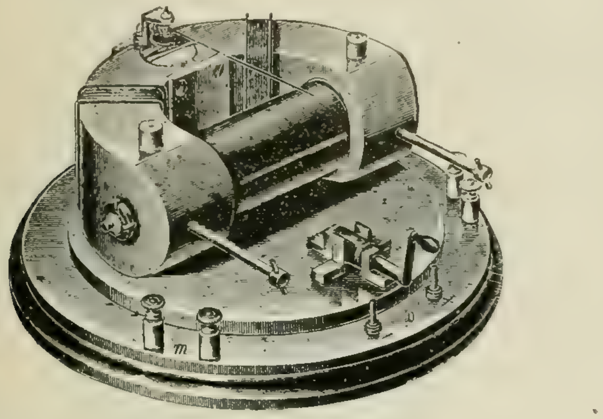
ACCUMULATOR CONSTRUCTION. FitzGerald. Lond. "Elec. Eng.," July 1.—In this continuation of his long serial (see "Digest," June 11) he further discusses the formulas in which the unit of service is taken as a basis in designing a cell, illustrating them with examples.

Units, Measurements and Instruments.

ABSOLUTE ELECTROMETER. Deprez. "L'Ind. Elec.," June 10; "L'Eclairage Elec.," June 25, and "L'Elec.," July 2.—A Paris Academy paper in which he describes a new form, claiming that the usual electrodynamometer is not an absolute instrument, because it requires a knowledge of the earth's magnetism where it is used, [illegible] to be absolutely exact. A torus of revolution [illegible] any closed figure around a vertical axis and around this torus is wound a perfectly regular solenoidal circuit, consisting of any number of layers of wire; before winding this [illegible] is introduced into the interior of the torus a [illegible] with any desired number of regular windings; the only conditions necessary are that the axis of revolution of this coil is parallel to that of the torus, so that all the windings are parallel to the diametric plane of the torus; the inner coil should, furthermore, be movable around an axis of rotation located in this diametric plane, which is perpendicular to the axis of revolution of the torus and to the axis of the inner coil, and should pass through its centre. When these conditions are fulfilled the turning couple is calculated by a simple formula, which he gives.

ABSOLUTE ELECTROMETER. Perot and Fabrey. "Jour. de Physique," June; abstracted in Lond. "Elec.," July 1.—They describe the latest form of their absolute electrometer for measuring small voltages. It is of the attracted disc type, the distance between the discs being extremely small, from 0.1 to 0.03 mm, which is measured and maintained by an optical device based on the reflection of rays and interference fringes. Very small E. M. Fs. can thus be measured (but how small is not stated in the abstract).

APPARATUS FOR MEASURING MAGNETIC QUALITIES. Kath.—In the "Digest" last week an abstract of this article was published, but by an error the wrong cut was reproduced; the following is the one to which the description applies. The cut which was reproduced last week shows the auxiliary apparatus and connections of this same apparatus; the two resistances shown are those for regulating the currents, the large circle at the bottom being the measuring apparatus itself, a view of which, without the cover, is now shown.



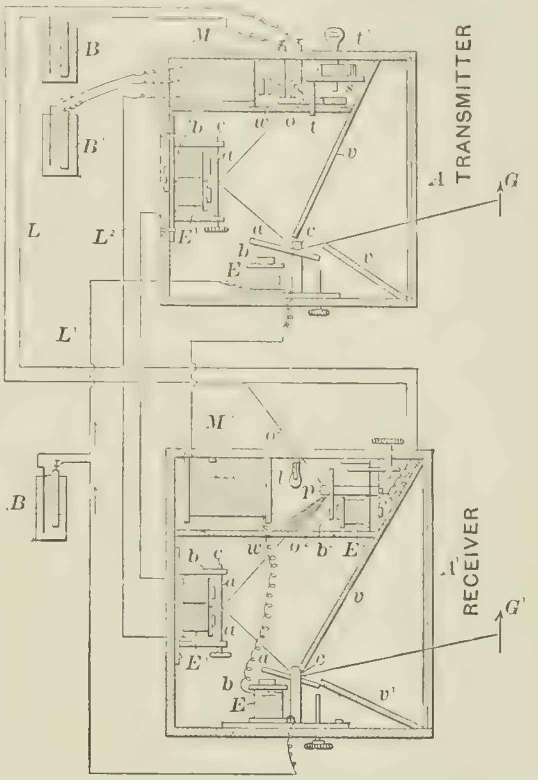
ONE-VOLT STANDARDS.—Lond. "Elec.," July 1.—A very brief, illustrated description of the Hibberd standards, which are now in the market. The recovery of these after accidental short-circuit is as rapid as that of the Clark cell; the temperature error is practically negligible, being considerably less than 0.01 per cent. per degree C.; the E. M. F. at 16° C. was 0.9993, and at 31° C. 1.0004; the cells can be made so as to give exactly one volt for any specific temperature. The cell is made of a zinc rod immersd in a zinc chloride solution of 1,380 sp. gr., separated from the mercurous chloride and mercury by a porous partition.

METER.—Lond. "Elec. Rev.," July 1.—A brief, illustrated description of an alternating current motor-type meter, measuring watt hours, made by the Electrical Company. Also a description of their latest arc lamp for both direct and alternating current.

Telegraphy, Telephony and Signals.

TRANSMITTING IMAGES.—"Electro-Techniker," June 15.—A short, illustrated description of the Szczepanik apparatus, about which so much has been said in the papers lately; several brief descriptions have already been referred to (see "Digest" April 9 and 23, May 7). The principle is that the image is divided into points which are transmitted and reproduced in such rapid succession that the received image is seen in its entirety. In the accompanying cut, the upper part shows the transmitter and the lower the receiver, the image transmitted being the arrow G; the rays (presumably first passing through a lens, which is not shown) fall on a mirror which is oscillated magnetically around an axis, and from here they are reflected by another oscillating mirror, whose axis is perpendicular to the first one; these mirrors are what are called line mirrors, and each separates the image into lines, the two together separating it into points, which are then reflected on to a selenium apparatus S, the cells of which are altered in resistance by the intensity of the light; this selenium apparatus is made of a sheet containing numerous insulated selenium cells, which are revolved by clockwork, so that new cells are continually being presented to the rays; the variable currents thus produced are sent through the line. The receiver has two similar line mirrors, which oscillate synchronously with those in the transmitter; by means of the electromagnetic apparatus E^2 the varying line current operates a small opening (referred to by a letter not on the figure), making it larger or smaller according as the current increases or diminishes; behind this screen there is a light 1 or a slit admitting daylight; the rays passing through this slit then fall successively on the two oscillating mirrors and are reproduced on the final screen in the form of a succession of points of light, which follow each other in such rapid succession that the whole image is seen at once. This is only for transmitting white light; when color also is desired he is said to use a prism, which decomposes the light from the original picture into its fundamental colors, which are then reproduced by another prism in the receiving apparatus, but this is not described.

The Lond. "Elec. Eng.," July 1, in a brief reference to his invention, states that selenium is affected by light in two ways; there is a change in the electric resistance, which is what is desired, but there is also a spontaneous change in the conductivity which is beyond calculation, and which is caused by molecular and chemical changes in the selenium, which arise as soon as the current passes through the cell.



CHARGING ACCUMULATORS FOR TELEGRAPHY. Brunelli. "L'Elettricista," April 1; translated into French in the "Jour. Télégraphique," June 25.—An article on the calculation of a primary battery for charging accumulators. Accumulators are preferred, as a single battery of these will simultaneously operate numerous telegraphic circuits, while with primary batteries there is usually one for each circuit. He discusses the relations mathematically and develops a formula which shows that the ratio of the main battery current to the current in each individual circuit is equal to 1 + (n—1) times the ratio of the internal resistance to the sum of the external and internal resistance; n is the number of circuits; from this, and from the largest variation allowable for the relation between the individual currents and the main battery current, the internal resistance which the battery may have can be calculated, and from this the number of cells in multiple which are required. This is then applied to the primary and secondary cells usually used for telegraphy in Italy, the current for the telegraphic circuits being taken as 14 milli-amperes; he thus finds that a telegraphic circuit in which this current is produced has a resistance equal to 64 times the number of cells required; the E. M. F. is one volt, and the internal resistance 7 ohms per cell; for the Gandini accumulator, having a diaphragm, which is the one used, the internal resistances is 0.1 ohm, and he shows that the voltage, when accumulators are used, can be reduced 10 per cent. for each circuit; moreover, the currents, when twenty circuits are connected, are each practically equal to that in a single circuit. He then discusses the problem of calculating the number of primary batteries required to charge accumulators; the telegraphic current for each circuit is equal to a continuous current of 0.001 ampere, flowing continuously, after allowing for the intermittent nature of the working current; the voltages are different, depending on the circuits. In many of the smaller stations it is advisable to charge with primary batteries, as less apparatus is required; the difficulty involved is that the cells are unequally discharged, owing to the different voltages required for the circuits; the most rational solution is to make as many connections with the charging primary battery as there are branch circuits leading from the accumulators to the telegraphic circuits; this arrangement has not yet been tried; 3.5 cells are required for charging each accumulator; an example is worked out for a case in which there are twenty-five circuits, and a table is given for facilitating the calculations; by merely multiplying the required voltage by a certain factor given for each current the number of primary cells required is given directly; in this method no further manipulations are required, as the cells are all permanently connected.

SIGNALING WITHOUT CONNECTING WIRES. Edser. Lond. "Elec. Eng.," July 1.—The continuation of his long article (see "Digest," July 2). The following analogy, which he gives among other things, may assist in giving some idea of the way in which electromagnetic disturbances are propagated through the ether according to Maxwell. Imagine a chain consisting of alternate links of iron and copper insulated from each other; if a current is started in the first copper link it will magnetize the next iron link which is threaded through it, and this will generate a current in the next copper link and so on, thus showing how signals could be transmitted to a great distance without any electrical connection in the usual sense of the word; if each copper link, instead of being continuous, was broken and the two ends connected to a condenser, and if it is assumed to be a perfect conductor and the iron to have no hysteresis loss, there will be no energy dissipated, the whole of the energy being transmitted along the chain; an infinite number of such chains between two points forms a rough model of Maxwell's ether. In his article he determines roughly the conditions necessary for the so-called wireless telegraphy; the general principles underlying the rival methods will be considered in his next installment.

SPECIAL TELEPHONE APPARATUS. West. "Elek. Zeit.," June 30.—A brief abstract of a recent paper describing telephone apparatus to be used in connection with high voltage installations and for mines; also a protecting fuse against strong currents.

TELEPHONY. Wietlisbach. "Elec. Eng'ing," July.—Reprints of two chapters from his book on telephony; the first is on the central office and the second on telephone service.

BALTIMORE. Fairchild. "Elec. Eng.," July 14.—A brief description of the exchanges of the Chesapeake & Potomac Telephone Company, in that city.

Miscellaneous.

OXYGEN FROM THE AIR. Claude. "L'Ind. Elec.," June 25. A short article on electro-thermics and the work of Linde. He shows the great value which a process would have for separating the air into its two constituents, and the effect which such a process would have on the electro-thermic industry. The Linde process of liquefying air is an absolutely closed cycle, and in this process the oxygen of the air liquefies first and evaporates last; by liquefying the air, therefore, and allowing it to expand again, a cycle of operations which involves the loss of very little energy, the nitrogen may be separated from the oxygen; in this way 5 cu. m. of oxygen were produced per hour per horse-power, according to d'Arsonval; this is about fifty times as much in weight "as the same hp-hour transformed into heat is able to produce from carbide of calcium;" at 1 cent per hp-hour this is greatly less than the lowest cost at present of oxygen, which is 16 cents per cu. m. Linde has already applied oxygen obtained in this way to the production of carbide of calcium, and the result has been very satisfactory; the cost of production of the latter material would, therefore, be very much less than when produced by the electric furnace as at present. Although this will supersede the electric process, he thinks there are many other fields left for the application of electricity to heating.

ZEITSCHIFT FUER ELEKTROCHEMIE, June 20.—An announcement that, beginning with July 1, this journal, which formerly was published semi-monthly, is to appear weekly.

UNION OF GERMAN ELECTRICAL ENGINEERS.—"Zeit. fuer. Elek.," June 19.—A running account of the recent meeting, and a brief abstract of the papers.

AMBROIN. Boehlendorff. "Elek. Zeit.," June 30.—A short paper describing this material. It appears to be similar to the descriptions previously noticed.

STANDARD DIAGRAMS. Jamieson. "Elec. Eng.," July 14.—A reprint with the illustration of the article noticed in the "Digest" last week.

SUBMARINE MINES."Sc. Am. Sup.," July 9.—In this, a large, well-illustrated special edition on "The Army and Coast Defense," an illustrated description is given of the methods of laying, connecting and exploding electrically connected submarine mines.

Square Post Knife Switch.

The [illegible] a square post knife switch, for which the [illegible] this switch, which it is stated has proven by use to be the most satisfactory low-priced knife switch on the market. There was considerable competition for the patents, and several concerns have already started to manufacture the goods. The Technic Electrical Works, however, being successful in securing the patents, states that it will prosecute all infringers. This switch is covered by two design patents, Nos. 28,890 and 28,891, issued to J. J. Zimmerlee, of the Technic [illegible].

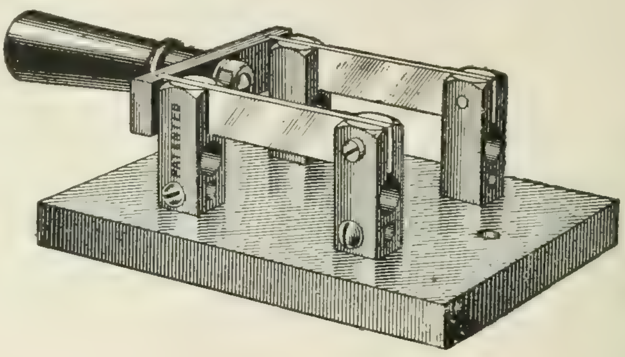
The Technic Electrical Works places a certificate on each switch, guaranteeing its electrical efficiency and mechanical construction, and will replace at any [illegible].

Potential Regulator for Series Incandescent Lighting.

One of the great obstacles with which the series system of incandescent lighting has had to contend has been its want of flexibility. If the circuit is laid out for the full number of lamps which the normal voltage will operate, a [illegible] of the possible number of lamps are connected in circuit, expensive or compli[illegible]

[illegible] is expensive, as the power consumed in the lamps is totally lost, and the lamps are worn out while their light is wasted.

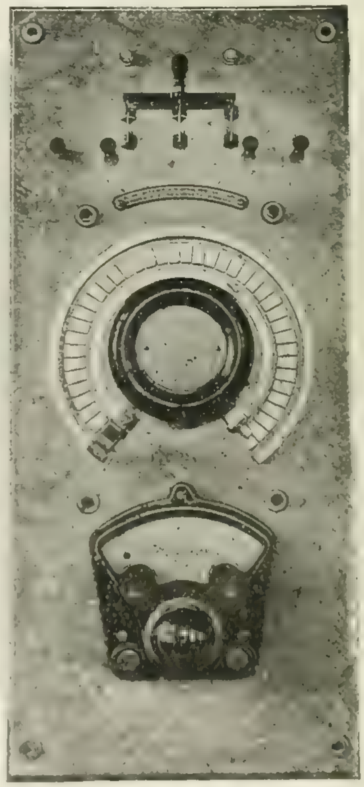
Reactive coils are placed in series with the circuit at the station. This method is also expensive, because the E. M. F. of the coil is out of phase with the voltage of the circuit and, consequently, the voltage produced within the coil will be much more than the actual reduction in the voltage of the circuit.



Square Post Switch.

Reactance or shunt coils are used in connection with each lamp in the circuit. Such coils can only produce approximate compensation for the lamps that may be extinguished and are not satisfactory for compensation for the lamps permanently out of circuit for the same reason that reactive coils are not satisfactory.

For satisfactorily controlling the voltage the General Electric Company has developed a form of potential regulator especially adapted for this work, by the use of which the series system becomes almost as flexible as a parallel system, and the power consumed in the circuit varies directly in proportion to the number of lamps in use. A regulator panel with ammeter, switch and fuses is shown in the illustration. The regulator is mounted on the back of the panel, and consists of a compensator, from the secondary winding of which, taps are connected to a set of contact blocks arranged in circular form on the front of the board. A hand wheel in the centre of the ring of contacts operated two arms carrying brushes which connect from the contact blocks to continuous rings on the inside and outside of the contact blocks. One of these arms is connected directly to the hand wheel, the other is connected through a bevel gear so that the direction of rotation of one arm corresponds to that of the hand wheel, while the other moves in the opposite direction.



Regulator Panel.

The compensator is so connected that whatever difference of voltage exists between the two concentric rings on the dial switch is added to or subtracted from the initial voltage of the circuit. If one arm be directly over the other, there is no difference of potential between these rings. If the hand wheel be turned to the left a gradually increasing voltage which will be added to that of the line, will be developed between the rings, while a gradually increasing voltage which will be subtracted from the initial voltage will be developed if the hand wheel be turned to the right. The ammeter below the hand wheel indicated the current in the circuit. When the number of lamps in circuit is changed it is simply necessary to turn the hand wheel until the proper current is indicated.

The compensators are wound for the standard currents of 3.5 and 5.5 amperes, and in either case will increase or decrease the initial voltage of 1150 or [illegible] range of voltage will be built, if desired.

NEWS OF THE WEEK

Financial Intelligence.

THE GROSS EARNINGS for June of the Edison Electric Illuminating Company of New York were $215,155.92, an increase of $42,125.20 over the gross earnings last year. The net earnings were $79,435.44, an increase of $16,230.18.

THE NEW ENGLAND TELEPHONE AND TELEGRAPH COMPANY, of New York City, has filed with the Secretary of State at Albany a certificate of an increase in its capital stock from $12,000,000 to $15,000,000. The debts and liabilities of the company amount to $3,505,404. The object of this increase was outlined in THE ELECTRICAL WORLD of July 9.

THE METROPOLITAN STREET RAILWAY COMPANY, New York City, reports for the quarter ended June 30, 1898, gross earnings, $3,230,763; operating expenses, $1,628,659; net earnings, $1,602,104; fixed charges, $1,101,240; surplus, $500,924; dividends, $375,000; balance, $125,824. It was announced officially on July 15 that a meeting of the stockholders of the Metropolitan Street Railway Company would be held on August 9 to authorize the issue of $15,000,000 in new stock, not $10,000,000, as was reported recently. Of the new stock it is stated that $10,000,000 is to be sold at once to the stockholders at par; the other $5,000,000 will remain in the treasury. The new issue will increase the capitalization of the company of $30,000,000 to $45,000,000.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
9 Murray St., NEW YORK, July 18, 1898.

INSPECTOR OF ELECTRICAL CONDUITS.—Frank J. Curran has been appointed inspector of electrical conduits in the Borough of Brooklyn, at a salary of $1,200 per year.

NO SEAT, NO FARE.—Councilman Christman introduced a resolution in the Municipal Council on July 12, providing that all corporations operating elevated or surface railroads or stage lines within the limits of the city of New York shall be required to furnish seats for all passengers, and that when each vehicle is filled with seated passengers a sign to that effect shall be conspicuously displayed on the outside of the car. The ordinance also provides that when a passenger boards a car without being notified that it is filled, and is compelled to stand up, he need not pay fare until a seat is furnished to him.

THE MURDER OF MR. GEORGE R. BLODGETT RECALLED.—On the night of July 11 the New York police caught and arrested William Mason, alias "Big Bill," who is charged with murder and robbery in Philadelphia and other places. Among the crimes with which this noted criminal is charged is the murder of Mr. George R. Blodgett, at Schenectady, N. Y., on December 3, 1897. Mr. Blodgett was counsel for the General Electric Company, and was shot at his home in a mysterious manner. The murderer escaped, taking with him twenty-seven pieces of silver plate. The General Electric Company offered a reward of $5000 for his capture. An effort to dispose of this plate gave the police a clue, which led to the shadowing of Mason and his final arrest.

THE TELEGRAM WAR-TAX.—A decision as to who shall pay for the stamp that is required to be placed on every telegram has just been rendered by Commissioner Scott, of the Internal Revenue Bureau, at Washington. He decides that it is the duty of the person who makes, signs or issues the message to affix the stamp on the same. Section 7 of the act provides that if any person or persons shall make, sign or issue any instrument, document or paper of any description whatsoever without the same being duly stamped for denoting the tax thereon, the said person or persons shall be deemed guilty of a misdemeanor, and on conviction thereof shall pay a fine of not more than $100. Telegraphic dispatches and messages are enumerated in the act as requiring the documentary one-cent stamp.

MORE UNDERGROUND CONDUIT ROADS.—The Metropolitan Street Railway Company announces that on July 20 it will begin the work of installing the underground conduit system on Sixth and Eighth Avenues, south of Fifty-ninth Street. It is expected that the work will be finished and cars running over these lines by September 15. While the work is in progress the horse-car service on these two avenues will be discontinued. Meanwhile upper West-side patrons via Eighth, Columbus and Amsterdam Avenues will be carried over the electric line through Fifty-ninth Street to and from transfer points at Seventh Avenue, Madison Avenue, Lexington Avenue and Second Avenue. The Metropolitan Company will furnish extra facilities on the Seventh and Ninth Avenue horse-car lines for the accommodation of the public until the improvements on Sixth and Eighth Avenues are completed and the new lines are in operation.

SOUTHERN NOTES.

WASHINGTON, D. C., July 15, 1898.

THE JAMAICAN TARIFF.—According to advices received by the Bureau of American Republics the new tariff of Jamaica places all apparatus and appliances of all kinds for generating, storing, conducting and converting into power for light and measuring of electricity on the free list.

ELECTRIC RAILWAY CONCESSION IN BUENOS AYRES.—Mr. James G. Kelley has, according to information received by the Bureau of American Republics, applied to the municipality of Buenos Ayres for a concession to construct two underground electric railways in that city. The roads are to be ready for use within three years after the granting of the concession. Fifteen centavos will be the maximum fare, and five centavos will be charged for parcels, and 6 per cent. of the total receipts is to accrue to the municipalities. Both lines, with the entire plant and all the rolling stock, shall become the absolute property of the municipality free of any claim or compensation at the expiration of ninety-nine years.

BUFFALO AND NIAGARA FALLS NOTES.

BUFFALO, N. Y., July 16, 1898.

THE WALKER COMPANY is putting in a 150-kw generator to furnish the motive power for the new trolley line to be run from Lima to Honeoye Falls over the tracks of an existing steam line. The car to be used is equipped with four 50-hp motors, and is designed to haul freight.

THE STATE RAILROAD COMMISSION has made a preliminary inspection of the Buffalo Valley line, from Buffalo to Java, and will give a hearing soon. One hearing was appointed, but has been postponed. This road has ample means behind it and may yet be graded this year. It is of special interest to the trolley public on account of the design to make a freight as well as passenger road of it.

SO EMINENTLY SUCCESSFUL have the new electric grain elevators proven, especially the Electric elevator, that it is asserted by an engineering expert that if the projected Sturges elevator should be built it and the two now running would practically drive all the wooden elevators in Buffalo harbor out of business. The electric elevators have demonstrated that grain can be handled so much easier and cheaper than was possible with the wooden ones driven by steam power that a practical revolution has already been wrought.

THE 1,000-HP single-phase generator building by the Walker Company for the electric light company at Niagara Falls is about to be placed in the power house of the Schoellkopf Hydraulic Canal Company in the bottom of the gorge at Niagara. It differs from most apparatus of that capacity by having a frequency of 125 cycles to correspond with other machinery already in operation in the building. Otherwise the frequency would be cut down to about 65 cycles. The pressure is 2000 volts, and the current goes direct on the wires of the lighting company. Most of it will be used in the hotels on incandescent circuits.

ST. LOUIS NOTES.

ST. LOUIS, MO., July 15 1898.

NEW STREET RAILWAY.—The city council made a report this week recommending the passage of a bill authorizing the South Broadway Improvement Association to build and operate a street railroad. The franchise will be for twenty-five years.

AUTOMATIC TELEPHONES.—The Bell Telephone Company now has agents soliciting orders for automatic telephones. These will be equipped with a coin-receiving slot device and will be placed chiefly in drug stores. The subscriber, by term of the contract, is to receive 10 per cent. of the money taken in by the machine. The new 'phones are expected to be put up not later than August 15.

GOVERNMENT ORDERS.—The work of the Kinloch Telephone Company has been very much delayed owing to the fact that all the insulated wire available is being supplied to the Government on rush orders. The Kinloch Company ordered its wire from the Kellogg Switchboard & Supply Company, of Chicago, which placed the $250,000 switchboard in the Century Building, and was to have been supplied by July 2. It is stated that no strenuous effort will be made to force the company to live up to its contract until the War Department has been fully supplied.

THE AMERICAN TELEPHONE AND TELEGRAPH COMPANY has moved its division headquarters from Cincinnati to St. Louis and will occupy rooms in the Telephone Building, Tenth and Olive Streets. Division Superintendent Gouverneur Calhoun has charge of the office and is also supervising an unusually large amount of new work undertaken by the company. The latter includes the construction of a test station at Madison, Ill., and the stringing of wires on new lines which are rapidly progressing toward Memphis and Kansas City. The removal of the division headquarters to St. Louis indicates that this city is to become a telephone centre. The new test station at Madison, Ill., will take the place of the present Ferry Street test station, and messages passing through St. Louis will hereafter pass through the station instead of being transmitted by the underground route. The Bell Telephone lines will hereafter converge in the Telephone Building.

PACIFIC COAST NOTES.

SAN FRANCISCO, Cal., July 10, 1898.

MR. W. F. C. HASSON is in Victoria, B. C., superintending the completion of the work of installing the British Columbia Electric Railway Company's 12-mile transmission system, which will furnish power for the street railways of that city.

RECENTLY INCORPORATED.—The Electro-Magnetic Weighing-Scale Company, of Sacramento, Cal.; capital stock, $1,000,000; objects, to manufacture electro-magnetic weighing scales, etc. The directors named are H. G. Smith, W. P. Owens, F. B. Smith, F. F. Smith and Edward Hanak.

THERE WILL BE A CHANGE in the San Francisco agency of the Fort Wayne Electric Corporation, Mr. Charles R. Lloyd having resigned as local representative. Mr. F. N. Delanoy, who has been bookkeeper under the present management for three years past, has been given the agency. Mr. Lloyd will soon leave for England to remain a year.

THE SAN FRANCISCO GABRIEL ELECTRIC COMPANY'S water-power electric station, installed by Los Angeles capitalists, is now in successful operation. Work has been prosecuted night and day on portions of this transmission line, known as the Kerchkoff system, in order to reach Los Angeles ahead of a competing company. Three Westinghouse two-phase generators are driven by direct-connected Tuthill water wheels, manufactured in Oakland, Cal. Messrs. Hasson & Hunt were consulting engineers for the electric company.

THE BOARD OF SUPERVISORS of San Francisco recently decided to follow the Merchants Association's plan in advertising for bids for street lighting beginning August 1 next. There will be arc lights on Market Street, from the ferries to Valencia Street, on Golden Gate Avenue, from Market to Devisadero, and on Folsom Street, from Third to Twenty-sixth Street. The lamps on the business streets and driveways are to be lighted every night in the year, although it is claimed that a three-night moonlight schedule would reduce the expense $30,000 a year. The prevalence of fog makes a moonlight schedule undesirable.

THE MARKET STREET RAILWAY COMPANY, San Francisco, has just successfully inaugurated its through electric service from the ferries to the ocean beach. A blue car leaves the Ferry Depot every half hour, running out Mission Street and zigzagging across town to pick up transfers from a number of lines. After traversing Oak, Stanyan and Fredericks Streets, the line follows H Street and the new roadbed on the right of way formerly used by the old Park & Ocean steam line to the Pacific Ocean near the Cliff House. A ten-minute service is given over a short line from the ferries to Ninth Avenue and H Streets. Also, a service from the Potrero, connecting at Eighteenth and Kentucky Streets with the new Market Street and Ocean Electric line. H. H. Lynch had charge of construction.

CANADIAN NOTES.

OTTAWA, Ont., July 16, 1898.

THE QUEBEC ELECTRIC RAILWAY has definitely passed into the hands of the Quebec, Montmorency & Charlevoix Railroad Company. Colonel Strathy, of Montreal, the representative of the new syndicate, paid the company which built the Quebec Electric Tramway, $1,500,000.

THE CITY COUNCIL of Hamilton, Ont., has decided, in respect to the street railway of that city, to submit the following questions to the ratepayers on July 27: (1) Shall the city purchase and operate the Hamilton Street Railway (2) If the city does not now purchase the Hamilton Street Railway should the council extend the franchise of the company for fifteen years?

THE REV. FATHER PARADIS, of colonization fame in Northern Ontario, is in Montreal, and his energies are being directed, just now, to secure an electric tramway from Dunreney, 2 miles from Verner, to the waters of Lake Trinagain, a distance of 26 miles. This lake is surrounded by fertile land and its connection with the C. P. R. is greatly to be desired. Father Paradis states that the water power is all that can be desired, and he hopes that with a little aid from the Ontario Government, the road can be completed in the near future.

MR. C. O. PALMER, manager of the Sun Life Insurance Company at Kingston, Jamaica, is at present in Canada in this vicinity. He speaks highly of the project of harnessing the Rio Cobre by the West Indian Electric Company, which is one of the largest schemes ever ventured in Jamaica. The works, which have already made considerable progress, are situated near the great tunnel at Boy Walk, at which point the river is 160 feet wide. The dam will stretch from one bank to the other, to be imbedded in the solid rock. In order to provide against all contingencies the dam will be three times as strong as its estimated pressure. The foundations of the dam have already been built. The concrete and masonry sunk in the rock of the river bottom will go 10 feet below the water, and above the water the walls of the dam will rise some 9 feet. The water is taken in from the dam by a pipe 8 feet in diameter. The pipe will convey about 20,000 cubic feet of water, or about 120,000 gallons a minute to the power works. It is provided with a steel valve to regulate and control the supply of water, and runs alongside the river for a mile and a quarter from the dam to the power house. The power house will be built entirely of steel and concrete, the steel work alone weighing 250,000 pounds. The river in its course for a mile and a quarter drops about 47 feet, which, added to the foot of the dam, amounts to 56 feet, which will be the fall of the pipe in its course to the works.

MONTREAL, Que., July 15, 1898.

A BY-LAW authorizing the construction of an electric railway between St. Catharines and Port Dalhousie has received its first reading in the St. Catharines, Ont., Council.

THE RATEPAYERS of Waterloo, Ont., have sanctioned the by-laws granting a bonus of $12,000 to the Galt & Preston Electric Railway Company for the extension of its lines.

[illegible] that the road will be constructed to Hamilton provided the Council buys the [illegible]

[illegible]

ENGLISH NOTES.

(From Our Own Correspondent.)

LONDON, July [illegible], 1898.

[illegible]

tically overthrew the micanite patent in an action brought by the owners of that patent for alleged infringement. In his judgment Mr. Justice Kekewich stated that a prior user of substances practically the same as micanite had clearly been proved. In the prosecution it was attempted to be shown that micanite differed essentially from previous compounds of mica, in that with micanite the mica has not to be cut into regular pices, but the elementary feather-edged scales are used without any other material to which to fasten them. In all previous attempts to build up a micaceous material the mica had been cut into regular pieces and shellacked piece by piece. Another important action is now going on and relates to the use of horizontal reflectors for alternate current arc lamps. This action, brought by the Helios Company, of Cologne, purports to claim for this company the patent right to place a horizontal mirror over the upper carbon of this kind of arc. The action is not yet decided.

FIRE AT A LONDON ELECTRIC LIGHT STATION.—Last week a disastrous fire broke at the back of the switchboard of the South Street, Manchester Square, station of the Metropolitan Electric Supply Company. The fire was caused by a piece of extreme carelessness on the part of the switchboard attendant, who inadvertently switched two machines in parallel. The supply from the Manchester Square station is on the old alternate system, in which the circuits are run independently and the alternators are never in any case paralleled, so that an arc was formed as soon as the man put in the wrong plug. This arc set fire to the india-rubber cables at the back of the switchboard and the flames very soon reached the roof, which was completely destroyed. By a piece of luck, the machines themselves, which are turbo-generators, were not damaged by the fire, but the water played considerable havoc among them. The fire occurred about midnight, but early the next morning it was possible to connect most of the mains to the trunk lines leading from the other stations of the Metropolitan Electric Supply Company, and later on the Grosvenor Gallery sub-station of the London Electric Supply Corporation also assisted, so that before dusk all lights were again burning. Two of the generating sets at the Manchester Square station have already been got into working order again, and the staff is hard at work putting things right. As at the present time the demand for new connections exceeds 1000 8-cp lamps per week, it is of the utmost importance that this station should be able to supply its full share of the load as soon as possible. The loss is fully covered by insurance.

THE BROMPTON AND PICCADILLY CIRCUS RAILWAY.—The latest addition to an important and gradually increasing class of suburban railway in London, viz., the Greathead tunnel underground railway, is the line which it is proposed to construct between South Kensington and Piccadilly Circus. The route is about 2 miles long, and will consist of double tracks in separate tunnels. There are to be seven stations in all, including the terminals, and the single journey will be performed in about ten minutes. The power house for this line is to be built on the Thames at Chelsea, and will be connected to the railway system by steel armored cables buried in the ground. The authorized share capital of this concern is $3,000,000, with borrowing powers of $1,000,000. The prospectus of this undertaking anticipates that a train mileage of 412,256 per annum will be run, and that the gross revenue will attain nearly 90 cents per train mile, the total expenditure not being more than 3[illegible] cents per train mile. It will thus be seen that it is expected to run the railway on the basis of 36 per cent. ratio between the total costs and the gross revenue. It is claimed that after paying an interest of 3½ per cent. on the borrowed capital there will be a margin sufficient for a 6 per cent. dividend on the share capital. This line, if constructed, will tap a very important part of the West End and Central London, as it will connect the existing underground railway at South Kensington with the new Waterloo and Baker Street electric underground railway at Piccadilly Circus. It thus connects, on either side, an extensive system of railways and suburban lines with a district that has hitherto only been served by horse omnibuses.

FRENCH NOTES.

(From Our Own Correspondent.)

PARIS, June 30, 1898.

ELECTRIC TRACTION, a new surface contact system. M. Louis Bertrand has invented a surface contact system which possesses some advantages. The principle of the system lies in the use of the car-wheel flange as it travels in the groove of the rails. The wheels bear at intervals on cams in the tram rail groove, and in this way set in motion current distributors. The advantage of this system is that there are no projections above the level of the roadway. But the question is, will it work continuously without getting out of order? Practical experiment only can settle this point.

IMPROVEMENT IN TELEPHONES, or more, correctly speaking, an improvement in the telephone service. Everyone knows how unpleasant it is to be interrupted in the middle of a conversation by the telephone girl breaking in and inquiring if you have done yet. Some of the exchanges have been furnished with a device to show the operator that the line is still in use without the necessity of breaking in on the conversation to find out. A small lamp is set up just above each number, and it lights up when the instrument begins to be used, and is extinguished when the receiver is returned to the hook.

A NEW ELECTRICAL TRAMCAR. The Fives-Lille Company is building an electrical tramcar which has some rather interesting features. The motors for propelling it embody some very noticeable improvements over those that have hitherto been used. Repairs are very easily made and do not require especially trained labor, all parts being on the interchangeable system. The motor is [illegible] wound, and its weight complete with gears and all accessories does not exceed [illegible] pounds. This is comparatively light weight, considering the power of the motor, which is [illegible] horse-power, but can be doubled or tripled for a short space of time. The speed, [illegible] r. p. m., is low enough to require only single reduction. The armature is ring wound, and the field is of a closed frame of cast steel made in a single piece, and is therefore rendered very strong. The car carries two motors, so that if one should need repair the car need not be put out of service. These motors are supported on brackets, and they drive the axle through a gear. The efficiency of transmission, including the gear, is 80 per cent. The universal controller which will be supplied to the car provides all the necessary control by simply turning a handle, such as starting, stopping, speed regulation, reversing and the application of the electric brake. The car body which will be used is a design appropriate to hot countries, or for use on lines running to bathing resorts, or for use in large cities and their suburbs during the summer season. It weighs, all complete, including machinery, about 10,500 pounds. The car framework, which is entirely of metal, is mounted on steel axles, forced into iron wheels, provided with steel tires. The wheel base is such as to allow the car to take a curve of 50-foot radius on a track not provided with guard rail or having a very wide groove. There is a question which for Continental European governments has another side, and one which is of great moment, too. That is the mobilization and transport of troops; the best planned movements may fail as the result of some accident which stops traffic at the critical moment. It is therefore of the greatest importance to military trains to attain the highest speed possible and a perfectly reliable service. The Fives-Lille Company, which manufactures in its shops at Givors all the brake apparatus used on the locomotives and carriages on the State railways and on the Orleans and Southern roads, has been led to make a study of the question of brake action. After lengthy and painstaking research and numberless experiments the company has evolved a mechanical equipment which makes it possible to stop without danger and with all desirable speed the longest trains used on the French lines.

General News.

NEW INCORPORATIONS.

THE EXETER TELEPHONE COMPANY, Manchester, N. H., has been formed with a capital stock of $3000.

THE MISSOURI & IOWA TELEPHONE COMPANY, Des Moines, Ia., has been incorporated with a capital stock of $25,000.

THE ALBION POWER COMPANY, Albion, N. Y., has been incorporated with a capital stock of $50,000. The directors are Frank A. Dudley, Wallace C. Johnson, Sanford T. Church and Albert Culver.

THE GROSS ELECTRIC EXPERIMENTAL COMPANY, Gillespie, Ill., has been incorporated with a capital stock of $12,500. The incorporators are: William M. Gross, John H. Eilers and William W. Williams.

THE CROWDUS COMPANY, Chicago, Ill., has been incorporated for the purpose of manufacturing electrical devices. Among those interested are Thomas B. McGragor, Frank G. Howser and Belle W. Barry.

THE ALVIN & ANGLETON TELEPHONE COMPANY, Alvin, Tex., has been formed with a capital of $2000. The incorporators are O. S. Cummings, A. J. Birchfield, F. J. Bush, A. W. Wilkinson and W. A. Leonard, all of Brazoria County.

THE OKLAHOMA TELEPHONE COMPANY, Guthrie, Okla., has been formed with a capital stock of $100,000. The incorporators are: Harry C. Barter and George R. Gorden, of Brownington, Mo.; William E. Moore and McGregor Douglass, of Oklahoma City.

THE MANHATTAN INSTITUTE OF ELECTRO-THERAPEUTICS, of New York City, N. Y., has been incorporated with a capital stock of $25,000. The directors are: Henry H. Goldberg and Ralph H. Goldberg, of New York City; and T. M. Buckley, of Brooklyn.

THE OSHKOSH, OMRO & BERLIN ELECTRIC RAILWAY CONSTRUCTION COMPANY, Oshkosh, Wis., has been incorporated with a capital stock of $25,000. The incorporators are: S. W. Hollister, J. W. Himebaugh, Clement C. Smith, J. H. Jenkins and A. B. Ideson.

THE COON RAPIDS ELECTRIC LIGHT & POWER COMPANY, Coon Rapids, Ia., has been formed with a capital stock of $5100. The officers of the new company are: President, A. N. Wilson; secretary and treasurer, O. D. Houghton; trustees, O. M. Taylor, L. B. Houghton and L. J. Wilson.

THE EPHRATA ELECTRIC COMPANY has been organized for the purpose of furnishing light, heat and power to the Borough of Ephrata, Pa. The capital stock of the company is $15,000, and the directors are: F. E. Bailey, Philadelphia; A. W. Mentzer, Ephrata; H. G. Mentzer, Ephrata; S. N. Bailey, Dillsburg; John W. Von Neida, Ephrata.

THE BEACON LIGHT COMPANY of Darby, the Beacon Light Company of Ridley Park, and the Beacon Light Company of Glenolder, Pa., have been incorporated. Each has a capital of $1000, and the directors are: George C. Hetzel, Ridley Park; J. E. Cochran, Jr., George S. Howell, and Thomas S. Hall, Chester, and E. H. Davis, Brooklyn.

THE CENTRAL ELECTRIC RAILWAY COMPANY, of Kansas City, Mo., has been incorporated with a capital stock of $1,000,000. Mr. James M. Davis, of New York City, is the principal stockholder. The new concern will merge with the Northeast Railway Company, and branch out into one of the leading city railroad properties in Kansas City.

THE LIMA-HONEOYE ELECTRIC LIGHT COMPANY, Buffalo, N. Y., has been formed with a capital stock of $125,000. The directors are: Hardin H. Little, Robert L. Fryer, John C. Conway, Peter P. Miller, Henry W. Box, Albert L. Williams and Clarence McGregor, of Buffalo; Alex. M. Holden, of Honeoye Falls, and Horace C. Gilbert, of Lima.

THE TELEGRAPH AND TELEPHONE.

ORRVILLE, OHIO.—The Millersburg Telephone Company is putting in an exchange in this place.

WAYCROSS, GA.—The long-distance telephone line has been extended to Douglas from Nichols, on the Waycross Air Line.

SPRINGFIELD, TENN.—The Cumberland Telephone & Telegraph Company is building a new line from Springfield to Baggettville.

JACKSONVILLE, TEX.—The Southwestern Telephone Company's line has reached this point, and is connected with the East Texas Telephone Company's system.

DETROIT, MICH.—The Detroit Switchboard & Telephone Construction Company has filed a notice that its capital stock has been increased from $100,000 to $250,000.

SAN FRANCISCO, CAL.—The Executive Council of Hawaii has signed a contract with the Scrymser Company to lay a cable from San Diego, Cal., to Honolulu and Japan.

WAYNESBURG, PA.—The Central District Printing & Telegraph Company has reduced its rates of rental to $15 per year for business houses and $12 for direct residence lines.

GOSHEN, IND.—The Central Union Telephone Company is reconstructing its system in this place. The poles will be replaced, the office equipped with two switchboards and everything else done to make the system a perfect one.

COLUMBUS, WIS.—The new exchange in this place of the Wisconsin Telephone Company has been completed. The metallic circuit between Columbus and Watertown is finished, and work will be commenced on the line to Portage and Baraboo.

TIFFIN, OHIO.—The Ohio Telephone Toll Line Company is building a line from Tiffin to Millersville. The Ohio Company's line begins at the city limits, and will connect with the Home Telephone Company's system, which operates in this city.

SIOUX CITY, IA.—The Northwestern Telephone Exchange Company has commenced the construction of a line from Spring Valley to Lacrosse. A long-distance service will thus be furnished to numerous towns along the Southern Minnesota Railway.

CLEVELAND, OHIO.—The Home Telephone Company, of this city, has been reorganized, Mr. Henry A. Everett being elected president and general manager; Mr. E. W. Moore, vice-president; Frank H. Price, secretary; John Sherwin, treasurer. The company is capitalized at $500,000.

SPRING VALLEY, MINN.—The Northwestern Telephone Exchange Company has begun the construction of a line from here to Lacrosse. This will give a long distance service to Wykopf, Preston, Lanesboro, Rushford and several smaller towns along the Southern Minnesota Railway.

NARRAGANSETT PIER, R. I.—A new Government cable was laid on July 11 between Block Island and Narragansett Pier. At Narragansett it connects with the Providence Telephone Company's line, thus giving direct long-distance communication from Block Island to New York and Washington.

WYNNEWOOD, I. T.—A telephone company has been organized in this place to build lines to various places in this section of the country. It is stated that all the money necessary to carry out the enterprise has been subscribed by the citizens, and the work will be commenced at once.

CHESTER, ILL.—The entire plant of the Chester Mutual Telephone Exchange has been transferred to Mr. A. G. Gordon. The system will be at once reconstructed, and the automatic switchboard will be replaced with a manual switchboard. New and improved instruments will also be put in.

CLEVELAND, OHIO.—Several months ago the telephone company decided to make pay stations of all telephones in drug stores. The druggists took the matter up and refused to enter into the contract. A meeting of the representatives of both sides was held a few days ago, and resulted in the druggists agreeing to the proposed arrangement.

GREENVILLE, S. C.—The Piedmont Telephone & Telegraph Company has been organized by George A. Browning, president of the Greenville Home Telephone Company. The new company will establish exchanges at Anderson, Abbeville, Greenwood, Laurens and other places. The exchanges will be connected by metallic circuit and long-distance instruments.

DETROIT, MICH.—The Fire Commissioners have taken final action relative to the proposed independent telephone system for the use of the department. The contract for telephone apparatus was awarded to the Holtzer-Cabot Electric Company, of Brookline, Mass., for $930, and for the cable to the Standard Underground Cable Company, of Pittsburg, Pa., for $3,081.23.

DES MOINES, IA.—The City Council recently ordered the Iowa Telephone Company to vacate the streets of the city, claiming that the company had no charter allowing it to operate there. The telephone company claims that it has the right to operate a telephone line in the city and string its wires on any street it desires to traverse, and that it would not comply with the order of the Council. It is likely that the case will be taken into court.

DES MOINES, IA.—It is stated that there is a movement on foot for the consolidation of all the independent toll lines in the State under one management, and the merging of the several companies into one organization. Propositions for the proposed consolidation have been forwarded to the management of the different lines, and it is stated that there is every indication that they will be accepted. A meeting to outline the general plan of consolidation will be called at an early date. The nucleus will probably be the Central Telephone Company, of this city.

WABASH, IND.—James Brairly, of Wauseon, Ohio, has formed a company and purchased the franchise of an abandoned telegraph line between Fort Wayne and Chicago, and will use it for an independent telephone line. By this means the network of northern Indiana independent telephone toll lines will be connected with Chicago, and ultimately with Indianapolis, when the New Telephone Company, of the latter city, gets its exchange into operation. It is stated that connection with many independent exchanges in Western Ohio and Southern Michigan will also be obtained.

PHILADELPHIA, PA.—The Common Council on July 11 passed an ordinance granting to the Drawbaugh Telephone & Telegraph Company the privilege of constructing and operating a system of electric wires and cables through or under the streets of this city, for the purpose of conducting a telephone business between various exchanges, subscribers and patrons. Col. Joseph S. Stokes is president of the Drawbaugh Company in Philadelphia, and Mr. J. R. Bartlett, of New York, is president of the parent company. The ordinance now awaits the signature of the Mayor. It authorizes and empowers the company to hire, rent, lease or purchase any underground conduit or system of cables and wires that may have been or may hereafter be constructed by the city or by any corporation, firm or individual under existing ordinances. The company is required to furnish for the use of the city, and without cost, two ducts or chambers in its conduits, and free telephone service is to be afforded to the various city departments. The company is required to fix the maximum cost of its annual service per instrument for business houses at $75, and for private dwellings at $50.

ELECTRIC LIGHT AND POWER

CHICAGO, ILL.—The Hyde Park Electric Light and Power Company has confessed judgment for $23,102.

CRESCO, IOWA.—Mr. B. S. Wilder is seeking a twenty-year franchise to establish an electric light plant in this place.

FORT WORTH, TEX.—Mr. Emmett A. Ellis has purchased a controlling interest in the Standard Light & Power Company, of this city, paying there[illegible]

UPPER SANDUSKY, OHIO.—The Citizens Electric Light Company of this place has completed arrangements to establish an incandescent light plant to be ready for operation by September 1.

FOSTORIA, OHIO.—The Fostoria Light & Power Company will probably be purchased by a Philadelphia company. The stockholders of the Fostoria Company will pass upon the matter.

BELOIT, WIS.—The Beloit Electric Light & Power Company has purchased the old Rock River paper-mill property, and will use it as an electric light and power plant. The purchase carries with it a valuable water power. The electric company will spend $25,000 in improvements.

CINCINNATI, OHIO.—The works of the Cincinnati Edison Electric Company, on Eighth Street, near Plum, were burned on July 9, entailing a loss of $40,000. It is stated that there was no insurance on the property. The fire was started by the explosion of a boiler. It is reported that the arc machines were not injured.

LYNCHBURG, VA.—On July 26 capitalists from New York and other places, who recently purchased the property of the Lynchburg Electric Company, including the street railway, will meet for the purpose of organizing and electing officers of the new company, which will be known as the Lynchburg Electric & Light Company.

BALTIMORE, MD.—The Northern Electric Company, of this city, has been awarded the contract to light the cathedral by electricity. The system of lighting will be elaborate and was planned by the Rev. C. T. Thomas, the rector, who has been studying the problem for two years. From 600 to 700 16-cp lamps will be placed in the building, which is now being wired.

CANAL DOVER, OHIO.—The firm of Leiser & Bowers has decided to build a large electric light and power plant for their new flour mill. The plant will be erected on the site of the old mill, which was destroyed by fire several months ago, and the water power from the Tuscarawas River will be utilized to generate electricity. It is proposed to distribute electric current to all parts of the county if a sufficient number of subscribers can be secured for light and power.

THE ELECTRIC RAILWAY.

[illegible], CONN.—At the annual meeting of the Waterbury Traction Company [illegible] Mr. A. M. Young, was elected secretary and a director. Mr. Young is president of the National Electric Light Association.

CLEVELAND, OHIO.—[illegible] has destroyed the car house of the Cleveland Electric Company, situated at Wilson Avenue, near Woodland Avenue. Eleven motor and trail cars were badly damaged. The loss of about $11,000 is covered by insurance.

CHICAGO, ILL.—The Chicago & Milwaukee Electric Railway Company on July 7 opened its line for traffic between Highland Park and New Chicago. There is but one track in readiness, but the switches at mile intervals are expected to permit of the use of several cars.

KENOSHA, WIS.—Another request has been made for a street railway ordinance by the Milwaukee, Racine and Kenosha Electric Railway Company. The question was brought up and discussed at a special meeting of the Council, and it was agreed to have a special committee appointed to draw a new ordinance.

ORANGE, N. J. The Suburban Traction Company's property was sold [illegible]. The sale was made subject to the certificates issued by the receiver, amounting [illegible]

[illegible] county seat with the Harlem Railroad. It is reported that New York capitalists [illegible] that will develop this enterprise is to be called the Jansen [illegible]

LEGAL NOTE.

[illegible] issue of 6 per cent. bonds of the company. It says that bonds were fraudulently diverted from their purpose. The decision places Frank De Haas Robinson, of Cleveland, in possession of the property hypothecated by Shipherd.

PERSONAL NOTES.

PROF. E. F. NORTHRUP, formerly of the University of Texas, Austin, Tex., is now connected with the Westinghouse Electric & Manufacturing Company, Pittsburg, Pa.

MR. HENRY G. ISSERTEL has recently taken the management of the Walker Company's New England office, his headquarters being at 53 State Street, Boston, room 313. Mr. Issertel's first experience in the electrical business was received in Boston. He was one of the corps of experts for the old Thomson-Houston Company, and in his capacity as engineer he assisted in the building and equipping of some of the principal roads in New England. The past ten years Mr. Issertel spent in New York City.

OBITUARY NOTE.

MR. JOHN MASON JACKSON, of Chicago, died in Honolulu, Hawaii, on July 6, at the age of thirty-nine years. His body will be embalmed at Honolulu and shipped to Chicago for interment. Mr. Jackson started for Yokohama, Japan, last October, partially on business for the Western Electric Company, of which he was treasurer, and partially for his health. He was there until two months ago, when he started for home. When he arrived at Honolulu he was so well pleased with the climate that he decided to stop there for a time and in his recent letters he stated that his health was rapidly improving. The news of his death was a great shock to his many friends. Mr. Jackson was in the employ of the Western Electric Company for twenty-five years.

TRADE AND MISCELLANEOUS PUBLICATIONS.

"GRAPHITE AS A LUBRICANT."—The 1898 edition of a pamphlet entitled "Graphite as a Lubricant," issued by the Joseph Dixon Crucible Company, Jersey City, N. J., has just been issued. Its contents are made up chiefly from those of the 1897 edition, but it has some additional matter covering four extra pages. Two or three things are worth noting: First, the lubrication of the engine cylinders; second, the hand oil pump; and third, the experience of an expert engineer with flake graphite in the way of saving power and oil. An official of the Pennsylvania Railroad Company used finely puverized graphite for lubricating a gas engine, with the most remarkable results in the way of better lubrication. The use of a hand oil pump in lubricating engine cylinders is not new, but it has been found that a small hand oil pump is one of the most efficient devices for introducing oil or graphite just where it is wanted. The pamphlet is well worth the careful reading of any engineer, and a copy of the same, as well as samples of the graphite, may be obtained by any one interested by addressing the company.

AUTOMATIC CUT-OFF ENGINES.—The Ball Engine Company, Erie, Pa., has issued a very artistic catalogue of its automatic cut-off engines for electric lighting, electric railways and general manufacturing plants. The advantages possessed by these engines for these services are concisely set forth, and a general description of the construction of the engine enables one to appreciate the good points of this well-known machine. The catalogue is very handsomely illustrated. The engines described and illustrated are of these types: Single cylinder engines, horizontal tandem compound, non-condensing and condensing, horizontal cross compound, non-condensing and condensing, vertical single cylinder engines and vertical cross compound. In the tandem compound engine the general features of frame, shaft, valve and governor which distinguish this company's single cylinder engine are preserved, while the arrangement of the valve motions, one on each side of the engine, avoids the unsatisfactory results of complicated valve gear. The cross compound engine occupies less floor space for equal power than a tandem compound engine and permits of a higher rotative speed and freer access to the pistons. In vertical engines the company builds single cylinder, tandem compound and cross compound. In the design of this engine due consideration was given to ease of access for adjustment or removal of any part subject to wear. An independent valve motion for each and every cylinder is employed, thus rendering each of these a perfect engine in itself. The means of lubrication are very complete. The design of the housings is such that there is an entire absence of vibration, and owing to the manner in which the shaft is introduced into the housings it is not necessary to disconnect any column or prop up any upper works either to place the shaft in position or to roll it out of place. The valve connections are simple and direct, and the engines are economical in the use of steam, the regulation being of the best.

Trade and Industrial Notes.

THE [illegible] COMPANY, Cleveland, Ohio, dealer in electrical supplies, [illegible]

THE WORKS of the Lincoln Electric Company, of Cleveland, were destroyed by fire on the night of July [illegible]

THE AMERICAN IMPULSE WHEEL COMPANY, [illegible] Liberty Street, New York, has secured the contract to furnish water wheels for the lighting [illegible]

THE WORKS of the Williams & Abbott Electric Company, Cleveland, Ohio, [illegible] destroyed by fire on May [illegible]. The company has located at No. [illegible]

CHANGE OF NAME.—The [illegible] Electrical Manufacturing Company, of Chicago, has changed its name to the Chicago Non-Refilling Bottle Stopper Company, and the [illegible] Electric Company, of Chicago, has changed its name to the [illegible] Company.

THE [illegible] WATER COMPANY, [illegible], Mich., is about to increase [illegible] by the addition of a tandem compound engine now being built by the Ball Engine Company, of Erie, Pa. The Ball Company has recently received orders from Mexico for several engines.

MESSRS MACHADO & ROLLER, 203 Broadway, New York, state that Whitney instruments are meeting with favor and a correspondingly increasing demand. The dead beat attachment to these instruments is proving to be a very serviceable device. The A. E. G. incandescent lamps, for which Messrs. Machado & Roller are the United States agents, are reported to be growing in favor among central station managers and consumers in general.

THE ELECTRIC APPLIANCE COMPANY, Chicago, has just issued a very neat circular of electrical house goods specialties for which it is general Western agents. The circular gives particular attention to the Noxall annunciator, showing in detail the construction and operation of the machine. The Electric Appliance Company will be pleased to send a copy of this special circular and price list to any of the trade who has not received the same.

MR. FRANK A. ROGERS has just accepted the position of general manager of the Cleveland Electric Company, Cleveland, Ohio, manufacturer of high-grade electrical specialties. Mr. Rogers was for a long time general manager of the Card Electric Company, of Mansfield, Ohio. The office and works of the recently organized Cleveland Electric Company are at 14-16 Middle Street, Cleveland. Mr. W. J. Morgan is the president of the company, Mr. F. C. McMillin, vice-president, Mr. O. P. Fisher treasurer, and Mr. N. C. Stevens secretary.

THE OHIO ELECTRIC SPECIALTY MANUFACTURING COMPANY, Troy, Ohio, states that all articles of its manufacture have been designed by persons at present connected with the company and others who have never had any connection with the company since its organization, and that all reports to the contrary have no foundation in truth. This company is the sole manufacturer of the "Perfection" brush. It states that all so-called improvements are unnecessary and not conducive to the good qualities of the brush. The high qualities of the brush manufactured by this company have not been sacrificed to price and all orders are filled with its usual promptness.

AT THE OMAHA EXPOSITION.—Among the engine room accessories shown at the Omaha Exposition is the Cross oil filter, which is manufactured by the Burt Manufacturing Company, Akron, Ohio. This company claims to be the largest manufacturer of oil filters in the world. The Cross oil filter is reported to be giving entire satisfaction wherever it has been placed, and its use is very extensive indeed. Extracts from letters received from concerns using this make of filter show that the device pays for itself in a comparatively short time. It effects a very considerable saving of oil, and the quality of the filtered oil is excellent. It removes all foreign particles from the oil in a very satisfactory manner, and by its use oil may be purified and used over and over again on engines.

MANUFACTURERS BUILDING.—One of the largest and best-equipped power buildings in the United States is the Manufacturers Building, Providence, R. I. This building has accommodations for upward of sixty manufacturing concerns, being particularly equipped with conveniences for the production of jewelry specialties, etc. The Manufacturers Building Company has just purchased a 250-kw, 500-volt Westinghouse Electric & Manufacturing Company's engine-type generator, 100 r. p. m., to be driven by an Armington & Sims Corliss engine. This generator will supply power for the operation of motors in the various manufacturing departments of the building. The engineering features of this establishment are under the direction of Lewis & Claflin, consulting engineers, whose wide reputation for engineering installations of the highest order is well known.

THE ELECTRICAL ENGINEER INSTITUTE OF CORRESPONDENCE INSTRUCTION is distributing a very attractive little circular entitled "Can I Become an Electrical Engineer?" which is sent free upon request, and which contains numerous portraits of prominent scientists and engineers who have succeeded in making the profession of electrical engineering what it is to-day. The standard of practical instruction set by the institute is of a decidedly practical nature, and among those who have prepared papers for its courses are Professor Francis B. Crocker, of Columbia University; Charles F. Scott, of the Westinghouse Electric & Manufacturing Company; Elmer G. Willyoung, William Maver, Jr., who is an authority on telegraphy, and Thorburn Reid, designer of electrical machinery, together with many others, who are well known in other particular branches. The home offices of the institute are at 120 Liberty Street, New York.

THE RARITAN COPPER WORKS.—The development of electrolytic processes for the production of refined copper has proceeded very rapidly during the past three years, and at the present time a very large proportion of all the refined copper is thus produced. The Westinghouse Electric & Manufacturing Company has installed a very large amount of apparatus for this class of service. One of the principal installations is at the refinery of the Anaconda Copper Company, Anaconda, Mont., where ten generators of 270 to 300-kw capacity have been installed. Another very large installation is that of the Boston & Montana Consolidated Copper & Silver Mining Company, Great Falls, Mont., where two 810-kw Westinghouse engine-type generators are in service. The latest comer in this field is the Raritan Copper Works of Perth Amboy, N. J., who are about to erect the largest copper refinery in the East. They have contracted with the Westinghouse Electric & Manufacturing Company for three 600-kw, 150-volt, engine-type generators, 150 r. p. m., with a nine-section switchboard for electrolytic service and the operation of two 75-kw. 220-volt, engine-type generators, which will be used for lighting and power service. The installation will it is stated be the most complete of its kind in the world.

Business Notice.

THE ILLUSTRATIONS in this issue were made by the Photo-Engraving Company, 9-15 Murray Street, New York City.

UNITED STATES PATENTS ISSUED JULY 12, 1898.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

11,678. ELECTRIC SIGNALING MECHANISM; L. G. Rowand, of Camden, N. J. App. filed Dec. 15, 1897. In combination, a main circuit, signaling devices on said circuit, a second circuit, receiving devices on said circuit, an electric device on said main circuit, a switch device consisting of two members, controlling said second circuit, the first member of which is moved in one direction, by said electric device when energized, and means to return said member to its initial position when said electric device is de-energized, and a device adapted to hold said second switch member out of electric connection with said first switch member in its movement under the action of the electric device, and means to retard the return movement of said first switch member when said electric device is de-energized.

607,018. UNDERGROUND ELECTRIC CONDUIT; T. Connelly, of Chicago, Ill. App. filed Nov. 12, 1897. A conduit composed of a series of tubes laid coaxially, said tubes being chamfered on their ends, and an unbroken, corrugated, metallic ring over the joints, for holding the said tubes in line.

607,027. AUTOMATIC FIRE EXTINGUISHING AND ALARM APPARATUS; H. Eversmann, of Cincinnati, Ohio. App. filed Aug. 21, 1897. In a sprinkler system for fire-extinguishing purposes, the combination of a normally charged supply pipe and a normally empty sprinkler pipe, an intermediate valve-housing to which each connects and through which they communicate, a valve fitted into this valve-housing with a sliding adjustment and dividing the same into two parts in a manner to prevent communication between such parts at all times, so that when that part of the valve-housing opposite to the charged pipe is filled with a liquid at a pressure exceeding the pressure in the charged pipe, such valve is adapted to hold the valve-housing closed against the charged pipe, an outlet opening in the charged part of the valve-housing and means to open and close this opening.

607,065. TROLLEY FOR THIRD RAILS; L. M. Maxham, of Boston, Mass. App. filed Sept. 1, 1897. In combination, the plain-surfaced third rail, the trolley wheel running thereon, bearing for said wheel adapted to resistingly permit a slight canting of the same, and means whereby such canting automatically guides said wheel toward the centre line of the third rail.

607,070. ELECTRIC CABLE FOR DRIVING CONVEYANCES; A. Norman, of Toronto, Canada. App. filed April 19, 1897. An electric cable consisting of continuous positive and negative conductors, insulating material between and surrounding the said conductors, and a switch for each conductor attached to and surrounding the cable.

607,078. ELECTRODE PLATE FOR ELECTRIC ACCUMULATORS; P. Ferdinand Ribbe, of Berlin, Germany. App. filed Jan. 25, 1898. An electrode plate, comprising a lead plate, having openings, the celluloid bars on each side of said plate and connected together through the openings thereof, said bars having undercut edges and the active material held thereby.

607,093. ELECTRICALLY HEATED ROLL; F. P. Snow, of Lynn, Mass. App. filed May 3, 1897. A hollow cylindrical shell of iron, or of other material that has slow electrical conductivity, two cylinder heads of copper, or of other highly conductive material united with said hollow shell, and a shaft of copper, or of other highly conductive material, uniting said cylinder heads, in combination with an annular core, formed of magnetic material encircling said shaft, and wound with insulated conductor, all adapted to be rotated about a common axis.

607,124. AUTOMATIC CUT-OUT FOR SECONDARY BATTERIES; W. L. Negbaur, of Brookline, Mass. App. filed Feb. 19, 1897. An automatic electric switch, comprising a magnet core provided with a non-polarized armature, a working circuit controlled by said armature, and two coils on said magnet core wound and connected to oppose each other, the said armature being operated by the differential.

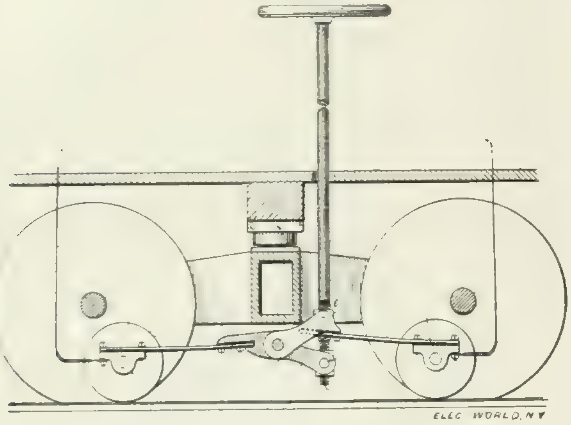
607,125. METHOD OF AND APPARATUS FOR GENERATING ELECTRICITY; W. L. Negbaur, of Brookline, and Jos. J. Feely, of Walpole, Mass. App. filed June 17, 1897. In a system for generating electricity, in combination with a storage battery, a dynamo having a magnetic shunt around its armature, a high resistance coil on said shunt adapted to be fed with a practically constant current, and a low resistance coil on said shunt connected in series with the external circuit and producing an opposite polarity to that of the first mentioned coil.

607,176. ELECTRIC BREAK FOR INDUCTION COILS; T. B. Kinraide, of Boston, Mass. App. filed Feb. 26, 1897. In an electric break, having a hammer vibrating against an anvil, and means to adjust the latter, means to rotate said anvil independently of its said adjustment.

607,177. ELECTRIC BREAK AND INDUCTION APPARATUS; T. B. Kinraide, of Boston, Mss. App. filed July 26, 1897. The combination with an electric break having an electromagnet, an anvil and a vibrating hammer, of a collector to concentrate the lines of magnetic influence, on said hammer.

607,185. ELECTRIC METER; W. D. Marks, of Philadelphia, Pa. App. filed Nov. 4, 1897. The combination with an electric meter wherein is used an ampere indicator, of a shaft, connections between said shaft and said ampere indicator, and a supplemental pointer carried by said shaft.

607,194. TROLLEY; W. H. Russell, of Chicago, Ill. App. filed May 24, 1897. The combination with a trolley arm or pole, of a base, comprising a tubular portion fitting over the trolley arm or pole, a flaring portion extending from such tubular portion upward and outward and a table at the upper end thereof, and a fork having a trolley wheel rotatably mounted therein, such fork comprising a tubular portion fitting over the table on the base, a pivot extending, in a vertical plane, through such fork and base, an arm on the under side of the fork, extending under the base and a spring on the trolley pole, engaging with such extension.



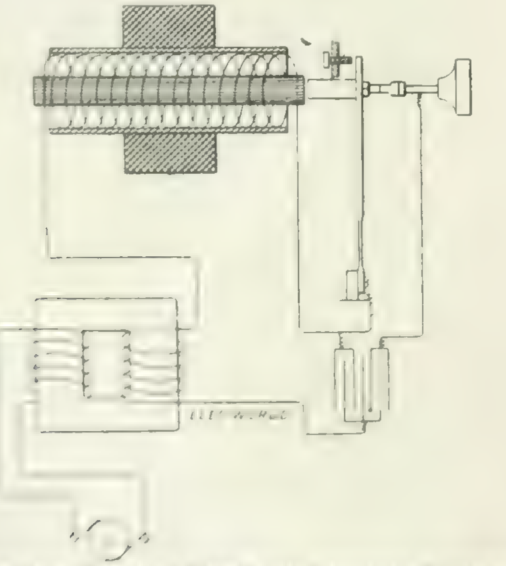
No. 607,065.—Trolley for Third Rails.

607,239. TELEGRAPH; L. W. Hildburgh, of New York, N. Y. App. filed June 2, 1897. In a system of electrical communication, the combination with the main line and a source of alternating current therefor, of means for controlling the flow of the positive and negative impulses from the generator by short circuiting one set of impulses at the time of generation of either set of waves, the other set being unaffected.

607,247. ELECTRIC MOTOR; W. S. Johnson and Henry Winkenwerder, of Milwaukee, Wis. App. filed Nov. 9, 1896. In an electric motor, the combination of an electromagnet and armature, one of which is capable of oscillating transversely to the lines of magnetic force, a weight for moving said oscillatory part in one direction, an elastic stop for limiting the movement and reacting upon the oscillatory part, and a circuit controller arranged to close the circuit at or near the limit of the return movement of the oscillatory part produced by the weight, and to break the circuit at or near the limit of its advance movement produced by the magnet.

607,250. ELECTRIC CUT-OUT; H. A. Lewis, of Norristown, Pa. App. filed July 14, 1897. An electric cut-out, provided with a circuit breaker and an electro-thermostat, comprising a tube for connection at one end with said circuit breaker, a head on the said tube, a hollow screw rod engaging the said head, to cause the tube to expand in one direction only, and a rod carrying a wire and held in the said screw and tube rod.

607,251. FUSEHOLDER, CIRCUIT BREAKER AND LIGHTNING ARRESTER; H. A. Lewis, of Norristown, Pa. App. filed July 14, 1897. The [illegible]



No. [illegible]—[illegible] Fuse and Lightning Arrester.

[illegible]

607,[illegible]. ELECTRIC [illegible]; H. Van Hoevenbergh, of New York, N. Y. [illegible]

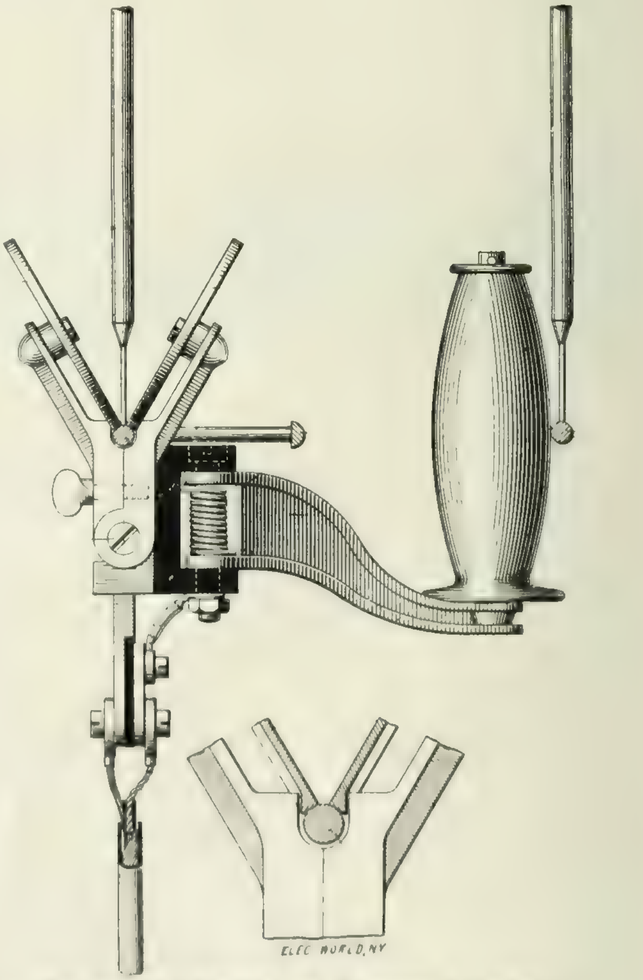
607,311. ELECTRIC CURRENT CONTROLLER; E. E. Werner, of Philadelphia, Pa. App. filed Feb. 23, 1897. The combination of the frame, a carrier journaled therein and having an annular groove in one face thereof, a hand-shaft having a friction roller bearing against one face of the groove in the carrier, and by which the carrier is turned, segmental resistance material on the carrier, a hand and a dial.

607,315. INSULATOR; C. L. Wingard, of Walla Walla, Wash. App. filed April 13, 1898. An insulator, constructed of two duplicate sections matching to form a tubular body, each section having its edges provided with interlocking shoulders, and each section also having a head provided with a notch leading to the bore thereof, through which notch the conductor may be passed, whereby the insulator may be placed on the conductor after the conductor is in place.

607,343. SWITCHBOARD AND ALARM MECHANISM; J. P. Conway, of New York, N. Y. App. filed May 5, 1897. In an electric alarm mechanism, the combination with the day and night alarm circuits, the main line being connected with the central office indicator and signaling devices, magnets adjustably secured to the switchboard, and in the main circuit having an armature lever adapted to engage with the said signaling devices, said signaling devices being provided with independent circuits, and means for closing either the day or the night circuits.

607,351. ELECTRIC RAILWAY; W. W. Doty, of New York, and James A. MacKnight, of Mount Vernon, and Charles Grauten, of New York, N. Y. App. filed Jan. 25, 1897. The combination of the feed wire, the sectional working conductor, and a series of circuit controllers, one for each section of the working conductor, each of said circuit controllers comprising a switch made with a conducting and non-conducting section, an electric actuating device electrically connected to the working conductor section belonging to that controller, and two circuit closers controlled by the switch, and so arranged that only one of them can engage the non-conducting portion of the switch at a time, one circuit closer operating, when the electric actuating device is energized, to connect the feed wire with the working conductor section belonging to the same controller, and the other circuit closer operating, when the electric actuating device is de-energized, to connect the feed wire with the working conductor section belonging to the next controller.

607,387. TROLLEY FOR ELECTRIC RAILWAYS; H. Van Hoevenbergh, of New York, N. Y. App. filed Aug. 31, 1897. A trolley provided with a plurality of wheels set at an angle to bear upon a supply conductor at their peripheries, said wheels being mounted in a frame provided with projections lying close to their sides to prevent spreading.



No. 607,387.—Trolley for Electric Railways.

607,[illegible]. ALARM SYSTEM; [illegible] Coleman, of Chicago, Ill. App. filed Oct. 18, [illegible]. The combination with an electric protective circuit, of a voltage changer situated therein at the alarm station, a device responsive to said voltage changer situated at the protected structure and acting to maintain the current constant within prescribed limits.

The Electrical World.

Vol. XXXII. NEW YORK, JULY 30, 1898. No. 5.

PUBLISHED EVERY SATURDAY BY

The W. J. JOHNSTON COMPANY,

9 Murray Street, New York.

Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York.

New England Office, 620 Atlantic Ave., Boston.
Western Office, 936 Monadnock Block, Chicago.
Philadelphia Office, 929 Chestnut Street.

SUBSCRIPTION IN ADVANCE, ONE YEAR, $3.00,

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THE ELECTRICAL WORLD,

9 Murray Street, New York.

Vol. XXXII. NEW YORK, JULY 30, 1898. No. 5.

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THE QUANDARY OF THE ISOLATED PLANT DESIGNER.

Isolated electric lighting plants for business buildings in large cities have reached, in some respects, a condition of absolute uniformity, but in other respects they differ widely. Quite a number of those most recently installed in New York city are described on other pages of this issue. From these descriptions, as from many others like them, it will be found that practically all isolated plants now installed use water-tube boilers and single-cylinder, single-valve, horizontal, high-speed engines direct-coupled to multipolar generators, but when it comes to the electrical details quite a divergence is found. The reason for this is the desire in many cases to provide an emergency connection with a public lighting system whose mains run in the adjacent streets, or what is known as a breakdown service. This compels the arrangement of the plant in such a way that it can be balanced on the three-wire, 220-volt system.

With a simple lighting plant this is easy. The feeders can be run on the three-wire plan, the neutral having twice the cross section of the outers and forming one pole when running two-wire on the 110-volt isolated plant machinery, the outers being paralleled for the other pole. But where motors of any considerable size, as elevator motors, etc., are used, this cannot be done, as, if the motors are wound for 110 volts, the public lighting companies will not allow connection to their three-wire mains. In a few plants regular three-wire systems are installed, requiring the running of at least two generators at all times. Some solve the problem by the use of two-wire, 220-volt systems, 220-volt incandescent lamps and 220-volt motors, sacrificing the economy of their lamps by 35 or 30 per cent. to obtain a simple system with emergency breakdown service. In the case of large plants where the generating units are of considerable number, the chances of a serious breakdown are so greatly reduced that the public supply is not considered a good investment, the cost of such a service, even if no current is used, being, generally, a considerable sum. Some plants depend upon storage batteries to tide them over any breakdown of the generating apparatus, while others, as one of those described in the article referred to, have both the storage batteries and the breakdown service.

There are several means of running 220-volt isolated plants and using 110-volt lamps without necessarily running two generators at the same time. The most common of these is the use of two 110-volt motors connected in series with each other and across the mains, and used as an equalizer. This plan does not, however, seem to have been used to any appreciable extent in isolated plant service. Wherever a storage battery is attached, the neutral can be connected to the centre of the battery, and any unbalancing of the loads between the two sides, tending gradually to charge one side of the battery more than the other, can be corrected by the switchboard attendant by means of throw-over switches on some of the lighting feeders, or can be taken care of by dividing the motor driving the battery booster into two 110-volt sections. By this means lamps of higher economy could be used, although it must be admitted that in many cases economy is no particular object, since at the season of greatest and most continued lighting loads the exhaust steam is used for heating purposes, and any reduction of the load would be followed by the use of an equivalent amount of live steam in place of the exhaust steam withdrawn. This condition differs greatly, however, in different plants. The cost of breakdown service to the consumer is generally considerable, since the central station must be provided with apparatus sufficient to carry the additional heavy load likely to be thrown on at any unexpected time, and current is so rarely used that the interest charges on this apparatus must be borne by a fixed charge against the consumer, whether he takes any current or not; and it is quite obvious, from the descriptions mentioned above, that many consulting engineers find it cheaper to install an ample storage battery capacity whereby a plant can be tided over any ordinary emergency, the cost of breakdown service being greater than the fixed charges on the battery and the incidental advantages of the battery being a clear gain. Among these incidentals is the well-known steadying effect on the dynamo output, with the consequent better voltage regulation and steam economy, and the ability to shut down the machinery at times of very light load.

THE PROPER RATIO BETWEEN ENGINE AND GENERATOR CAPACITIES.

It is customary in selecting generators for direct coupling to steam engines to take the rated power of the engine, multiply it by three-fourths and choose a generator with a capacity in kilowatts as nearly as possible approaching that figure. This practice is based on the simple reasoning that if the engine will generate a certain amount of power, the dynamo which it drives should be of a size to absorb that power. Sometimes a dynamo is chosen a little smaller, allowance being left for the internal losses. A consideration of the nature of engine and dynamo rating will show the poor grounds for this practice.

Engines are, as a rule, rated at the power which they will generate at the most economical point of cut-off, this being but a small fraction of the stroke. For this reason they are capable of giving a far greater power when necessary, and this greater power may be demanded from them with, of course, decreased steam economy, continuously without any injury to the engine whatever. Dynamos, on the other hand, are rated, as a rule, on the output which they will give continuously without heating beyond a point endangering their insulation, or a margin of safety below that temperature. What ratio their most economical load bears to this rated load depends entirely on the design of the machine. It may be the same, it may be far less, and in some cases even more.

For generating units used with steady loads, as with storage batteries or in large stations where the number can be varied to fit the load, the dynamo and its corresponding engine should certainly give their greatest economy at one and the same load, and the load should be maintained as near this point as possible. For units intended to carry highly fluctuating loads, as, for example, small railway or isolated plant elevator loads, the considerations involved are a little different. It is customary to run such units at an average load considerably below that at which they are rated in order that the fluctuations shall not rise much or any above the rated load, although this is hardly necessary with the improved commutation and ventilation of the latest machines. Such being the case it would probably be better to reduce the size of the engine to a rated output considerably below that of the dynamo, since the former is far more readily capable of carrying overload without danger than is the latter. An increased economy of steam would be the result of such a change.

On the other hand, some engineers take the opposite course, a case of this occurring in an isolated plant described in another column where generators of [illegible] are [illegible] coupled to engines of different sizes, the large driving elevators and the smaller for the lighting load. A more satisfactory regulation is obtained in this way, but it is probably due to the fact that the large engine brings with it a larger fly-wheel and also governs the same fluctuations of load with a smaller governor motion than would a smaller engine.

PARTY LINE TELEPHONE SYSTEMS—SERIES OR MULTIPLE.

With more than two instruments permanently connected in a single telephone circuit it is necessary, unless some selective call system (all of which are quite complicated) is used, to retain all the call bells in the circuit at all times. If the instruments are connected up in series, voice currents, when the line is in use, must overcome the resistance, and, what is worse, the impedence of the call-bell magnet windings. If the line is run on the multiple plan, all the instruments being bridged across the two wires, or between one wire and the ground, each call bell becomes a source of leakage of the voice currents. For a proper distribution of the call bell or signaling currents on a multiple line, since the source of these currents may be at any one of the stations, it is essential that the impedance of each of these bell magnets forming a bridge from one line to another shall be high compared with that of the main lines, otherwise the bell or bells connected near the calling station will shunt off a large portion of the current and the resistance of the line will cut down that going to the distant bells by an amount depending on the various resistances.

Obviously, in such a system it is unnecessary to leave all the talking sets of the various stations permanently bridged across the wires, since they are not needed for calling purposes, and can be open circuited when their respective receivers are on the hooks. Consequently, when conversation is carried on over such a multiple line, the current sent out by the transmitter finds as paths to the common return the one receiver where it is wanted and all of the call bells. No talking sets being across the line when the calling signals are sent out, and no signaling being necessary when the line is in use for talking, it is a simple matter to make the call bells of a much higher resistance than the telephone coils and to reduce thereby the leakage of telephone currrents through the bell windings to a negligible quantity. Further, on account of the higher frequency of telephone currents as compared with signal currents the leakage is still further reduced by the self-induction of the call-bell coils which, of course, increases as the resistance is increased.

The arrangement of the instruments in multiple in this way and the utilization of this principle for preventing leakage of the telephone currents was patented by Mr. J. J. Carty, March 31, 1891, No. 449,106, and considerable litigation has been caused by the infringements of independent telephone interests. A decision of the United States Circuit Court in the case of the Western Electric Company v. the Millheim Electric Telephone Company, et al., has recently been handed down in favor of the complainant. The defense set up was lack of invention, since the novelty practically simmers down to winding the coils to a higher resistance, a course which would be instinctively adopted by any electrical engineer in changing any system—whether lighting, power, telegraph or telephone—from series to multiple distribution.

Silver Wire Fuses.

One of the largest companies in Germany has found that fuse wires made of silver are more satisfactory and much more reliable than those of lead. For small cross-sections they can be much more accurately made, and will blow at more definite currents. They are used on 250-volt incandescent light circuits.

Some Coming Conventions.

NATIONAL ASSOCIATION OF STATIONARY ENGINEERS.

The convention of this association will be held in Pittsburg, Pa., during the week beginning September 7, the headquarters being at the Monongahela House.

THE ASSOCIATION OF EDISON ILLUMINATING COMPANIES.

The nineteenth convention of the Association of Edison Illuminating Companies will be held at Sault Ste. Marie, Mich., on September 12 and 13 next. The members will make the trip to the Soo by steamer, the Eastern members taking the boat at Buffalo and the Western contingent going aboard at Detroit.

CONVENTION OF FIRE AND POLICE TELEGRAPH SUPERINTENDENTS

The third annual convention of the Fire and Police Telegraph Superintendents and Municipal Electricians will be held at Elmira, N. Y., on August 9 and 10. All city officials are invited to be present. Papers touching on electrical matters will be read by the following named gentlemen: Capt. William Brophy, Boston; S. L. Wheeler, Springfield, Mass.; John W. Aydon, Wilmington, N. C.; F. B. Foster, Corning, N. Y.; M. W. Mead, Pittsburg, Pa. The headquarters of the convention will be at the Hotel Langwell. Mr. Will Y. Ellett is president of the association, and Mr. H. F. Blackwell, Jr., is secretary.

THE STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK.

This association will hold its sixteenth annual convention at the Hotel St. George, Brooklyn, N. Y., September 13 and 14. Papers on the following engineering subjects will be read: "Points on the Care of Dynamos;" "Low Joints, How to Prevent Them;" "The Power Station from an Economic Standpoint;" "Track Bonding, How Can We Obtain the Best Results?"; "General Track Construction;" "The Most Approved Method of Freight and Express Service on Suburban and Interurban Lines;" "Are Air and Power Brakes on Electric Cars Practicable?"; "The Most Approved Plan of Long-Distance Power Transmission;" "The Effect Upon Street Railroads of the Application of Electricity to Steam Roads."

ELECTRICAL PAPERS AT THE MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

Among the papers of electrical interest to be read before Section D of the American Association for the Advancement of Science at the coming meeting in Boston, August 22-27, are the following: "High-Speed Influence Machines," by Charles F. Warner, Cambridge, Mass.; "Proposed Methods of Determining the Frequency of Alternating Currents," by Carl Kinsley, Falls Church, Va.; "Combined Absorption and Transmission Dynamometer for Laboratory Purposes," by Prof. J. J. Flather, Lafayette, Ind.; "On the Use of a Platinum Resistance as a Pyrometer in Boiler Tests," by Prof. F. C. Wagner, Terre Haute, Ind.; "A Comparison of the Efficiency of the Rheostat and the Series Parallel Controller for Electric Cars," by Prof. Thomas Gray, Terre Haute, Ind.

THE AMERICAN STREET RAILWAY ASSOCIATION.

Papers on the following subjects will be read at the convention of this association in Boston September 6 to 9:

"Maintenance and Equipment of Electric Cars for Street Railways," by M. S. Hopkins, electrician Columbus Street Railway Company, Columbus, Ohio; "To What Extent Should Railway Companies Engage in the Amusement Business," by W. S. Holmes, general manager Metropolitan Street Railway Company, Kansas City, Mo.; "The Carrying of United States Mail Matter on Street Railways," by W. S. Dimmock, general superintendent Omaha & Council Bluffs Railway & Bridge Company, Council Bluffs, Ia.; "The Comparative Earnings and Economy of Operation Between Single and Double Truck Cars for City Use," by Richard McCulloch, electrical engineer Cass Avenue & Citizens' Railway Company, St. Louis, Mo.; "Inspection and Testing of Motors and Car Equipments by Street Railway Companies," by Frederick H. Perkins, electrical engineer Toledo Traction Company, Toledo, Ohio; "Cost of Electric Power for Street Railways at Switchboard, Both Steam and Water," by R. W. Conant, electrical engineer Boston Elevated Railway Company, Boston, Mass.

Units in Magnetic Testing.

BY DR. HUBERT KATH.

In the trade of dynamo-iron it has become the custom to specify the qualities of the material in question by giving an "induction curve" (or "magnetizing" or "permeability" curve), because the iron seller is well aware of the fact that he cannot give any short description of the qualities important to the dynamo-builder by naming one or two "coefficients," as for other purposes he might do, by naming the "coefficient of elasticity" or the "coefficient of rupture," etc. As there is no general theory giving reliable formulæ for permeability, hysteresis, etc., in terms of such coefficients, no other method remains than that of representing the magnetic qualities by drawing their respective curves.

To render this method a standard one the author takes the liberty of recommending the following propositions to the reader*:

1. In order to give a full representation of the magnetic qualities of any sort of iron it is supposed to draw:

(a) a curve of induction beginning from $\mathcal{H} = \mathcal{B} = O$ and running up to about $\mathcal{H} = 150$ c. g. s. units, with soft iron, or $\mathcal{H} = 300$ c. g. s. units, with hardened steel;

(b) a hysteresis curve between $\mathcal{H} = +150$ and $\mathcal{H} = -150$ c. g. s. units.

(It is sufficient in this case to draw only one-half of the cycle, the latter being symmetrical on both sides of the $\mathcal{H} = O$ axis.)

2. The unit of co-ordinates should be taken

(a) for the values of induction in all cases 1 mm = 100 c. g. s.;

(b) for the values of the magnetizing force: with soft iron (up to 150 c. g. s.) 2 mm = 1 c. g. s. unit and with hardened steel (up to 300 c. g. s.) 2 mm = 2 c. g. s. units.

3. If, in printing these curves, a reduction has to take place, it should be one-half or one-quarter of the original size.

In these propositions the induction $\mathcal{B}$ is introduced. This might seem more practicable than the calculating of the intensity of magnetization "$\mathcal{J}$" ($4\pi\mathcal{J} + \mathcal{H} = \mathcal{B}$) and has already been generally adopted. Secondly. The values of the abscissæ are taken as the intensity of the magnetizing force, $\mathcal{H}$, and not as ampere-turns per centimeter. There is no doubt that ampere-turns per centimeter is a more generally used quantity than intensity of the magnetic force, $\mathcal{H}$. But by accepting the latter all the quantities of the curve are taken in c. g. s. units. Besides, this way of representing the curves is quite generally adopted in scientific researches, and the reduction $\mathcal{H} = 0.4$ ampere-turns per centimeter presents no difficulty.

The chief question is, whether or not the description, given by the curves above proposed, is sure to be a full and reliable specification of the magnetic properties of iron.

With field magnets of cast steel or iron, we desire to know the permeabiity up to, and a little above, "saturation." It will be conceded that, with magnetizing forces up to 150 c. g. s. units, this point is thoroughly covered. In sheet iron for alternating-current machinery the hysteresis losses should be known, and it is confessed that cycles from + 150 to — 150 c. g. s. are not the ones generally applied. Nevertheless this cycle will enable one to compare the different materials in this respect. To facilitate the calculation of the hysteresis losses the values of some more cycles should be given, say the values of a cycle from $\mathcal{B} = +10{,}000$ to $-10{,}000$ and of a cycle between $\mathcal{B} = +5000$ and -5000.**

The coercive force and the residual magnetism of hardened steel will be sufficiently marked in a cycle from $\mathcal{H} = +300$ to -300 c. g. s. units.

For special researches the unit of the abscissa could be enlarged to 4 mm = 1 c. g. s., the unit, $\mathcal{B}$, remaining the same. Taken all in all, a general adoption of the convention proposed would save a great deal of trouble to those who have to compare often magnetic tests of different materials; a standard representation allowing one to recognize at a glance the superior qualities of one material compared with another.

Fig. 7 on page 116 shows curves drawn on co-ordinate paper after the manner described above.

Accumulators in German Central Stations.

From recent statistics it appears that 98 per cent. of the continuous current central stations in Germany are provided with accumulators, the total capacity of which is 31 per cent. of the total power of these stations. Many that previously did not have accumulators have now added them as the most convenient way of enlarging the station.

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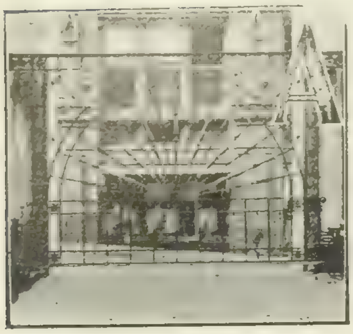
*See "Electrotechnische Zeitschrift," p. 407.

**The coefficient of hysteresis losses is not a constant, but differs up to 40 per cent., as researches of the German Reichstanstalt have shown.

Some New Isolated Plants—I.



A LARGE number of office buildings of the highest class have recently been finished in New York city, and the diversity in some features of their isolated electrical plants makes these installations of considerable interest, the descriptions which follow allowing a number of interesting generalizations and conclusions to be drawn.

THE EXCHANGE COURT BUILDING.

One of the largest of the modern office buildings is that located on Exchange Place and fronting also on Broadway and New Street, the building being constructed around the three sides of an areaway known as Exchange Court. The isolated plant is fed with steam by four Babcock & Wilcox water-tube boilers placed under the Broadway sidewalk, two boilers being at each end of the boiler room, with an ample coal bin, holding 40 tons of coal, between the two pairs. A reserve bin is also provided, holding 150 tons. The coal can be shot into either of these bins directly from the street. Water is supplied to the boilers through a Ward feed-water purifier and an Excelsior feed-water heater.

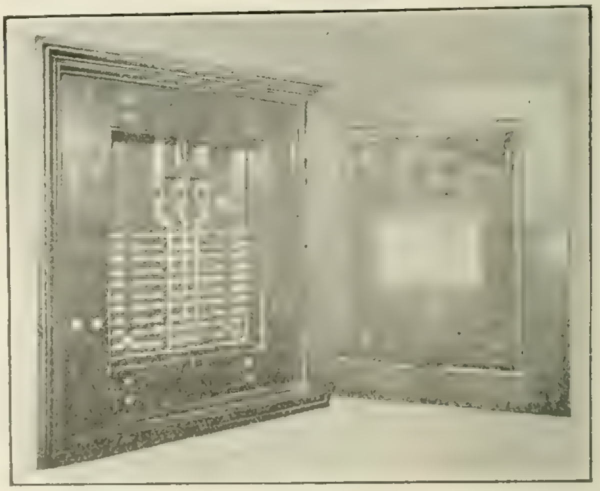
The generating units consist of six Ames engines direct-coupled to General Electric dynamos. The four larger dynamos are each of 100-kw capacity, two of them being coupled to 17 x 16 engines, and two to 16 x 14 engines, the different sizes of engine cylinders on the same generators being provided for the two varieties of work which the machines will carry. The heavier cylinders are intended for the power load, and the lighter ones for the lighting load, on the principle that the power load is a very variable one (consisting of screw-type elevators), and the generators are therefore capable of carrying without overheating much higher instantaneous loads than the more evenly loaded machines used in the lighting service. On account of this capacity for carrying brief severe overloads a larger engine cylinder can be used. One 75-kw and one 50-kw units are also provided for light loads and for properly proportioning the generating capacity to the load. Steam and exhaust headers run overhead through the engine room, mounted on stanchions, and every engine branch is dripped through a separate trap attached just above the stop valve, so that the steam in all the piping is at all times dry, and an engine can be started instantly when wanted without danger of water entering the cylinder. One of these traps, carefully lagged, appears in the accompanying illustration of one of the generating units.

The plant runs at 110 volts, and is therefore unsuited for break-down service on public supply. The units are so many in number, however, that this is hardly necessary. Nevertheless, to provide against any possibility of failure, a storage battery is now being installed, consisting of sixty cells of the chloride accumulator, each cell being installed with thirty-one plates, giving a capacity of 400 amperes for ten hours, with sufficient room, however, for ten more plates, if it is found desirable to increase the capacity of the battery. A motor-driven booster is to be installed to control the charging and discharging of the accumulators.

The main switchboard is of no little interest, being arranged with the two panels at each end receding from the front of the board at an obtuse angle, reducing considerably the space occupied by the board and rendering the arrangement of the back of the board much more compact and convenient. The main panels of the front and these two side panels enclose three sides of a con- [illegible] behind the board. This is shown in one of the illustrations. The switchboard is provided with two complete sets of bus bars, one for power and one for lighting, with a powerful screw-operated bus junction switch on the face of the centre panel. Across the top of the board (see illustration) is the [illegible] instruments, [illegible] Below these is a row of three voltmeters, the middle being a ground detector with appropriate switches, and flanking it on either side is a voltmeter with an eight-point voltmeter switch for throwing it onto [illegible] Below the ground detector is the bus junction switch, and below each voltmeter [illegible] in a handsome glass case, one instrument measuring the entire power load and the other the entire lighting load. Below these instruments are six triple-pole, double-throw generator switches for throwing the machines onto either the power or lighting busses, and below them, again, are six Ideal circuit breakers in the machine circuits. An interesting peculiarity of these switches is the fact that the hinges are used for carrying current, but are not depended upon, separate clips being provided each side of the hinge to grasp the blade, these clips being mounted on the same base and stud as the hinge itself, thus utilizing the carrying capacity of the hinge, but reinforcing it with clips to make it equal in conductivity with the clips grasping the outer ends of the blades. Each pole of the main switches consists of two blades.

Of the two receding side panels, one carries the switches and circuit breakers of the power feeders and the other the switches of the lighting feeders. There are no indicating instruments in the feeder circuits, and no circuit breakers in the lighting feeders, but the latter are all fused on separate marble panels in the room at the rear of the switchboard. These panels appear in the illustration of the back of the board, which also shows the ingenious arrangement of the bus bars. The four positives and negatives are carried at the same height just below the machine rheostats, the two equalizers being farther down. It will be seen that this arrangement throws all heavy copper down toward the floor, the lighter connections, voltmeter, rheostat, lamp wires, etc., being above and clear of the heavy busses.

The six passenger elevators in this building are Sprague screw machines, four of them being mounted in one double-deck battery supplied by the four panels shown in the illustration, the other two being separately mounted in another part of the building. In addition to these there are three electrically driven hoists made by the same company, one for ashes, one for safes and one for the mammoth gate of decorative ironwork spanning the court entrance. This gate, which is shown in the initial illustration, weighs over 5000 pounds, and is not counterweighted. It is pushed up by two plungers from below, the lower ends of the plungers being connected by chains with the electrically driven hoist. The gate was built by the J. B. & J. M. Cornell Iron Works.

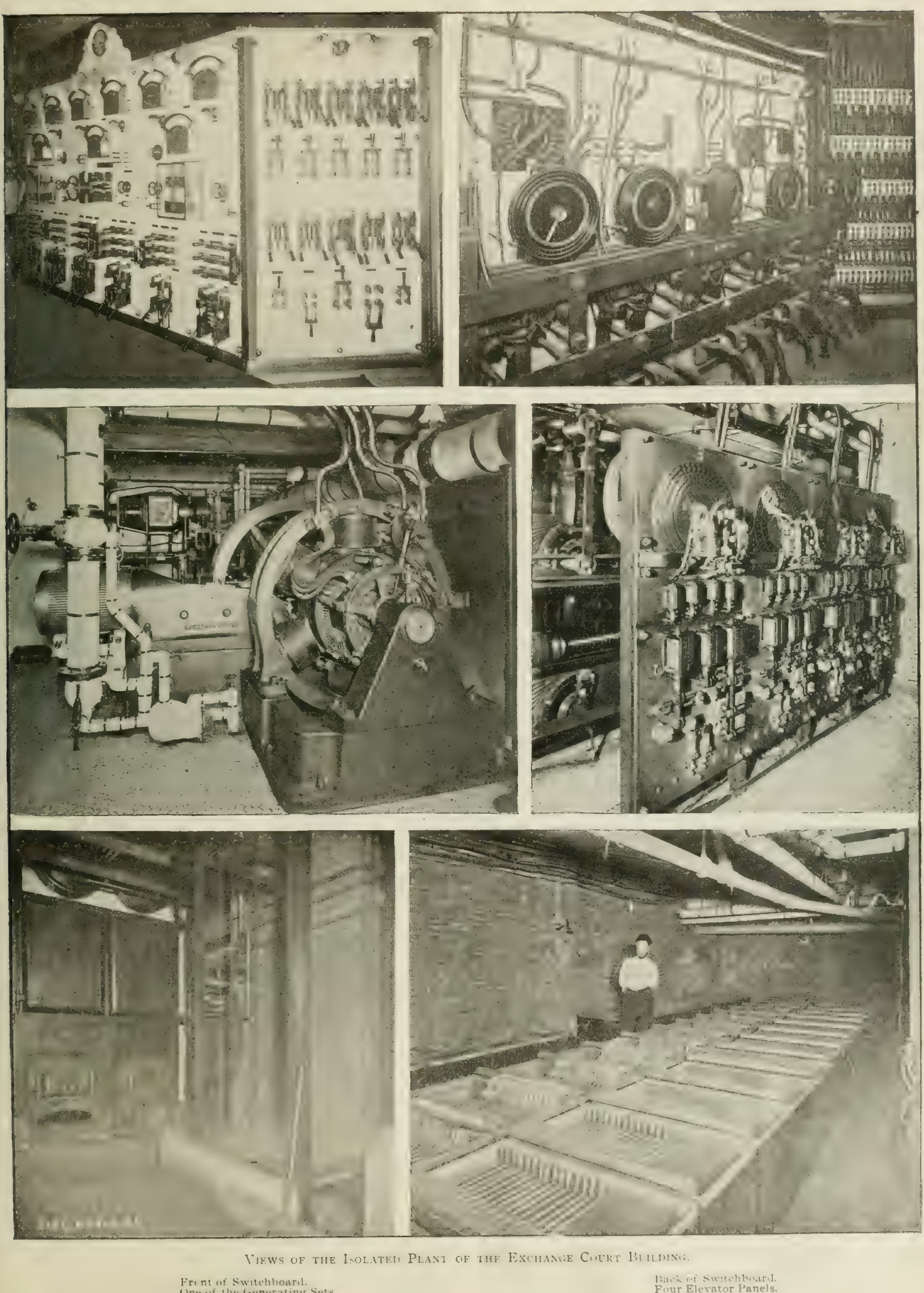


Panel Box, Exchange Court Building.

The building is wired for 5500 lights. All the electrical work was done by the Tucker Electrical Construction Company, including a complete wiring system for telephone, telegraph, ticker, synchronous clock service, etc. The panel boxes are unusually neat, being lined throughout with marbleized slate, a marbleized slate cover being mounted on the inside of the hardwood door. Mounted under a sheet of plate glass on the inside of this cover is a complete diagram of the circuits attached to the switches in that particular panel box, with data as to the sizes of the conductors, so that it may be instantly told whether they are becoming overloaded or not. The chief engineer of this plant is Mr. C. E. Goodrich.

THE WASHINGTON LIFE INSURANCE BUILDING.

On the 1st day of May, 1897, an old building standing on the corner of Broadway and Liberty Street was vacated by its tenants preparatory to its removal to make way for a new structure. On the first day of May, 1898, the new building, twenty stories high and of the most elaborate and costly construction—that of the Washington Life Insurance Company—was opened to tenants.



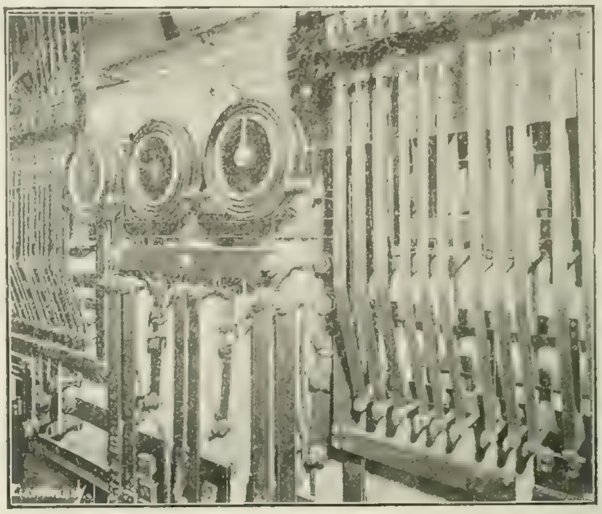
Views of the Isolated Plant of the Exchange Court Building.

Front of Switchboard.
One of the Generating Sets.
Two of the Boilers.

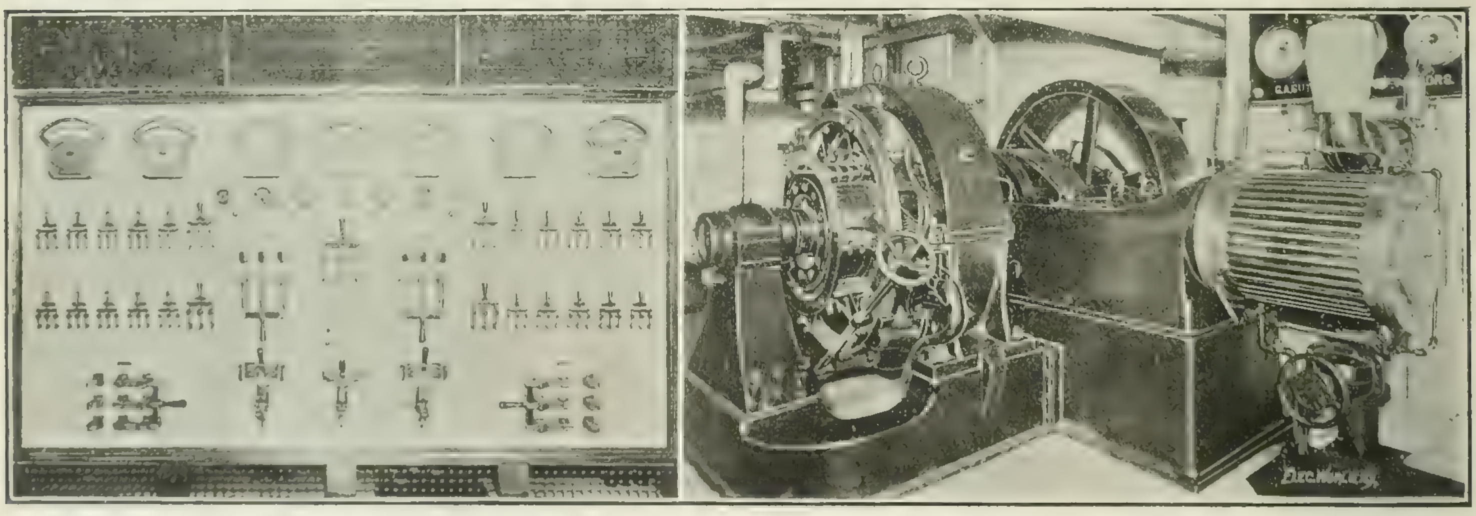
Back of Switchboard.
Four Elevator Panels.
The Storage Battery.

A peculiarity of the electrical plant of this building is the fact that there was no consulting engineer connected therewith. The contract for the dynamos, switchboard and wiring, including the telephone and telegraph circuits, was let to the Western Electric Company, the boilers and engines being contracted for separately. The plant is supplied with steam by three Babcock & Wilcox boilers, three Ball & Wood horizontal single-cylinder, high-speed engines being direct-coupled to three Western Electric multipolar generators, two of which are of 100-kw capacity and the third of 50-kw capacity. These generators are fitted with the Western Electric Company's new brush holder, combining several advantageous features. The brush holding studs are mounted between two continuous copper rings, one over the inboard and one over the outboard end of the commutator. Alternate brushes are metallically connected with one and insulated from the other, thus making these rings serve as cross-connecting leads in addition to their mechanical service. The brushes are supported from the field yoke on a rocker ring, and are also fitted with a single handle for raising them all or for simultaneously increasing or reducing the pressure of all of them upon the commutator. The machines are also fitted with a new means of readily connecting together the series field coils with accessible low-resistance joints. The plant runs at 110 volts, there being no motors of any consequence in the building, which is wired on the three-wire system and fitted with breakdown service on the Edison street mains at 220 volts. When running on the isolated plant the positive and negative lines are multipled, and the neutral with ample copper is the opposite pole.

The switchboard is a remarkably neat one, surrounded above and below with a handsome brass grating. The feeders run from the switchboard to each pair of floors through the building, no circuit breakers being provided in the feeders, which are, however, fused on separate panels mounted behind the main board. The lines are run entirely in iron-armored conduit to marble-panel boards throughout the building.



Behind the Switchboard, Washington Life Building.



The Switchboard and One of the Generating Units in the Washington Life Building.

The engine room is handsomely finished in enameled white tile with vitrified tile floor. The elevators of this building are hydraulic.

[illegible] the stru- [illegible] switch-board in the first floor, to which come all cables from the streets. [illegible] The tele-graph, ticker and clock service, etc., is looped throughout the build-ing, [illegible] From [illegible] All of this work, as well as the installation of the [illegible] Washington Life Insurance Company, was done by the Western Electric Company, under the personal direction of Mr. J. M. Parker of the [illegible] department.

THE CUSHMAN BUILDING

On the corner of Broadway and Maiden Lane a building covering a plot of ground but 24 x 48 feet in size and rising to a height of thirteen stories, all told, has been recently erected, and, oddly enough, fitted with a complete isolated plant. It was originally intended to supply this building from the street service, but it being found afterward that it would be cheaper to run its own plant, in spite of the small size, the plant had to be designed to fit into the spaces between the structural features in the sub-basement, and this difficult problem was left to the consulting engineers, Messrs. Osterberg & Sutton.

The sub-basement is immediately above the caissons on which the building rests, and is divided by three great latticed girders into four rectangular spaces, each about 12 x 24 feet in size. The solution of the problem presented is an interesting one. In the first place it was decided to put in Sprague screw type elevators. These are about 28 feet long, but when double-decked, thanks to their very lean proportions, they could just be squeezed between the struts of the girders. There being evidently no room for a boiler, the part of the equipment was omitted and steam is taken from [illegible] New York [illegible] Steam Power Company and [illegible] In so small a plant it is not, of course, desirable to run more than one generating unit, and on account of the very high fixed charge for a breakdown service, which is, for a [illegible] the cost of current, it was considered desirable to have some other form of reliable reserve to tide over a brief breakdown to the generating unit. For this reason a storage battery was installed.

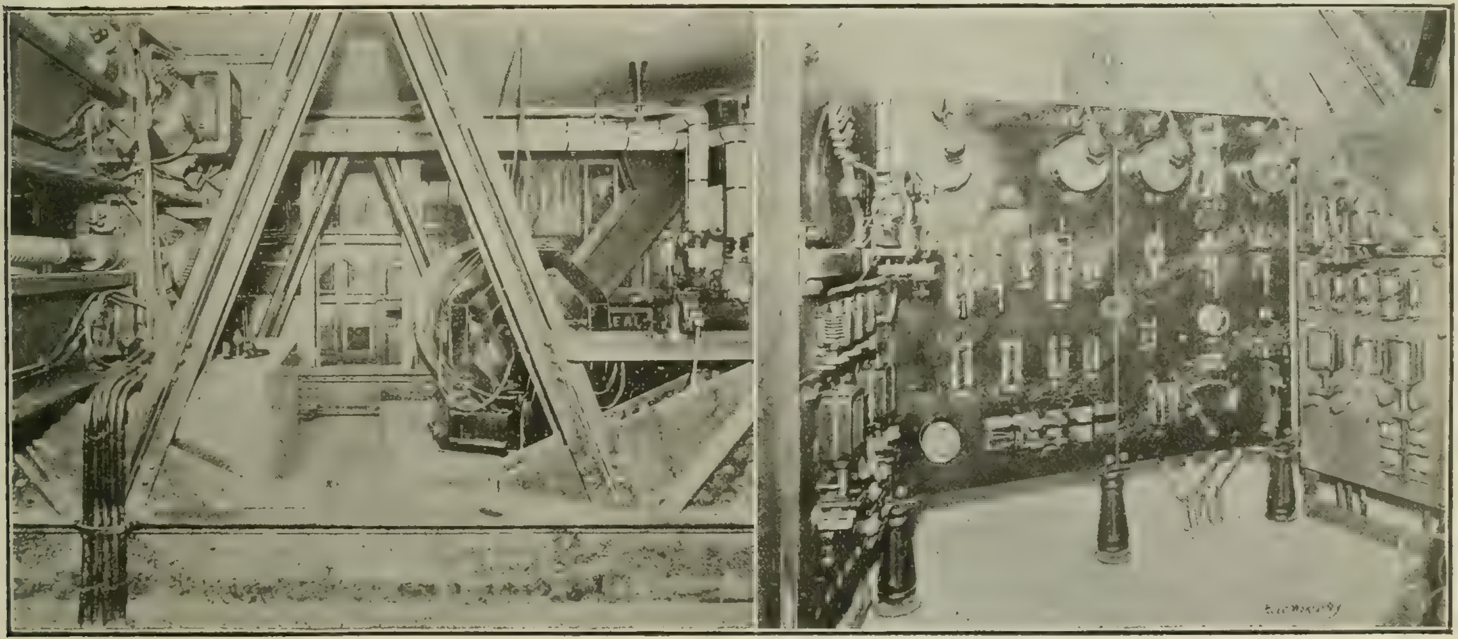
The four small rooms available are used as follows: The first is made into a battery room and is divided from the rest of the sub-basement by a partition largely of glass to keep out the fumes; the second is filled by the generating unit, pumps, hot water heater, etc.; the third by the switchboard and the battery booster; and the fourth constitutes the engineer's headquarters, desk room, etc. The whole is finished in white, with an enamel tile dado, a vitrified tile floor and eventually a white finish will be put on all of the structural ironwork, making it a very attractive little plant in spite of its disadvantageous location.

The generating unit consists of a 25-hp Ideal engine coupled to a 20-kw Eddy dynamo, running at 300 r. p. m. This unusual ratio of engine to dynamo capacity was chosen because of the fact that engines will stand without any danger whatever a continuous overload much greater than will generators, and by making the generator of ample capacity this overload feature can be made use of, and the engine can also be kept at a more economical point of cut-off, with a good economy in the generator. The plant runs at 230 volts two-wire, as it was originally planned to work it with a breakdown service.

The switchboard consists of two panels, one for carrying the generator and feeder switches, the other the storage battery and booster control mechanism, and is flanked on either side by the controlling panel of one of the Sprague screw-type electric elevators. Immediately in front of the switchboard stands the motor-driven booster, which in this case is not a differential machine but is fitted with a plain shunt winding controlled by hand through a rheostat on the board. In normal operation the lighting feeders are run directly from the generator, the electric elevators are connected directly to the battery and the booster is inserted to raise the dynamo voltage to properly charge the battery. As there is no differential winding to prevent the fluctuation of the battery load affecting the charging current, the latter increases somewhat when the elevators take current, but by a small amount when compared with the total current taken by the elevator motors. The fluctuation of dynamo voltage is thereby rendered negligible. The switching arrangements are so arranged that the motors can be thrown on the generator, the lights on the battery, or everything can be thrown together with the booster in or out, or boosting up or down.

The battery consists of 118 "chloride" cells, with a capacity of 400 ampere hours at a ten-hour discharge rate. The plates are mounted in glass jars, which are supported in sand trays placed in turn on glass insulators in a wooden framework. The rear tier is triple-decked, the forward tier being lower, so that a comprehensive view of all the cells can be obtained from the engine room. The plates of adjacent cells are not burned into common busses, but the busses are bolted together by lead-covered bolts, thus making the cells far more readily removable at some sacrifice of conductivity. The steady load on the engine, because of the battery and the ability of shutting down at times of light load, must reduce greatly the cost of steam, which for the months of May and June amounted to but $70 and $84 respectively.

P. M. Mowrey & Co. were the contractors for the electrical work, the chief engineer of the building being Mr. John Leudemann.



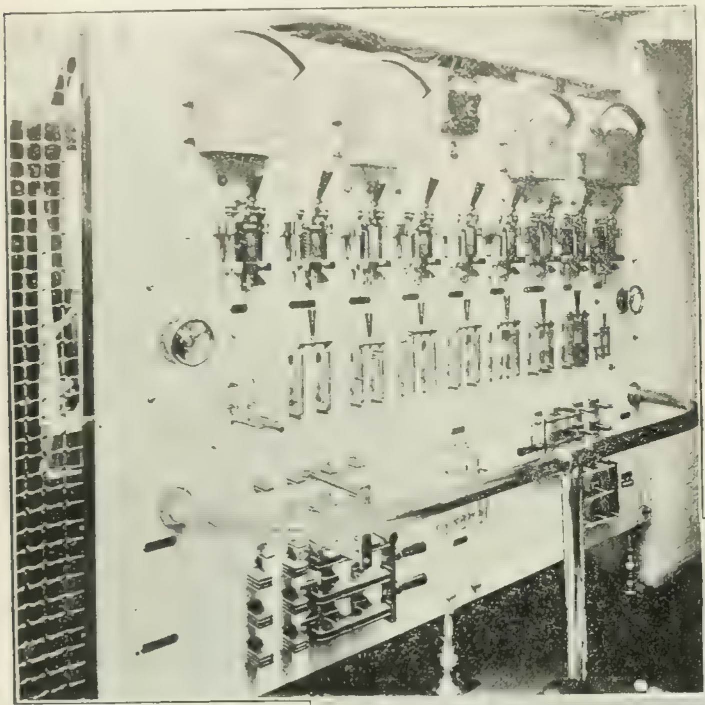
GENERAL VIEW AND SWITCHBOARD IN THE CUSHMAN BUILDING.

THE SINGER BUILDING.

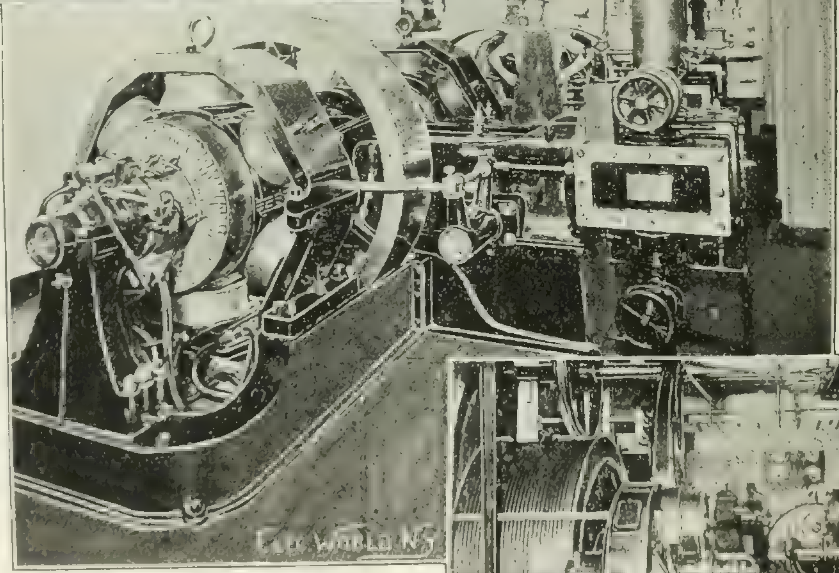
The Singer Manufacturing Company, which is well known to the electrical trade through its association with the Diehl Manufacturing Company, has recently constructed at the corner of Broadway and Liberty Street, a handsome modern office building for its own use and for general office rental. The isolated plant is designed on some novel lines. The equipment consists of four Ball & Wood engines direct-coupled to five Diehl dynamos. Two of these units, 25 and 50 kw, respectively, are used for the lighting service and three of 35-kw capacity each are used for running the elevators, which are driven by Otis electric engines equipped with the Leonard system of control. As is well known, this system of control requires a generator for each elevator, there being no rheostats to cut down the rush of current in the motor in starting, the excitation of the generator fields being controlled by a rheostat in the car, the polarity and voltage of the generator being determined thereby. With the motor fields constantly excited to saturation from a separate source, the direction and speed of the motor depend, of course, solely on the polarity and excitation of the generator, which in turn is directly under the control of the attendant in the car. In the equipment in the Singer Building the dynamo armature is connected directly to the motor armature without even a switch in the circuit, there being no provision even for interchanging the connections of the dynamos and motors, so that each dynamo always drives the same motor, unless some temporary wiring is put in.

The current for exciting the elevator dynamo and motor fields and operating the magnetically controlled elevator brakes is taken from the lighting system, and the following electrical safeties are easily provided. A slack cable-stop opens the supply of the dynamo field and applies the brake; a switch operated by the safety catch on the car accomplishes the same; the governor in the head of the shaft opens the dynamo field circuit, but the opening is shunted by a resistance, so that it merely serves to slow the machine down. A limit stop worked by the usual screw and dog arrangement on the machine operates, as the car approaches either limit of the shaft, a Geneva lock mechanism by which resistances are successively inserted into the dynamo field circuit, thus slowing the machine down step by step independent of the operator, until finally the brake is applied as the car reaches the limit. The whole system is a most simple one, the entire absence of switches, rheostats, circuit breakers and other more intricate current-controlling mechanism in the motor circuits being remarkably different from the complications of other control systems. One of the elevators is fitted with a back gear, by which the worm of the tandem worm gear may be uncoupled from the armature shaft and driven at a considerably slower speed than the latter. This is intended for use in lifting safes or other very heavy weights, this elevator, its cable, sheaves, drum and gear being sufficiently heavy for this, and the back gear allowing the engine, dynamo and motor intended for running lighter loads at higher speeds to carry this heavy load at a lower speed with no greater effort. The three elevator generators are driven by two engines, two of the generators being mounted on opposite ends of one engine shaft.

A novelty in elevator signals is in use in this building, each floor being represented in the car by a miniature lamp, which is illuminated when the button on that floor is pressed and extinguished when the first car passes that floor, by an automatic machine in the head of the shaft, installed by the Elevator Supply and Repair Company.* By pressing a button any operator can prevent his car from extinguishing the signals, in case he does not stop for the passenger signaling.



Switchboard.



Double Generator Set and

The switchboard shown in the illustration carries only the lighting system. It is equipped with lighting and power busses, throw-over switches, a breakdown switch for Edison service and switches and I. T. E. circuit breakers in all of the feeders. One of the feeders [illegible] is prepared every noon a lunch for the president and officers of the Singer Manufacturing Company, the cooking being done entirely by electricity. It is intended, when the breakdown service is installed, to equip one of the elevators for use with the street current, and to accomplish this the armature will be rewound with two commutators, which, when connected in series, will make the machine available for running on 220 volts, and, of course, a suitable form of controller will be put in.

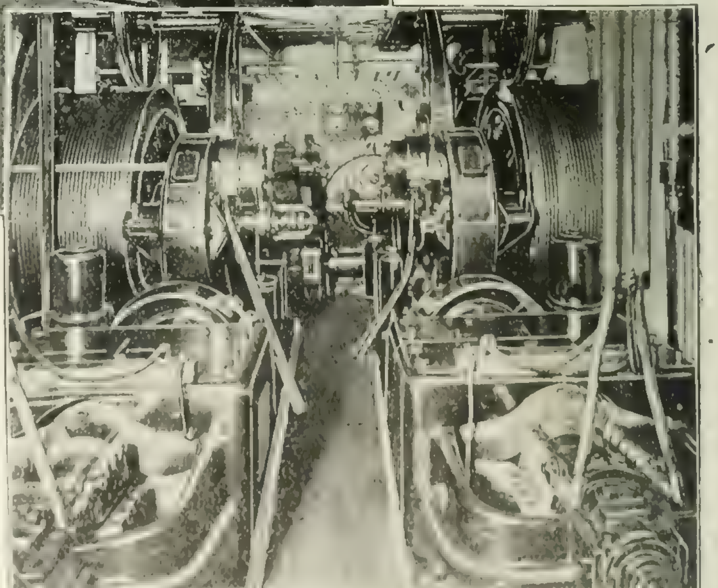
[illegible] consists simply of a cylindrical steel tank with its axis mounted [illegible] operated the circuits being carried to many push buttons throughout the build- [illegible] are provided, two push buttons, one in each circuit, being side by [illegible] running up through the building, with fire hose connections scattered throughout the different offices. By pressing the button at any point a chemical stream can be obtained in a few seconds' time. The engineer in charge of this plant is Mr. H. Bishop.

The Long-Distance Telephone.

The use of the long-distance telephone has diminished passenger travel on the railroads. The extent of the loss suffered by the railroads is not very well known, and the importance of it is not admitted by all; but the newspapers have now and then given certain definite statements from well-informed men, says the "Railroad Gazette," from which the following is quoted, and there can be no question that the value of the telephone is increasingly appreciated. Another bit of significant evidence, reported on good authority, is the statement of a railroad officer that the business of one of the limited trains between New York and Chicago has been practically ruined by the telephone.

This result is not very surprising. One of the definite objects had in view in putting on 25-hour trains between New York and Chicago was the accommodation of brokers and business men of Chicago and the Northwest, who demanded quick time. Their trips to New York were taken on occasions of utmost importance, when a little time meant thousands of dollars. By means of the "Limited" the broker or business man was taken to New York in the quickest possible way. He talked as fast as he rode and made an equally quick return to Chicago. The business man was willing to pay the price assessed for this development in rapid transit.

Then came the introduction of the long-distance telephone. People at first were slow in realizing its benefits. Slowly but surely they have, however, come to appreciate its significance. A broker or grain dealer in Chicago has in mind a "big deal;" he telegraphs to New York asking for certain information and adds: "Call me up by long-distance telephone and give me your answer." The result is that for [illegible] a talk is held with the New York man. Having received the telegram, he has had an opportunity to concentrate his expressions to the shortest possible statements; he has even jotted them down and at the proper time calls up his man and transacts his business. So it is done every day.



Elevators in the Singer Building.

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*[illegible]

Electroplating on Wood.

BY C. F. BURGESS.

An electrical industry of considerable importance is that which depends upon the deposition of metals from aqueous solutions of their salts by the electric current, for the purpose of imparting an ornamental or protective coating. The increasing uses which are being found for such coatings, and improvements in the processes for applying them, are contributing to a rapid growth of this industry.

This work is confined almost entirely to the deposition of a metal or alloy of metals on metallic surfaces, although the deposition of metals on non-conducting substances is practiced to a limited extent in such processes as the manufacture of parabolic reflectors in which the metal is deposited on a prepared glass form, from which the coating is afterward removed, and in the production of electrotypes which are made in a similar manner, wax instead of glass forming the mould. Most books treating of the electro-deposition of metals refer to methods for coating leaves, flowers, wood and other non-conducting substances, and give various methods for so doing. These methods are usually so expensive and difficult of execution that they cannot be used extensively, though it is reported that in Germany the plating on wood has become an industry of some importance.

There is little question that if an adhesive coating of metal could be easily and cheaply applied to wood and similar materials a considerable demand for such work might be found. Designs carved in wood and coated with copper and brass would compete with the rather expensive copper, brass and bronze castings used for ornamental purposes, and picture frames and mouldings could be given a true metallic surface instead of the metallic appearance, which is usually imparted by means of metallic paints, which have little durability. The wooden handles of instruments, such as are used by surgeons and dentists, when coated with nickel would be both light and easily cleaned without the annoyance of the handles becoming loose and cracking when subjected to alternate wetting and drying. Innumerable instances might be mentioned where a metallic surface is desirable where great strength is not necessary and where lightness is advantageous, in which the electroplating process might find application.

The prime requisite for producing such a deposit electrolytically is that the body to be coated shall have a conducting surface, and it is with the formation of such surfaces that the various processes have to deal. After such surfaces have been obtained the electro-deposition is quite simple.

Electrotypers obtain such a surface by applying a conducting graphite to the wax mould, but such surfaces not only require considerable care in application, but they are not adhesive, which, of course, is desirable in that work, but would be a drawback if a permanent coating is required. The application of gold leaf and metallic powders is open to the same objection. An ideal coating would be one in which the fibres are thoroughly impregnated with a metal, and it is with the view of forming such a coating that the following processes are used.

As the metal in a liquid state cannot be absorbed by the wood, recourse must be had to the soluble salts of metals. By immersing the wood in solutions of such salts, the surface will become impregnated with the metal, which, however, is not in such a condition that it will conduct the electric current, for there are no chemical compounds which will offer sufficient conductivity for the purpose in view. The next step then is to change the metal into its elementary condition, which may be accomplished by a reduction process.

The usual method of recovering a metal from a compound is by the use of a reducing agent, such as carbon, in the presence of a high heat, but such process is prohibitive on account of the action of the heat on the wood surface. For this reason an easily reducible salt must be used, which will not require the application of a high temperature to effect the liberation of the metal; such salts being those of gold, silver and platinum.

A typical process of such a nature is that which employs a solution made as follows:[1] 1.5 g. caoutchouc and 4 g. wax are dissolved in 10 g. carbon bisulphide, and this is mixed with solutions of 5 g. phosphorus in 60 g. carbon bisulphide and 4 g. powdered asphaltum in 5 g. turpentine. After immersing the wood in this solution and drying, it is dipped in a solution of 2 g. of silver nitrate in 600 g. water until the surface assumes a dark metallic appearance, and after rinsing in water it is finally dipped in a solution composed of 10 g. gold chloride in 600 g. water, after which it is ready to receive the electrolytic deposit.

A somewhat similar method is the employment of a solution of chloride of gold or platinum in sulphuric ether, to which a solution of sulphur in some heavy oil is added. On slightly heating this compound a sufficient consistency is attained to allow a film being laid on the surface to be plated. The object treated in this way is moderately heated in a muffle until sulphur and chlorine are completely volatilized, the gold or platinum adhering firmly to the surface.[2]

In a recent paper by Cowper-Cowles[3] on the electrolytic process for the manufacture of parabolic reflectors, a simple method is given for rendering glass surfaces conducting, which might possibly be applicable to surfaces of wood. It is as follows: The surface is dipped into a solution consisting of .5 per cent. of silver nitrate, .5 per cent. of caustic potash, and .25 per cent glucose.

None of these methods have been tried by the writer, but it is quite evident that they have one or more of the following objections: expensive materials, danger to workmen, and time and care necessary for the operation. With the view of obtaining some process for obtaining this first metallic coating, which should be free from these objections, some work was carried on in the electro-chemical laboratory of the University of Wisconsin, and with quite satisfactory results.

The purpose was to employ materials less expensive than the silver and gold salts, and to effect the reduction by utilizing the reducing action at the cathode of the electrolytic cell. The intensity of the reducing action at the cathode depends upon various conditions, such as current density and nature of electrolyte, and is due to liberation of the materials which exist in the solution as the electro-positive ions. If a solution of a metal salt is used in which the metal is the positive ion, that metal will be deposited with a reasonably low-current density, and little or no reducing action will occur. If the current density be increased so that hydrogen is liberated, or if a solution be used in which hydrogen is the positive ion, the well-known reducing action of hydrogen may be noted. If a potassium or sodium salt be used in the electrolyte, the reducing action is much more marked.

The intensity of the reducing action at the cathode may be taken as approximately proportional to the amount of polarization at that electrode, when unattackable electrodes are used. Some measurements which were made to determine these values gave the following results. Employing carbon electrodes the maximum cathode polarization was found to be, with NaCl, 1.00 volt; with NH_4Cl, .73 volt; with HCl, .32 volt; with KOH, 1.11 volt. These figures would indicate that the potassium and sodium salts are the best to use for the purpose in view, and this was confirmed upon trial.

The following is a description of the process by means of which a metallic surface on wood and other non-conducting materials has been obtained. The wood is first immersed in a saturated solution of copper sulphate, and then thoroughly dried, leaving the pores of the surface filled with copper sulphate. On exposing to the action of hydrogen sulphide gas, or immersing it in an aqueous solution of that gas, the copper in the sulphate is changed to copper sulphide. A copper-conducting wire of small diameter is then wrapped uniformly around the object so that each portion of the surface shall be within about one-half inch of the copper conductor, and it is suspended as a cathode in a solution of common salt (NaCl). A current density of a rather high value is used, and the cathode products will decompose the copper sulphide, the action being represented by the following formulæ:

$$CuS + H_2 = H_2S + Cu,$$
$$CuS + Na_2 = Na_2S + Cu,$$
$$CuS + Na + H = NaHS + Cu.$$

Metallic copper is thus set free. This coating is black and without a metallic appearance, but it conducts the current as desired. It forms first at the points of contact of the wire and the wood and gradually spreads over the entire surface, the time necessary for this operation being about ten minutes, using the proper solution and current density. The object may then be transferred to the copper sulphate or other plating bath, where a coating to any desired thickness may be obtained.

The coating thus formed will be an exact reproduction of the surface of the wood, the grain being clearly shown, and will be sufficiently adhesive to stand grinding and burnishing.

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[1] "L'Electricien, Vol. XII., 1896, p. 268.

[2] "London Electrician," 1880, p. 110.

[3] "Journal Inst. Elec. Eng.," March, 1898.

The purpose of transforming from copper sulphate to the sulphide is to render the salt insoluble in water. Otherwise, on placing the article in the bath of sodium chloride, the copper sulphate would be redissolved and no continuous coating could be formed. The copper sulphide, on the contrary, is quite insoluble, and it is also more easily reduced to the metallic state.

Copper compounds are preferable to similar compounds of the other common metals, owing to the high conductivity of copper and the less stable compounds which it forms.

In the process just described a separate bath is used for the reduction of the sulphide, but this may be just as readily accomplished is some metallic bath where the metal is deposited simultaneously with the reduction of the sulphide. A potassium copper cyanide solution is such a one that the processes of reduction of the copper sulphide and the deposition of the metal from the solution may be carried on simultaneously, for here the potassium forms the electropositive ion, while the $CuCy_2$ is the negative. The copper is deposited by a secondary reaction.

A solution of silver nitrate used in place of the copper sulphate will enable the process to be carried on more rapidly, though the greater cost of the silver salt is a disadvantage.

If the material to be plated is one which will expand on absorbing moisture, it will do so when placed in the plating bath. Consequently, after it has received its metallic coating, upon drying it will contract and thus cause the coating to wrinkle up and become loose. This may be avoided by leaving the object in the bath for only a short time; then drying it, and repeating the process until the desired thickness is obtained. Or, the following process, which I have used satisfactorily, may be employed:

The wood is first immersed in hot paraffin, which it readily absorbs, and is thus rendered impervious to moisture. It is then placed in gasoline, which dissolves the paraffin near the surface and renders it capable of absorbing the metallic salt. The trouble caused by expansion is thus entirely removed.

By the above process articles of wood, vulcanized fibre, and hard rubber have been given firm, adhesive coatings of copper, nickel, zinc, silver, etc., which were capable of being polished as readily as though deposited on metallic surfaces, and the process appears to be one which might readily be put to commercial use. It at any rate shows one of the many ways in which the oxidizing and reducing actions which take place at the electrodes of an electrolytic cell may be put to a practical use.

Valuable Electrical Patents of One Week.

A surprising number of patents covering processes or machines which have already reached a wide use in the arts was issued on July 19. Among these are the following: The solenoid controller of the Walker Company; the regulating switch for boosters and auto-converters manufactured by the Westinghouse Company; the cast-in field magnet used by the Walker Company; the sectional or button rheostat manufactured by the American Electric Heating Corporation; and a modification of the Sayers winding. Other patents of interest are those covering the division of field magnet poles to prevent distortion, the patent being owned by the Siemens & Halske Electric Company; a means of feeding three-wire direct-current circuits with single commutator rotaries, patented by Mr. B. G. Lamme; and a contact button electric railway system patented by Prof. S. H. Short.

London's Second Underground Electric Railway.

The Waterloo & City Railway, an electric road about 1½ miles [illegible] service, the time between terminals being five minutes, with a max- [illegible] river.

The Siemens and Halske Magnetic Testing Apparatus.*

BY DR. HUBERT KATH.

Magnetic measurement has become a matter of great importance ever since the first dynamo-electric machine was constructed; and a good deal of pains has been taken to find suitable methods. Nevertheless magnetic testing with these methods may appear to be a troublesome thing, when compared with the simplicity of other measurements; for example, the determination of electrical resistance. However, the fault is not with the methods or with the apparatus, but it is caused by the want of any theory, giving a full account of all magnetic properties concerned in terms of a few functions and "constants." If such constants were defined, it would be an easy task for apparatus builders to construct a handy instrument for determining them. As a matter of fact, if the question is only to determine single values, there are many simple and skillfully constructed instruments admirably adapted for this purpose. However, as matters are, a thorough knowedge of the qualities of any iron can be acquired only by ascertaining the whole set of values, as they are represented by general consent, by "magnetization curves" or "curves of induction." But the methods which enable us to take these curves with some reliability—as, for instance, the magnetometric or ballistic methods—are hardly fit to be employed by unskilled persons, requiring a great deal of attention even with the learned physicist. For these reasons it is proper to call attention to an apparatus, which will give scientific accuracy and yet which may be worked by unskilled hands.

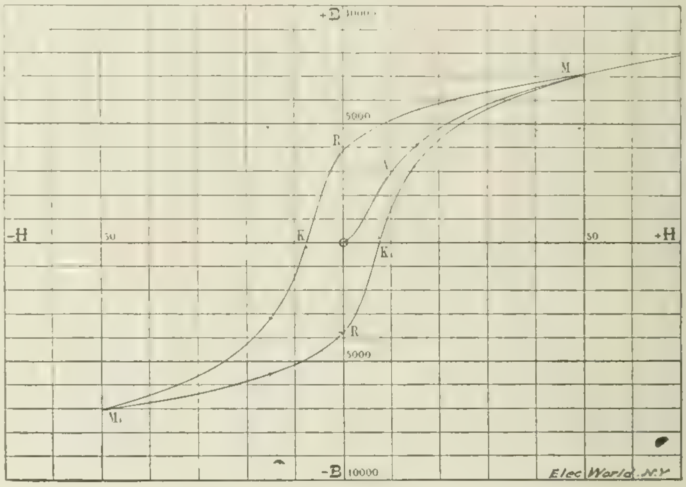

FIG. 1

In order to state more precisely what is meant by "magnetic values" we may briefly recall those magnetic properties of iron which are important to the electrician. Fig. 1 represents the usual form of induction curve, the magnetizing force $\mathcal{H}$ being the abscissa and the induction $\mathcal{B}$ the ordinate. *O A M* (Fig. 1) represents what is generally called the curve of induction, sometimes also the "virginal curve," as it begins from the non-magnetic state of iron, $\mathcal{B} = O$, $H = O$. This is the principal curve wanted for the calculation of field-magnets, giving by the ratio $\mu = \frac{\mathcal{B}}{\mathcal{H}}$ the "permeability" corresponding to each value of $\mathcal{H}$ or $\mathcal{B}$. The curve *M R K M* is obtained by beginning with a high value of $\mathcal{H}$, decreasing to

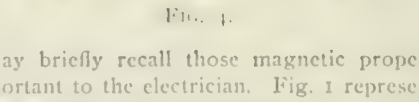

FIG. 4.

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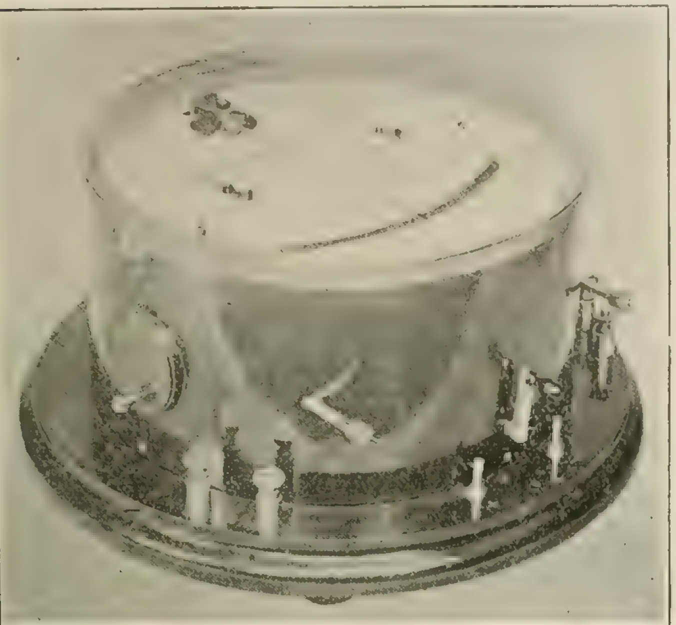
*A paper read in April [illegible] before the [illegible] Verein, Berlin, and communicated by the author. See also "Elektrotechnische Zeitschrift," June [illegible] zero, reversing the magnetizing force, and increasing again to the same negative value of $\mathcal{H}$; returning in the same way to M (M_1 R_1 K_1 M), completing a "cycle of magnetization."



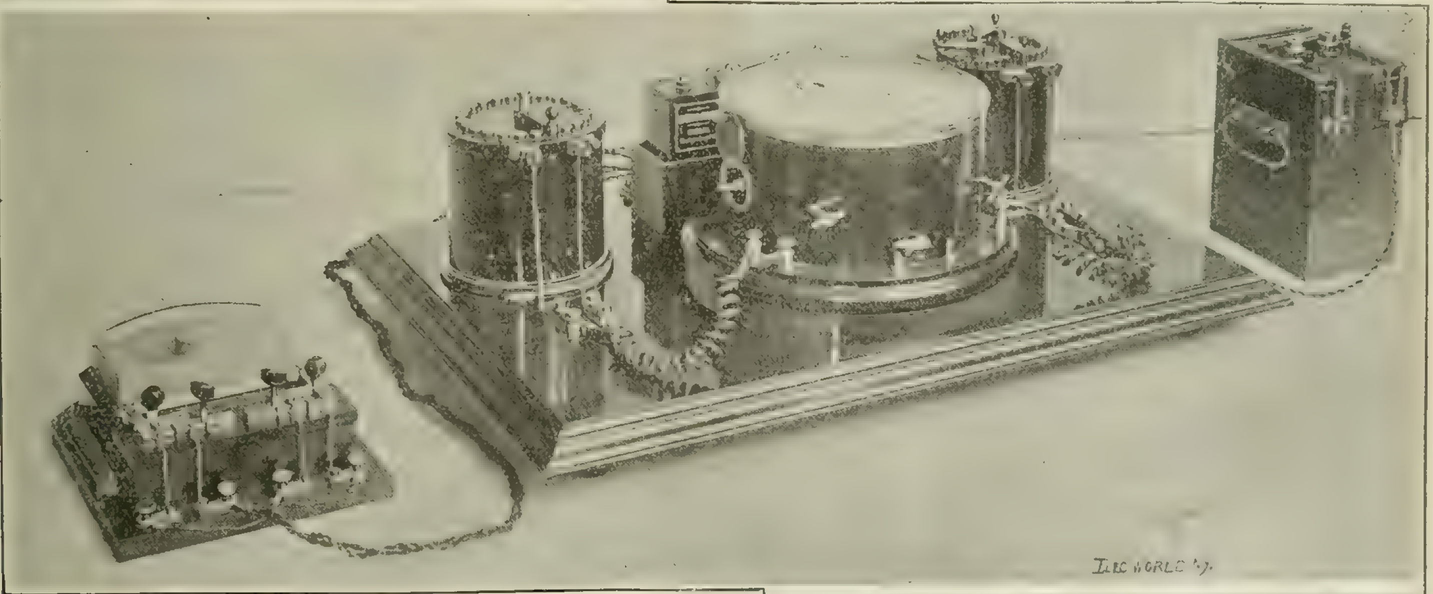


FIG. 2.
FIG. 5.

The area of this gives us the hysteresis loss by the integration.

$$A \text{ in ergs} = \frac{1}{4\pi}\int \mathcal{H}\, d\,\mathfrak{B}.$$

A cycle, like the one described, thus defines the losses by alternating-current magnetization, which are of importance in transformers and other alternating-current machinery. To test samples of hard steel for permanent magnets, a cycle of magnetization, taken up to magnetizing forces of say 300 c. g. s. lines, will be sufficient. The value of the ordinate when $\mathcal{H} = O$—viz., R or R_1—is the residual magnetism, and the value of $\mathcal{H}$ when $\mathfrak{B} = O$—viz., K or K_1—is the coercive force.

Since eddy-current losses are not solely dependent on the magnetic cycle, they cannot be expected to be indicated by a magnetic testing apparatus. Methods allowing measurements of eddy currents will therefore be somewhat difficult and require special arrangements.

The requirements for a magnetic testing apparatus can be stated, according to the above remarks, as follows: The apparatus should not be difficult to work, and it should enable the operator to take magnetization curves similar to those represented by Fig. 1 within any reasonable range of magnetizing forces. The test-pieces should be simple in form.

The Siemens & Halske magnetic testing apparatus will enable anyone to make tests in the way pointed out above. It was first placed before the public by its inventor, Mr. Koepsel, in 1894.* The improvements in methods of magnetic measurement and magnetic materials since then led the author to some modifications of the apparatus and to the construction of suitable accessory instruments.

The apparatus (Fig. 2) consists, as Figs. 3 and 4 show, of an iron yoke, J, embracing a cylindrical space in which is placed the movable coil, s, wound upon a rectangular frame and pivoted on a vertical axis. The frame is maintained in its zero-position by means of springs, one of which is to be seen in Fig. 3 above the frame of s.

The ends of the testing-bar, P, are fixed into the yoke by means of the clamping-pieces, K, and screws. S is the magnetizing coil, which is so wound as to give a magnetizing force equal to one hundred times that of the magnetizing current "m" in absolute units. Through the movable coil, s, an auxiliary current, kept constant during each test, is passed. The scale of the apparatus reads directly the values of induction $\mathfrak{B}$, per square-cm. section of the bar, even for sections differing from the normal. To effect this, the current, h, in the coil, s, has only to be chosen inversely proportional to the section of the bar.

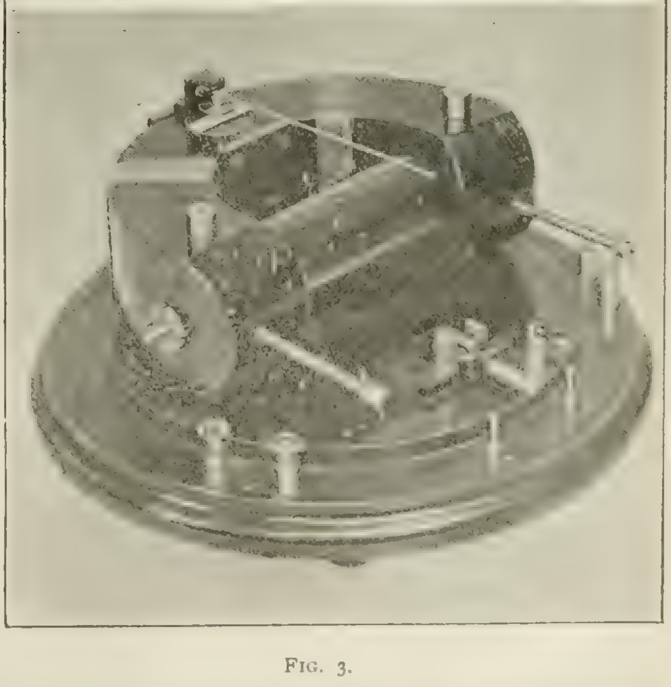


FIG. 3.

The principle of the apparatus is the reverse of that of the modern type of ammeters. Instead of measuring the intensity of a current sent through a movable coil between the poles of a permanent electromagnet, as is done in the meter, the current in the coil, s, is kept constant and the varying intensity of the induction in the bar or the magnetism of the electromagnet is indicated by the deflections of the needle. Some turns of wire round the yoke, which are to be seen in Fig. 3, are connected in series with the coil, S, and serve a special purpose. The lines of force in the magnetizing coil, *S*, outside of the specimen, would exert a disturbing effect. This is compensated for by creating an inverse magnetization of the yoke by means of passing the current, *m*, through these turns.

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*See THE ELECTRICAL WORLD, vol. XXIII, p. 649, vol. XXIV, pp. 81, 215, 266

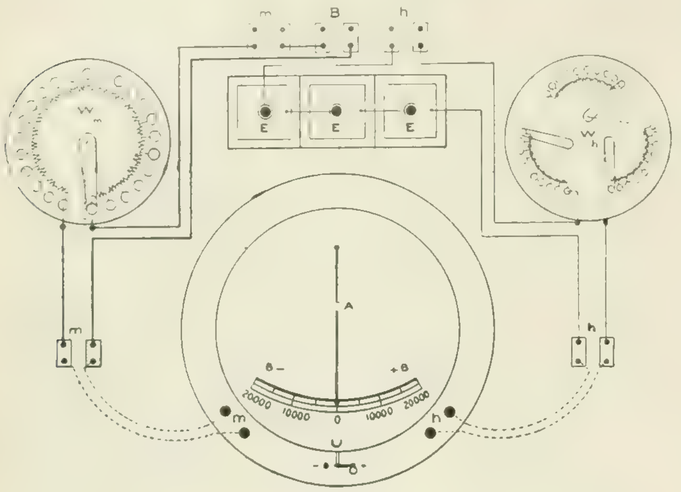


Fig. 6

Figs. 5 and 6 represent the whole magnetic testing arrangement, consisting of the magnetic testing apparatus, a resistance, W_m, for regulating the magnetizing current, *m*, the battery, *E E E*, and the resistance, W_h, for the auxiliary current, *h*. The battery (4 volts) which gives the magnetizing current, *m*, is supposed to be placed aside, as well as the amperemeter for measuring the currents, *m* and *h*, which, being of the permanent magnet type, ought to be placed at some distance so as not to influence the indications of the apparatus.

The influence of the earth's field is reduced by placing the apparatus always in the same angular position.

To measure both the currents *m* and *h* with a Siemens and Halske milli-volt and ammeter of 1 ohm resistance the plug-switch shown to the extreme left in Fig. 5 has been constructed.

The manipulation of the arrangement is very easy. The testing piece is chosen 200 to 270 mm. long, and, if a cylindrical bar, 6 mm. in diameter; in case of laminated iron, strips of 5 mm. breadth are made into a bundle about 5 mm. thick. After having fixed the testing piece the current, *h*, is adjusted to correspond with the section. To take a curve like *O A M*, Fig. 1, the operator simply closes the commutator, *U* (Figs. 4 and 6), and moves the sliding contact of rheostat, W_m, from point to point, reading at each step the value of ℋ as shown by the ammeter and that of 𝔅 on the instrument dial. To take a hysteresis cycle the manipulator commences with a high value of the magnetizing force, for example, 150

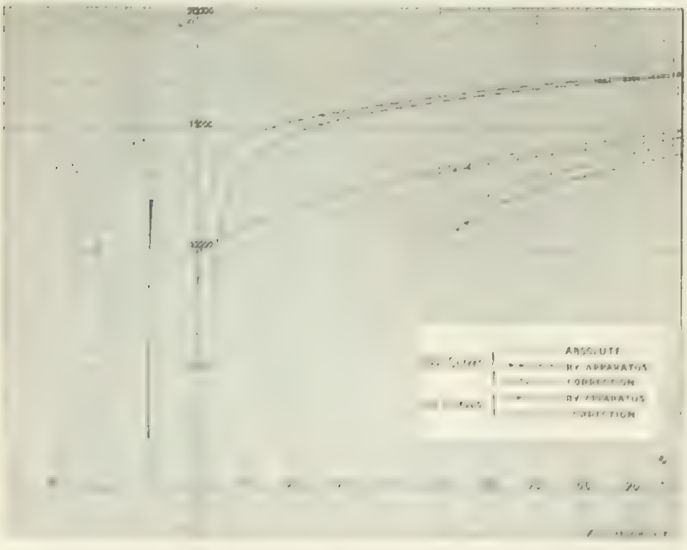


Fig. 7.

[illegible] The sliding contact may be [illegible] It is moved then [illegible] then the current is reversed and the sliding contact moved gradually from [illegible] to [illegible] the corresponding readings give the curve (Fig. 1), *M E K M*.

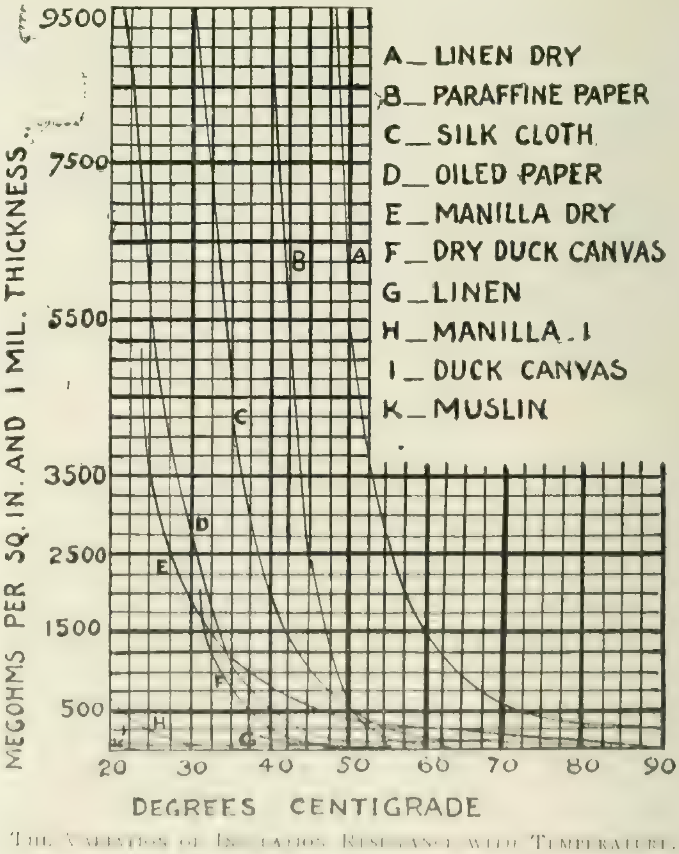
As was noted above, the curves obtained in the apparatus are almost the same as the "absolute values" which would be derived from magnetometric observations of an ellipsoid. The proof of this is given by the test which was made on the apparatus recently by the German Physikalisch-Technische Reichsanstalt. Two bars, one of fairly hard steel, the other of very soft iron, were first tested in the apparatus; and then the corresponding curves of absolute values were determined. The results are plotted in Fig. 7, giving the upper halves of the cycles. By "absolute values" are meant values derived from ring or ellipsoid measurements, ballistic tests on yokes giving but approximate values.

Of the tests with the steel bar, the dotted line was derived from the ellipsoid, and the full line from the apparatus. To obtain the absolute values from the readings on the apparatus a correction of ℋ has to be made for each point of the curve. On the left side of the Fig. 7 the correction curves are plotted separately, showing how far and in which direction every point of the original curve has to be displaced (parallel to the axis of ℋ) in order to meet the "absolute curve."

With the soft iron bar it would have been impossible to draw the ellipsoid curve beside the curve of the apparatus on account of their proximity; however, the correction curve is given. In most testing the correction may be treated as a negligibly small quantity. For soft iron apparently it is very small, and even with harder material it is small relatively to the breadth of the curve. If the corrections are once made the test in the apparatus is as rigorously accurate as could be wished, even in scientific measurements.

The Effects of Temperature on Insulation Materials.

In the 1897-98 issue of "The Technograph," published by the engineering societies of the University of Illinois, Prof. William Esty gives the results of a series of tests of insulation resistance of several materials at varying temperatures. The abrupt fall of the resistance



The Variation of Insulation Resistance with Temperature.

of many materials used in armature and field insulation at temperatures approximating those at which such parts run is shown in the accompanying curves. It may be seen that dry linen gives the highest specific resistance, approaching the vertical asymptote at 50° C. Paraffin paper comes next and silk cloth next, etc., in the list of materials experimented with, there being a great difference between the resistance of these materials and some others, such as manilla paper and muslin.

DIGEST OF CURRENT ELECTRICAL LITERATURE AMERICAN AND FOREIGN

By Carl Hering.

Dynamos, Motors and Transformers.

ELECTRIC GENERATORS. Parshall and Hobart. Lond. "Engineering," July 8.—A continuation of their long serial (see "Digest" last week). In discussing commutator heating they give practical information, some of which is as follows: Copper brushes may be used to a density of 200 amperes per sq. in. of contact surface and even higher in small machines; carbon brushes should preferably not be run above 40 amperes per sq. in. of contact surface except in small machines, while under good conditions much higher densities may be used; the pressure need seldom exceed 2 pounds per sq. in. of bearing surface; 20 oz. per sq. in. is good practice; in railway motors this is considerably greater. At a peripheral commutator speed of 2500 ft. per minute, which corresponds to good practice, the rise of temperature of the commutator will seldom exceed 20° C. per watt sq. in.; this may be greater with arrangement for ventilating; the rise of temperature should preferably not exceed 50° C. for running at full load. The contact resistance of carbon brushes at 20 oz. per sq. in. of bearing surface and at ordinary current densities and speeds is about 0.03 ohms per sq. in. of contact surface on each brush; the contact resistance for copper brushes need not exceed 1-10 of this, and with good conditions will be less. In estimating the friction loss, the coefficient of friction under favorable circumstances is about 0.3. The application of these constants is illustrated with an example. Careful tests fail to show any considerable decrease in contact resistance on increasing the brush pressure beyond 20 oz. per sq. in., nor does it change greatly for different speeds and current densities. The loss through windage and bearing friction is dependent on the nature of the design and the method of driving; in certain high-pressure alternators it ranges from 1 to 3 per cent.; large, direct-coupled, slow-speed generators will have considerably less than 1 per cent., and those of 1000 kw or over should have a friction loss well within ½ per cent. A discussion of the design of the magnetic circuit is then begun; the solution of the magnetic problems is generally largely empirical on account of the very great difficulty in calculating the magnetic leakage and of determining the precise path of the flux in the non-magnetic material; analogies between electric and magnetic circuits are misleading; for calculating purposes it is assumed that the magnetic flux distributes itself according to the reluctance of the several paths between any two points; the difference of the magnetic potential between two points is equal to the sum of the several reluctances between these points multiplied by the flux density along the line over which the reluctances are taken; the proportion of leakage flux increases with the flux density in the core and with the magnetic force. The reaction of the armature is discussed; with generators and leading brushes the reaction is opposed to the field magnets and increases the leakage; with motors and leading brushes it increases the flux and diminishes the leakage; in an alternating generator it diminishes the flux with a lagging armature current or increases it with a leading current; in a transformer with a lagging current it diminishes the effect of the primary current, and with a leading current it increases it. The effective flux is equal to the resultant magneto-motive force divided by the reluctance of the magnetic circuit; the effects of these reactions must therefore be carefully calculated in the design of a magnetic circuit; there is no fixed ratio between the amounts of copper and iron required to produce a certain magnetic flux; the most economical result is arrived at by a series of trial calculations; the energy used in the field magnets with continuous current machinery should not usually exceed 1 to 1.5 per cent., depending on the size and speed; in transformers the conditions are different, and the general design consists in securing a definite efficiency and satisfactory thermal conditions for minimum cost of material and labor. In continuous current dynamos the armature reaction, as a factor in determining the field magnets, is of greater importance now than heretofore, as the sparking and heating limits have been increased; there are numerous examples of good dynamos in which the magneto-motive force of the armature at full load is equal to those of the field magnets, and in certain satisfactory dynamos constructed by one of the authors it was 50 per cent. greater; this increases the series coils for a compound machine; from practice it is found that the component of the armature magneto-motive force opposing the magnets is from 18 to 30 per cent. of the total armature magneto-motive force corresponding to a lead of the brushes of 9 to 15 per cent. of the distance between the neutral points. The armature reaction, therefore, greatly increases the material in the field magnets by increasing the economical length of the magnet coils and cores, which in turn increases the leakage. The output of alternators is now limited largely by the regulation as distinguished from the heating limit; for inductive lines for power purposes they are frequently designed with one-half the armature reaction that would be used for lighting; a fuller discussion of the reaction in alternators is promised. In continuous current machines the general practice is to laminate only the pole faces, but in alternators the cores, at least, should be laminated for their entire length; the pulsations of the flux, due to the variations in the reluctance are greatest in the inductor type, and are one of the objections of most varieties of this type.

THREE-BRUSH REGULATION FOR DYNAMOS.—Lond. "Elec.," July 8.—An illustrated description of the Sayers automatic method. If an additional brush bears on the commutator about midway between the others the voltage between this brush and either of the others is practically the same, and about half the voltage of the machine; if a load is then put on the armature the field is distorted and the voltage between the middle brush and the backward main brush is reduced, while the other is increased, the effect being proportional to the load within certain limits, depending on the permeability of the system. If the shunt of the machine be wound to give the light-load ampere turns with half the machine voltage it may be coupled with one end to the forward main brush and the other end to the middle brush; an increased load will then cause an increased voltage on the shunt, and therefore increased ampere turns, tending to a constant voltage on the machine terminals, or even a rising characteristic. The results of some experiences with a 300-ampere machine are given in the form of curves and tables, first with the shunt connected in the ordinary way and then in the new way; in the latter case the rise of pressure on the shunt between no load and full load is 22 per cent.; there was no detrimental sparking at the middle brush, which was of carbon, one-quarter inch thick. The arrangement can be easily applied to any existing machine having more than one coil in series (provided there is an even number of coils), the coils being connected in parallel to adapt them to half the voltage.

COUPLED MOTORS FOR VARIABLE SPEEDS. Carus-Wilson. Lond. "Elec. Eng.," July 8.—A brief abstract of a Physical Society paper describing the action of two electric motors coupled so that they will drive at different speeds. The two shafts, which are in line, are fitted with a bevel gear working with an intermediate gearing whose axis is at right angles to that of the shafts, and which is free to rotate; by running the two motors at different speeds the revolution of the intermediate wheel will depend on the difference between the two speeds or on their mean, thus enabling any variation of speed to be produced.

PRACTICAL USE OF SINGLE-PHASE MOTORS. Hoadley. Lond. "Elec. Rev.," July 8.—An article on the use of such motors in England chiefly in connection with the Worcester plant, in which the single-phase current is used more for motor work than in any other town in England, except London; the aggregate of the motors connected is 90 to 100 horse-power. He endeavors to show that it is both practical and convenient to use such motors, and that the interference in the supply of the light is not as great as has been claimed; the difficulties that exist are either not very great or can be overcome with more knowledge and experience. Some data concerning these motors is given, and the charge for such power is discussed. Otherwise there seems to be nothing important in the article.

THREE-PHASE, TWO-PHASE TRANSFORMER. McKissick. "Amer. Elec.," July.—A short article on the design, construction and test of a 2.5-kw transformer of this kind; the object was to determine how far theory dictated correct practice; the method of the design was due to Ryan and the Scott method of phase transforming was used.

PHASE TRANSFORMERS.—"Amer. Elec.," July.—A short, illustrated article of an elementary nature.

COMPOUNDING AND EQUALIZING CURVES. Borden. "Amer. Elec.," July.—Some curves obtained from three direct-connected dynamos.

Lights and Lighting.

LIGHTING A HALL.—Lond. "Elec. Eng.," July 8.—Answers to a request to compare the annual cost of lighting a large hall by incandescent and arc lamps.

PROPER METHOD OF ILLUMINATION. Bowman. "Elec. Rev.," July 20.—A reprint in full of the paper which was abstracted in the "Elec. World," July 9, p. 44.

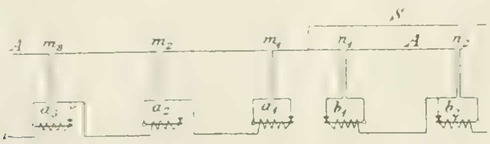
Power.

COST OF WHOLESALE POWER.—Lond. "Elec.," July 8.—In the leading editorial of that issue the figures concerning the Lachine Rapids plant as given in Walbank's recent paper, are summarized and deductions are made therefrom for the distribution of electrical energy from coal fields, as in Great Britain such large water powers do not exist. It is thought that the steam-driven machinery would cost about as much as the water power plant on so moderate a fall as at these rapids, and therefore this item remains about the same; the cost of fuel, which must be added, is assumed to be 0.2 cents per unit, based on a constant full load, hence this represents the cost which should be added in order to give the price at which power could be furnished from coal fields; the wholesale supply in that country from such a plant would therefore not exceed 0.6 cents per unit at the substations, and a price of 1 cent per unit for wholesale or continuous consumption might therefore be profitable. (An abstract of Walbank's paper is reprinted in the same issue.)

ECONOMY IN POWER INSTALLATIONS. Eberle. Lond. "Engineering," July 8.—A long abstract, with numerous tables and some curves, of the article noticed in the "Digest," October 30; another abstract in English was noticed in the "Digest," Jan. 15.

Traction.

CUTTING OUT BROKEN TROLLEY WIRES. Folco. "Elek. Zeit.," July 7.—A brief description of an arrangement which he suggests by means of which a trolley wire which has broken and thereby becomes grounded is cut out of circuit. Ordinarily when this occurs the circuit breaker at the station should open the circuit, but it will only operate when the ground connection is very good, for otherwise the current will not be great enough; his apparatus overcomes this objection. The switches for cutting out sections are replaced by his automatic apparatus, the coils for which are not connected in the main circuit, but in a special circuit, which, under normal conditions, is almost entirely without current; when the wire is broken the main current must pass through this coil of the last automatic apparatus, through which it has to flow to the break; this will operate the cut-out at that point. The arrangement is shown diagrammatically in the adjoining figure, in which A A is the trolley wire and S a feeder; four of the automatic cut-outs are shown below, and the circuits will explain themselves; if the wire should break and be grounded between any two of the cut-outs, then the nearest cut-out between it and the station will operate and all the sections beyond, as also both ends of the broken wire will be disconnected. One of the conditions is that current must be flowing to cars beyond the break, which condition is generally fulfilled; the end sections, as well as the one to which the feeder is connected are not protected, but they may be made as short as is desired.



UNDERGROUND RAILWAY IN LONDON.—Lond. "Elec.," July 8.—Extracts from the prospectus of the Brompton and Piccadilly Circus Railway Company, which it is proposed to construct between South Kensington and Piccadilly Circus by means of the double deep-tunnel system. The length of double track is to be 2 miles, and the tunnels 11.5 ft. in diameter; there are 7 stations in all, and the single trip is to occupy ten minutes; the detailed estimated expenses are given, and a comparison made with those of the Liverpool and the City and South London rail[illegible].

MONT SALEVE. Jacquin. "L'Eclairage Elec.," July 2.—A long, illustrated description of this electric mountain railway near Geneva. This line was opened in 1892, and is said to be the oldest rack and pinion line which is operated electrically.

HALIFAX.—Lond. "Elec.," July 8.—An illustrated description of this new trolley line.

SLIDING BAR CONTACT. Stobrawa. Lond. "Elec. Rev.," July 8.—A translation in abstract, with the illustrations, of the article noticed in the "Digest" June 12.

AUTOMOBILES. Reyval. "L'Eclairage Elec.," July 2.—Illustrated descriptions of those made by a French company, including a diagram of the controller; the motors drive the rear wheels by [illegible]

RENTED POWER OF RAILWAYS.—"Amer. Elec.," July.—[illegible] by that journal sent to the various railway companies in this country which rent or purchase their power [illegible] them the price which they [illegible] can be given, as the conditions in the various cases are so different.

APPLICATION OF ELECTRICITY TO STEAM RAILWAYS. Brangs. "Elec. Rev.," July 20.—A reprint of a short paper [illegible] Master Mechanics' Association. He reviews the [illegible] by which electricity can be [illegible] and believes it is safe to say that the possibilities in the near future will overstep even the [illegible]

Installations, Systems and Appliances.

ACCUMULATORS FOR LIGHTING AND TRACTION SYSTEMS. [illegible] Lond. [illegible] July 8.—A reprint of his [illegible] paper. He discusses and describes [illegible] the methods of connecting the batteries and [illegible] the advantages. The efficiency of the [illegible] will seldom exceed [illegible] per cent under [illegible] the prime cost of a battery [illegible] is given [illegible] the same as for steam dynamos and boilers for the same output. For the continuous current lighting station he shows two systems of connecting for the three-wire system; in the first, most of the dynamos are connected directly to the outer mains only, there being two separate dynamos for balancing the accumulators and the circuits, regulating cells being cut in and out as required; he thinks it much better, however, to have the battery charged and discharged as a whole, in order to treat all cells equally, and this is not possible with this arrangement; he therefore recommends another, which is preferable; in this all the dynamos are connected directly across the outers, two smaller ones, in series, having a middle wire connection besides; there are no regulating switches at all, except when the battery is being discharged; no variation of the voltage of the dynamos is required in charging, as the extra voltage is added to the voltage of the bus bars by means of a small booster in the charging circuit; there is one of these on each side of the system; during discharge the pressure is varied by means of back E. M. F. cells. For alternating current lighting stations he also advocates the use of accumulators, as they can be used as a standby for the exciting plant, or in small stations to run the plant during the hours of light load, through the medium of a motor alternator; the plant could conveniently consist of an engine, motor and dynamo on the same shaft, with a clutch coupling between the engine and the two dynamos, which latter are permanently connected; during the daytime the engine would drive both, the continuous current dynamo charging the cells, whereas when the engine is shut down the continuous current dynamo is used as a motor to drive the alternator. The great advantage of using accumulators in traction power houses is shown by means of a load curve, where it was found that with this addition one dynamo will easily do the work of two, and can be kept at a very regular load, so regular, in fact, that lighting could be done from the same machines; the batteries are then connected directly to the bus bars without any regulating switches, but they must then be of ample size, with a low internal resistance, and the dynamo should be shunt-wound with a falling characteristic; a booster is used for fully charging the cells. In order to assist the battery to discharge when the total load exceeds the output of the dynamos at a charge when the load is less, a compound-wound booster is sometimes used, as is shown in an illustration; it is motor-driven and has two field windings in opposition to one another; when the line current is equal to the output of the dynamos the two windings neutralize each other and the booster will develop no voltage, but when the line current is less the shunt winding will predominate, and the booster will charge the cells, whereas when the line current is greater a series winding will change the polarity and add pressure to the battery circuit, helping it to discharge. The great complication in the use of automatic switches and the irregular chargings of the cells are strong arguments against their use; they will not be necessary when the battery is large enough to do its work. Accumulators are also of great service in the substations at the ends of long traction systems. He recommends the use of batteries when tramways are supplied from lighting stations, which is greatly to the advantage of the latter; during the evening the machines could be used for lighting, and the accumulators for traction, while after midnight the batteries could be charged, so that the load on the boilers and engines is nearly constant. The discussion, which is reprinted, is favorable to the use of accumulators.

250-VOLT INSTALLATIONS. Passavant. "Elek. Zeit.," July 7.—A reprint of a recent paper in which he describes a new material and some new wiring accessories for 250-volt lighting systems; an illustration is given of an improved form of switchboard for installations in houses, the chief object of which is to avoid the short circuiting occurring where formerly the wires crossed near each other. For fuses one of the largest companies in Germany has found that silver wire offers a very excellent material; it is much more reliable than lead and for smaller cross-sections it can be made much more reliably and accurately than when lead is used; the interior part of the plug fuses is filled with plaster of paris; up to 25 amperes these fuses are very satisfactory. A device is also described, the object of which is that fuses for different currents cannot be inserted in the same screw plugs; a small, metallic ring in the socket prevents any but the proper plug from being screwed in and held fast in the socket; fuses for even stronger currents than 25 amperes are now also made of silver, either as single wires or as several in parallel; tests have been made up to 200 amperes. He claims that apparatus now exists which is very satisfactory for voltages up to 250, and is quite reliable. Switches should be determined to a certain extent by the watts—that is, a good switch for 20 amperes at 100 volts would be reliable for 10 amperes at 200 volts; he claims that an installation made for 250 volts is even more reliable than one for 125 volts, partly because the current is smaller and partly because any faults will develop very quickly. The discussion is also published, but appears to contain nothing of importance.

CENTRAL STATION STATISTICS FOR GERMANY.—"Elec. Zeit.," July 7.—A very complete table of statistics, covering nineteen full pages of data for the year ending March 1; there are also included a summary and some editorial remarks; only such central stations are included which supply whole cities or districts. The number of central stations is 375; the continuous current is exclusively used in 81 per cent of all the stations, and represents [illegible] per cent of the total power; this does not include those which also use the single-phase or three-phase alternating current; the number of continuous-current stations has greatly increased, but the percentage of the total power is slightly less, owing to the fact that one large station has also adopted the three-phase current; 89 per cent of the continuous current stations use accumulators to the amount of 31 per cent. of the total power of the stations; accumulators have been added to many of these, in order to enlarge the capacity of the station. The number of alternating-current stations has increased only slightly, but the power represented has increased more; twenty-nine stations, as compared with twenty-six for the previous year, use the alternating current alone, and represent 14,706 kw; the number of three-phase stations increased from sixteen to twenty-three, and the power represented is 14,195 kw, an increase of more than 84 per cent; besides these, there are fifteen using the three-phase and continuous current and five using the alternating and continuous current; these comparative figures are given in a separate table; 58 per cent of all the stations are run exclusively with steam, and this represents 84 per cent. of the total power; 14 per cent. use water power exclusively, and, although their number has increased, the total power has diminished; those using water power and steam have increased considerably—namely, from 45 to 76—and the power from 5255 to 9224 kw; the number of stations using water alone are almost exclusively of less than 100 kw, and are, therefore, only quite small; 36.5 per cent. of all the stations are run partly by water power; gas power is being used more, but almost exclusively for small stations. 61.6 per cent.—that is, more than half the stations—have a capacity of less than 100 kw; 142 have from 101 to 500 kw, 20 from 501 to 1000; 14 from 1001 to 2000, 8 from 2001 to 5000, and 3 with more than 5000 kw; the largest station in Germany is one of those in Berlin, having a capacity of 6708 kw. During the past year the increase has been quite great; the number of continuous current stations using no accumulators has diminished; the total motor load has increased greatly. Another table gives the number of lights and the power of motors connected, making a total of 111,539 kw, the motor load being 28.9 per cent. Another table gives what is called the "degree of saturation" of a number of the cities in connection with the lighting; this gives the number of incandescent and arc lamps (the latter reduced to the former) per 1000 inhabitants; this is greatest in Bremen, where it is 338; in Berlin it is 178; in Hamburg, 134; in some of the smaller cities it is nearly 300.

WINCHESTER.—Lond. "Elec." and "Elec. Eng.," July 8.—A brief, illustrated description of this plant, which has been erected for a capacity of 6000 lamps of 8 cp; there is a battery of accumulators of 230 cells, and the balance on the three-wire system is maintained by motor-driven boosters, or what is called a balancing transformer.

EDINBORO'. Newington. Lond. "Elec. Eng.," July 8.—A reprint of a recent paper giving a brief description of this plant, which was designed by Professor Kennedy. There are four direct-coupled sets at 390-kw capacity, two for the low-tension continuous-current system and two for the high-tension alternating-current system; two batteries of accumulators are also used.

WAKEFIELD.—Lond. "Elec. Rev.," July 8.—An illustrated description of this single-phase alternating-current plant, in which 2000 volts are used in the feeders and 400 volts on a three-wire system in the distribution; there is also a four-cell refuse destructor plant in connection with this.

UNIFORMITY IN PLANT AND APPARATUS. Wordingham. "El'ty," July 20.—A reprint of the paper noticed in the "Digest" July 9.

Wires, Wiring and Conduits.

ELECTRIC WIRING. Gardner. "Amer. Elec.," July.—Various comments on changes which have developed in wiring methods. He does not favor the plain gas pipes with wires drawn into them; in a wooden timber building he thinks porcelain work is the safest.

Electro-Physics and Magnetism.

ROTATION OF CATHODE RAYS. Braun. "Wied. Ann.," No. 6; abstracted briefly in Lond. "Elec.," July 8.—A thin bundle of cathode rays strikes a fluorescent screen at the end of a vacuum tube; a bar magnet penetrates through the vacuum through this screen, and is protected by a glass tube; the rays then form a ring around the bar magnet. He investigated "whether this ring represents the influence of cathode rays, which are in a state of rapid rotation around the pole;" several tests showed that there was no evidence of rotation.

TRANSPORTABLE X-RAY APPARATUS. Levy. "Elek. Zeit.," July 7.—A reprint of a brief, illustrated paper describing a simple, portable apparatus, devised by him.

IMMERSED LUMINOUS ELECTRODES. Braun. "Wied. Ann.," No. 6; abstracted briefly in Lond. "Elec.," July 8.—Aluminum electrodes can be used for the chemical rectification of current; in this connection he discovered that the aluminum electrode in the electrolytic cell emits over its whole surface a white or yellowish red light. The phenomenon is best studied by means of a thin strip or wire of aluminum, which is viewed in a revolving mirror. The luminosity gradually disappears with a constant current.

POTENTIAL FALL IN GASES. Capstick. Lond. "Elec.," July 8.—A brief editorial abstract of a Royal Society paper on the cathode fall of potential in gases. He gives the details of his experiments, which show that if the gas is pure and dry, the electrodes clean, the metal not acted on chemically by the gas, and the current not so strong as to make the negative glow cover the whole cathode or extend to the walls of the tube, then the cathode fall has a definite value for each gas, which value is independent of the pressure or the current strength, appearing, in fact, to be a constant for the gas. He endeavored to find whether there is any intelligible relations among the falls of three gases, one of which is formed by the combination of the other two. The value found for hydrogen was 298 (presumably volts), which agrees closely with the result of Warburg.

ELECTRIC AND MAGNETIC FIELDS. Lienard. "L'Eclairage Elec.," July 2.—A highly mathematical article on the electric and magnetic field, produced by an electric charge concentrated at a point and moved in any desired way.

THEORY OF THE HALL EFFECT IN A BINARY ELECTROLYTE. Lehfeldt. Lond. "Elec. Eng.," July 8.—A brief abstract of a Physical Society paper in which he discusses the effect which might be expected by theory; his theory is in favor of the negative results of Roiti and Florio.

THERMOPHONES. Braun. "Wied. Ann.," No. 6; abstracted briefly in Lond. "Elec.," July 8.—He shows that the effect noticed by Preece in 1884—namely, that sound may be propagated by the periodic changes of temperature produced by an oscillating current—is essentially the same as the phenomenon noticed recently by Simon, who used the arc as a telephone transmitter. The Preece effect can be indefinitely increased in sensitiveness by superposing the variations on a strong, steady current, the variations being directly proportional to the latter.

Electro-Chemistry and Batteries.

ELECTROMOTIVE PROPERTIES OF CHROMIUM. Hittorf. "Wied. Ann.," No. 6; abstracted briefly in Lond. "Elec.," July 8.—He describes the electrochemical properties of this metal, which can now be obtained in large quantities. It appears in three different states, which are usually shown only by different metals; in the inactive state it is a noble metal, reduces no other metal from its salt solutions, and stands at the electro-negative end of the series, next to platinum; in another state its place is immediately above zinc, and it precipitates other metals from their solutions; in the active state it takes up three times the amount of the anion which is taken up in the inactive state; the active state is that possessed by fresh fractures of the metal; it quickly passes into the inactive state when exposed to air. As an anode it may, with the same electrolyte, assume its three grades, according to the solvents and the temperature; its most stable condition at ordinary temperatures is that which corresponds to the passive state of iron.

ELECTRO-DEPOSITION OF PLATINUM. Cowper-Coles. Lond. "Elec. Rev.," July 8; reprinted in "El'ty" (N. Y.), July 20.—Brief descriptions of a number of different published processes.

ELECTROLYSIS OF CHLORIDE OF CALCIUM SOLUTIONS. Oettel. "Zeit. f. Elektrochemie," July 7.—A description of his extended researches made in 1894; the results agree almost completely with those obtained by Foerster and Bischoff.

Units, Measurements and Instruments.

BRIDGE METHOD OF COMPARING LOW RESISTANCES. Callendar. Lond. "Elec.," July 8.—Some remarks on the method of Muller and Wallau, which was described in the "Elec. World" March 5, page 296. He calls it a bridge method, and states that if not the most expeditious in most cases it is certainly one of the oldest and simplest, and with suitable apparatus may be made the most accurate method of comparing low resistances; the only new feature in this method, as recently described, is the use of a pair of 10,000-ohm boxes instead of a slide box or slide wire; the substitution was originally proposed by Lord Rayleigh as a makeshift for a high-resistance slide; for low resistances it is particularly objectionable, partly on account of the expense and partly on account of the want of sensitiveness; it is far preferable to use a slide wire and a galvanometer of low resistance. It is not generally necessary, as claimed by the authors, to take four separate observations, more particularly if a high-resistance slide is used, provided the ends of the slide wire are connected directly to the potential terminals at the outer ends of the unknown resistance and the other one, by wires of relatively low resistance; the batteries supplying the main current must not be connected to the ends of the slide wires or to the potential terminals, but to the main current terminals of the resistance under test. The great advantage of this method over the potentiometer method is that it is quite unnecessary to keep the testing current rigorously constant, as claimed by the authors; it is also possible to use much smaller testing currents without loss of accuracy. The Kelvin double bridge method possesses several advantages, but is of much less general application. He then describes some tests made with this single-bridge method for measuring some low-resistance shunts at a railway power house, and the results were very satisfactory; he used a slide wire; an equally accurate determination could not have been made with the shunts in position, under these conditions, with so little trouble, by any other known method.

APPARATUS FOR TESTING RAILS.—Lond. "Elec. Rev.," July 8, and Lond. "Lightning," July 7.—A brief, illustrated description of a convenient switchboard for use in measuring the resistance of rails at the foundry. A current from a battery of accumulators is passed through the rail, which is laid on two knife edges separated a fixed distance, and connected to a volt meter; the current and the voltage are measured, and by means of a table the resistance is obtained directly. It is only for testing rails at the factory and not in place. The resistances measured are as low as 0.0001.

JOINT TESTING. Constable. Lond. "Elec. Rev.," July 8.—An illustrated article supplementary to the one by Raymond-Barker noticed in the "Digest" May 28, and describing a zero method; in the present article some modifications are described and discussed.

ACTION OF CONDENSERS FOR INDUCTION COILS. Dell. "Elec. Rev.," July 20.—A short description of some experiments. He used a separate interrupter for the induction coil, operating it by an independent battery, and then repeated various experiments with and without the condenser; the make and break of the coil itself was locked, and he claims, therefore, that its condenser was out of use; the condenser, which he switched in and out of circuit, appears to have been connected across the spark gap of the independent interrupter. Vigorous sparks were obtained from the secondary, but those at the break of the primary were very small, when the condenser was used; but when it was cut out, the opposite was true; when a Leyden jar or Tesla coil was connected in the secondary in shunt to the spark gap, the condenser had no effect, as it was immaterial whether it was used or not; the same was true of a double cathode Crookes tube attached to the Tesla coil; neither was there a noticeable difference observed when Geissler tubes were attached, although a slight difference was obtained with a very long tube. He concludes that the condenser destroys the spark at the break of the primary and makes the spark in the secondary; if the arrangement does not require a spark larger than that obtained without condensers, the condenser is entirely without effect. He also noticed that when the spark gap was closed, or very nearly so, there was an interference of some sort with the running of the interrupter. (He says nothing about the capacity of the condenser, and it would seem that this might affect the results considerably.)

RESISTANCE FOR LARGE LOADS.—"Amer. Elec.," July.—An illustrated description of a wire resistance and another of a lamp resistance which was designed for simplicity and cheapness. A low-grade steel wire of No. 14 was used, and could easily carry 10 amperes; it was mounted in successive zig-zag lengths, which were equal to each other and could be variously connected together.

Telegraphy, Telephony and Signals.

TELEPHONE EXCHANGE IN PARIS. Touanne. "Jour. Telegraphique," June 25.—The beginning of a well-illustrated description of the large central exchange on Gutenberg Street.

RAILROAD TELEPHONE. Bernheim system. "L'Elec.," July 2 and 9.—An illustrated description of this system, which is used by the Northern Railroad of France.

TELEGRAPHY AND TELEPHONY IN SWITZERLAND.—"Elek. Zeit.," July 7.—Long extracts, with tables, from recently published statistics for 1897.

COMMUNICATION IN TRAINS. Lond. "Elec. Eng.," July 8.—A brief description from the London "Times" of the method used on the Great Eastern Railway.

TELEPHONE ANNUNCIATOR. Brown. "Amer. Elec.," July.—A note stating that if a small piece of paper is placed between the hammer and the bell of a telephone call it will be held there if the bell is not rung, but will drop out if it is; a person who has been absent from his office can in this way tell whether the bell has been rung during his absence.

SWITCHBOARD DROPS. Miller. "Amer. Elec.," July.—An illustrated description of a self-restoring switchboard drop for telephone work.

INDEPENDENT TELEPHONY AT THE TRANS-MISSISSIPPI EXPOSITION.—"West. Elec.," July 16.—Short description of some of the exhibits.

Miscellaneous.

MEASURING CAPACITIES. [illegible]. "L'Elec.," July 2.—A French translation of the article noticed in the "Digest" Feb. 19.

EFFECT OF ELECTRICITY ON PLANTS.—Lond. "Elec. Rev.," June 24.—A note stating that the [illegible] Tower, which is being [illegible], is to be provided with collectors for atmospheric electricity, the currents from which will pass into experimental gardens, [illegible] in the ground in earth plates.

TELEPHONE INDUCTION COILS. Holmes. "Amer. Elec.," July.—A note stating that the coils used by the largest company in this country [illegible] in the primary and [illegible] in the secondary. The [illegible] formerly [illegible] longer [illegible].

A Semi-Dry Battery.

The Electric Gas Lighting Company, Boston, Mass., is manufacturing a semi-dry battery, which is recommended as being adapted for gasoline engine launch work, portable gas engines for agricultural purposes, nickel-in-the-slot machines and similar work, requiring hard and exacting battery service. The trade designation of this cell is the "Sampson semi-dry battery." The cell was designed to meet the requirements for a portable, non-spillable, open circuit battery, which should be contained in a jar not easily broken and possess great initial strength and long life, even exceeding the No. 2 Sampson battery.

The negative element of the cell is a hollow fluted carbon cylinder, around which is fastened a strong linen bag, containing a large amount of specially prepared depolarizing compound. A heavy reinforced cylindrical zinc forms the other element. Both elements are sealed in a porcelain jar with a preparation of black wax, thus obviating the possibility of spilling the fluid. The dry salts are placed in the jar, and it is only necessary to fill the latter with water to make it ready for immediate use.

Belt Dressing.

A good belt dressing, as every engineer knows, not only adds to the life of the belt, but enables it to transmit more power. Not only is more power transmitted, but a very important advantage is secured in reducing the strain on the bearings, because a belt treated with a dressing can run slacker than one not so treated. A tight belt necessarily puts much more strain on the bearings than a slack belt.

The Cling-Surface Manufacturing Company, 10 Court Street, Buffalo, N. Y., manufactures a belt dressing which is known in the trade as "Cling-surface," and which, when applied to belts, penetrates the leather, canvas or rope and produces a smooth and clinging surface. It does not oxidize or evaporate, as do grease or oil, consequently what goes into the belt remains there.

Running Slack Belt.

The accompanying illustration gives a good idea of the result of using this belt dressing. Formerly this particular belt was kept taut in order to transmit the necessary power, but since the application of "Cling-surface" the belt runs slacker and, it is stated, develops more power than it did formerly, at the same time relieving the strain on the bearings.

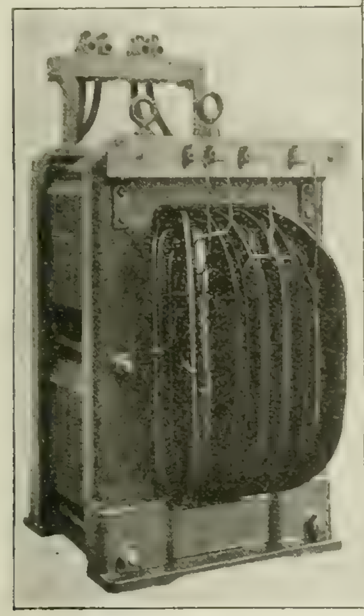
"Cling-surface" is very extensively used by all manufacturing concerns, and judging from testimonial letters received by the company it is giving excellent satisfaction to those who are using it. All report less wear and tear and more available power.

Self Cooling and Water Cooled Transformers.

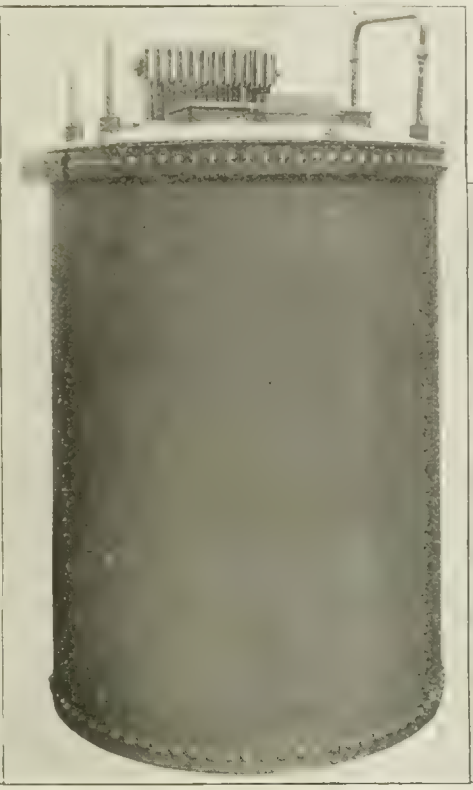
Other conditions being the same, the temperature of a transformer depends upon the surface exposed to the cooling medium.

As the capacity of a transformer is increased its external or radiating surface increases much more slowly than does the loss, so that the dissipation of the heat generated becomes a more and more serious problem as the capacity of the transformer is increased. In order to obtain a radiating surface which should increase in a somewhat more adequate proportion to the capacity of the transformer, the Westinghouse Electric & Manufacturing Company several years ago changed the design of its transformer from the long type, in which a great portion of the coils was inclosed by the iron, to a type having a short length of iron and a great portion of the coils outside the iron. The idea was then conceived of dividing the winding into several thin parallel coils, and spreading these apart outside of the iron. The method of spreading the coils, which gives an enormous increase in radiating surface, not only makes a remarkable difference in the temperature of the ends, but also in the average temperature of the transformer, and it has been found by careful measurement that where the coils are thin and spread well apart, the temperature of the ends is practically the same as the temperature of the interior of the transformer. This is what would be naturally expected, as the coils being thin, the portion in the iron being short and the copper an excellent conductor of heat, the heat generated in that portion of the coils under the iron is conducted to the ends, from which it is readily dissipated into the surrounding medium. The converse of this is also true. Where the coils are thick and are not separated or spread, there will be some portion of the coil which will be at a temperature very considerably higher than that indicated by the increase in the resistance of the windings, which necessarily gives the average temperature of the windings. The maximum and not the average temperature is the dangerous one.

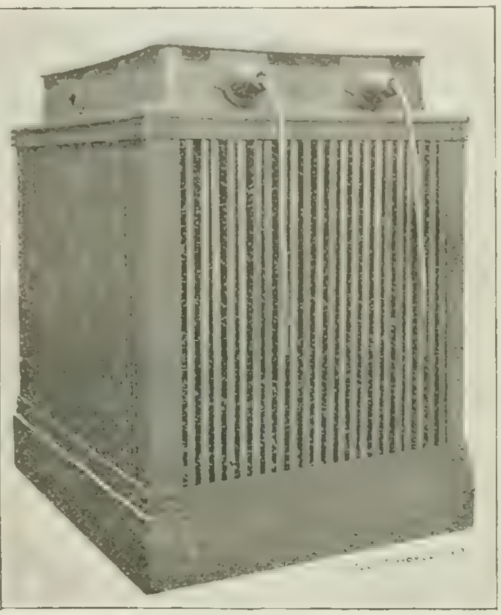
The great advantage of the spread coil method of ventilation is that the gain in radiating surface is obtained without increased weight and without sacrificing the efficiency of the transformer. Where the spread coil is not used there are only two ways of increasing the radiating surface—one is to separate the coils from one another by spacing strips, the other to so proportion the shape of the transformer that there will be a large amount of radiating surface exposed to the air. The adoption of either of these plans means lower efficiency or increased weight, or both. Where the coils are separated by air or oil spaces all the ventilating space is lost so far as the electrical performance of the transformer is concerned, and as this space is extremely valuable its loss affects directly the efficiency of the transformer. Where the design of any but very small transformers is such that the outside surface is sufficient for radiating the heat without separating the coils, the shape of the transformer must be so great a departure from the best proportions that high efficiency is obtained only by an excessive amount of material, and the point is very soon reached where the most radical departure from the best design does not give sufficient cooling surface.



300-kw Transformer, Showing Spread Coils.



750-kw Water-Cooled Transformer.



500-kw Self-Cooling Transformer.

Oil in a transformer plays several important parts; it materially strengthens the insulation; it prevents oxidation of the insulation, and, being an excellent conveyor of heat, tends to equalize the temperature, preventing any one spot from becoming seriously hotter than the rest of the transformer. A very fluid oil having a high fire test and high insulating qualities has been adopted by the Westinghouse Company for use in its transformers, for it has been found that where a heavy viscous oil is used much of the good effect of the oil as a cooling medium is lost as the heavy oil is very sluggish in its movement even when hot, and therefore does not circulate rapidly. It also tends to clog up any small openings which may be left for its circulation.

In addition to the advantages enumerated above, the oil transformer is the only one that has been made self-cooling in large sizes without enormously increasing the amount of material used. When a transformer has once been placed in position in its oil case, it is no longer subjected to danger from moisture or from mechanical injury of any kind. On the other hand the transformer cooled by an air blast is likely to have blown into it damp air, dust, dirt and foreign substances of any kind which happen to be drawn into the blower. That the oil insulated type of transformer is rapidly gaining ground is shown by the fact that the smaller companies which have been free to choose their own type are gradually adopting the oil insulated transformer for their standard.

All oil transformers manufactured by the Westinghouse Company may be divided into two classes—self-cooling and water cooled. The self-cooling type is used on all sizes up to and including 500 kilowatts; the water-cooled type on larger sizes. Both classes have the coils spread at the ends, both are oil insulated, both are without moving parts and require no attention after being once installed. The accompanying illustrations show typical examples of these two types of transformers. So closely do the two types resemble each other that when a transformer is seen outside of its case it is impossible to tell whether it is designed to be self-cooling or water cooled; the only difference is in the case.

The self-cooling case is made of heavy sheet iron mounted in a rigid angle iron frame work, which serves as a protection from mechanical injury and as a support for lifting. The surface of the sheet iron is broken into numerous deep narrow corrugations, which increase very greatly the surface exposed to the air. The cover is in two portions, the terminals being brought through the lower part. The upper part is easily removed and allows an examination of the terminals. This transformer requires absolutely no extraneous cooling devices, thus avoiding all loss in efficiency due to power required for blowers, pumps, motors, etc. It requires neither special foundation nor air chambers, and no attention whatever after being installed.

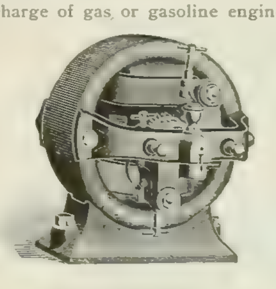
The popularity of this type of transformer is shown by the fact that since January 1, 1898, over 34,000-hp capacity has been sold; 26,750 horse-power is for 10,000 volts or higher; 9730 for 20,000 volts or higher; 130 horse-power for 60,000 volts.

The water-cooled type is used only on sizes too large for the application of the self-cooling method. Its use is therefore quite restricted, it being employed only in very large installations where large transformer units are required and where there is a cheap supply of water. The case is of boiler iron, circular in form, with a light cast-iron cover. Just inside the case and close to the sides is placed a spiral of iron pipe, through which the cooling water is passed. This coil extends only part way down the case, usually to about the top of the coils. The position of the cooling oil is such that it is in the very best place for cooling the heated oil as it rises to the top, so that the maximum amount of heat is carried off with a given amount of water. An exceedingly small amount of water is required for cooling a transformer, a 100-hp transformer requiring about 1 gallon per minute. The ends of the cooling coil may be connected directly to the water supply mains; or in a water-power plant, a pipe may be led from some point in the flume to the transformer, a head of a few feet being ample for forcing sufficient water through the cooling coil.

While the water-cooled transformer is not so ideally simple as the self-cooling one, it resembles the latter in requiring no pumps, blowers or motors, no special foundation or overhead oil tanks, and in requiring no attention after being once installed.

Dynamo for Igniting the Charge of Gas Engines.

The machine illustrated herewith is designed to meet the demand for a small generator to take the place of primary or storage batteries for igniting the charge of gas or gasoline engines, and in its construction it is stated that no pains have been spared to make it perfectly satisfactory for this purpose.



Small Dynamo.

In designing a dynamo for this class of work special requirements must be met and peculiar difficulties overcome. Moreover, the machine must be strongly and carefully constructed in order to stand the prolonged and exacting work which is imposed upon it. The bearings of this dynamo are extra long and lined with babbitt metal of the best grade. They are supplied with wick oilers and reservoirs, holding enough oil for a week's run. The commutator is constructed of tempered copper segments of extra width, and is as solidly constructed as those in the larger machines produced by the manufacturer, the Elbridge Electrical Manufacturing Company, Elbridge, N. Y. The carbon brushes are of ample carrying capacity. The brush holders are of the automatic self-adjustable type, and hold the brushes squarely on the commutator.

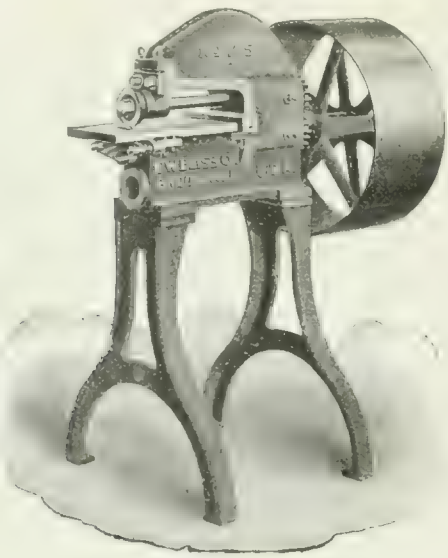
Owing to the special construction and winding of this machine no induction coil is needed, and a large, bright spark is always obtained at the breaking of the circuit. The dynamo will never "lie down" when short circuited, and will always increase its output at the moment a spark is obtained.

This dynamo is not adapted to starting a gas engine, as it will not generate sufficient current until running at about its normal speed. A battery is therefore needed for starting, but as it will be used only a few moments each day, it does not become exhausted as quickly as when constantly in service. A spark coil is necessary for the battery circuit.

This machine may be attached to the floor, wall or ceiling, and the base may be bolted to the top, bottom or either side of the field ring, as may be desired by the purchaser. At a speed of 1200 r. p. m. it has a greater output than three large cells of Edison-Lalande battery, and the current is always available while the engine is running. Although designed to run at a speed of 1200 revolutions, a considerable range is permissible and good results may be had anywhere between 1100 and 1200. No harm whatever results if the machine should be accidentally run backward. The dimensions, weight, etc., of the dynamo are as follows: Weight, 47 pounds; speed, 1500; height, 10 inches; length of shaft, 12½ inches; pulleys for flat belts, ranging from 2 to 6 inches in diameter, and grooved pulleys for round belts, ranging from 2¼ to 5¾ inches.

Slitting or Circle-Cutting Shear.

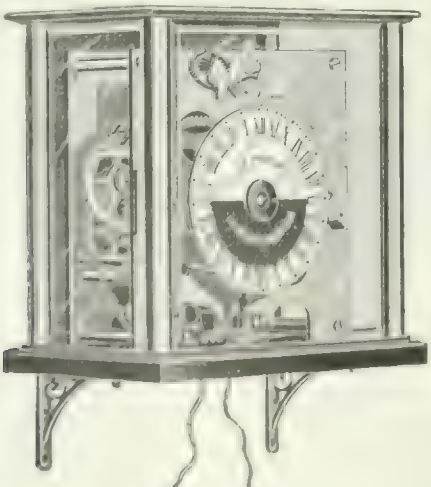
The shear shown in the accompanying illustration is built by the E. W. Bliss Company, Brooklyn, N. Y. This shear is especially useful in electrical manufacturing concerns for cutting up stock, and also for cutting out armature discs, which have to be notched in a successive operation in a power press. For this latter purpose, the machine has to be supplied with a special circle cutting attachment. When so arranged the machine will cut circles from 4 to 40 inches in diameter. The Bliss Company, however, builds larger machines for this kind of work: also shears specially adapted for cutting the inside as well as the outside of armature discs. Besides building a great variety of shears, it also manufactures presses, dies, etc., specially adapted for electrical work. It [illegible] on the market an automatic armature disc notching press, which is used in connection with its shears, and which is claimed to be the most accurate machine obtainable for this class of work.



A Useful Shear.

An Automatic Time Switch.

[illegible] herewith is applicable to the control of both direct and [illegible] to turn on and off currents at any hour of the day or night for seven consecutive days without any attention whatever. Its appearance is that of a handsome French clock with a very strong eight-day movement. The movement actuates a twenty-four-hour dial, which makes one revolution in the course of each day. At the top of the dial is a fixed pointer from which the actual time is read. This dial is, in addition, [illegible] motion the mechanism which turns the switch. The switch is operated with a positive movement and as strongly as though turned by hand. The power is derived from one end of the main spring, while the power which runs the regular clock train is taken from the other end. When the second pointer reaches the reading point the switch is turned off in the same way.



An Automatic Switch.

The advantages of this time switch are numerous and obvious. One of its most popular uses is the turning on and off electric lights in show windows and stores. It may be used with good success in illuminating signs which burn a large number of low candle-power lamps and which are required only a few hours in the evening. It is likewise applicable to burglar alarm systems.

This serviceable device is manufactured by Messrs. Hubbard & Mortson, 42 Union Place, Hartford, Conn.

The Victor Non-Short-Circuiting Burner.

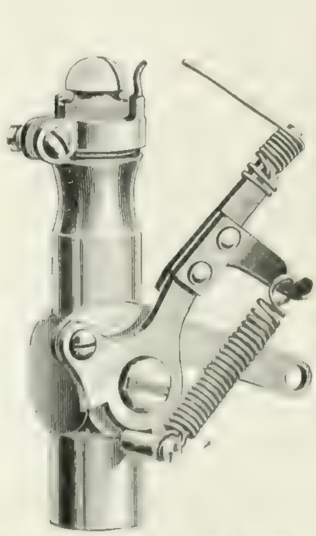
An improved gas igniting attachment for burners is shown in an illustration below. This device operates in a manner directly the reverse of most igniters, in that, instead of pulling down on a pendant to turn on and ignite the gas, it is pushed up. Two advantages are claimed for this device; first, that it is absolutely non-short-circuiting, and second, that it permits no escape of gas. In ordinary electric gas lighting burners when the lighting wires catch and stick, as they often do, a short circuit is made, the battery is run down and has to be renewed. With the Victor these troubles are said to be entirely avoided. The movable electrode with the wipe spring is insulated from the base to which it is riveted, and carries no current except when the lever is pushed up against it by the pendant rod in the act of lighting. Then, as soon as released, the rod drops again, thus breaking all connection with the insulated electrode. Even if the lighting wires should stick together there is no current passing through them. In the Victor the weight of the pendant has a tendency to turn off the gas in case the springs should drop or stretch and lose their elasticity, and in this respect it is a distinct advantage over the style depending on the downward pull for its operation. This feature avoids all accidental escape of gas under these conditions.

The Victor pendant burner is manufactured by Messrs. Vallee Brothers & Co., 625 Arch Street, Philadelphia, Pa.

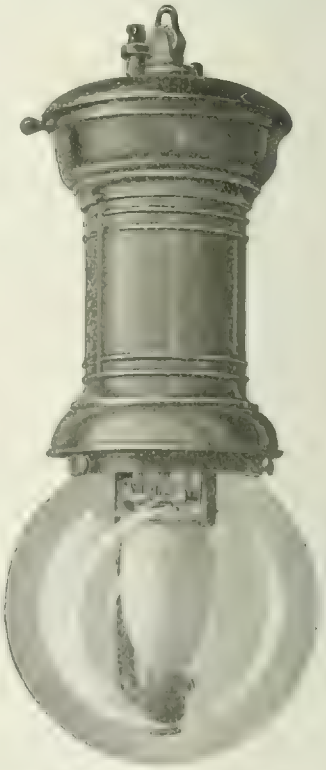
The "Monarc" Lamp.

The "Monarc" lamp is presented to the trade by the Albert & J. M. Anderson Manufacturing Company, Boston, Mass., as embodying a number of progressive features in line with genuine improvement. It is only 22 inches over all, and in designing it nothing in the way of strength, ample insulation and large radiating surface for the resistance has been sacrificed. Special attention has been given to provide good contact for the carbons, and the shape of the inner globe is such as to give the best diffusion of light. The arc is so thoroughly enclosed that the combustion of carbon is reduced to a minimum. The construction of this lamp is such that every part can be readily removed and replaced, and a novel device enables extreme ease of trimming.

The "Monarc" burns 150 hours, and owing to its simplicity of construction and the fact that all mechanical details have been carefully and correctly worked out, there is the least possible deterioration through the wearing of parts.



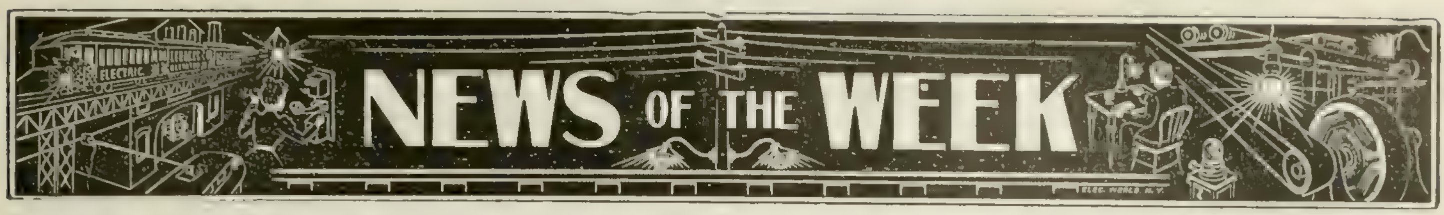
The "Victor" Gas Igniter.



The "Monarc" Lamp.

The standard lamps require [illegible] amperes, but are furnished to take 3 or [illegible] amperes if so desired. The Class A lamps are designed for [illegible]-volt circuits, and have a range from [illegible] to [illegible] volts, each lamp having a resistance of [illegible] ohms. Class B is for multiple series lighting on street railway circuits, ranging from [illegible] to [illegible] volts, each lamp being provided with the same resistance as that in the Class A lamps.

[illegible]



NEWS OF THE WEEK

Financial Intelligence.

THE NASSAU ELECTRIC RAILROAD COMPANY, of Brooklyn, will increase its capital stock from $6,000,000 to $15,000,000, the State Railroad Commission at Albany having given its approval.

THE SPECIAL MEETING OF THE GENERAL ELECTRIC COMPANY.—According to a Boston financial paper, the notice being sent out by President Coffin, of the General Electric Company, of the special meeting of the company on August 10 next, contains some interesting facts. The notice states that the directors of the company being of the opinion that the valuation at which patents, franchises and good will have been carried in the balance sheet, namely, $8,000,000, was excessive, and that the fair and reasonable value of this item is the sum of $4,000,000, have by resolution directed this item to be reduced to that amount upon the books of the company, as of June 30, 1898. The directors believe that a reduction of the share capital of 60 per cent. of its present amount will make the share capital of the company equal to the amount of net assets. Any surplus net earnings from and after August 10 will then be applicable to the payment of secured dividends on the preferred stock and future dividends on both classes of stock.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
9 Murray St., NEW YORK, July 25, 1898

THE METROPOLITAN STREET RAILWAY COMPANY has applied to the Dock Board for permission to build a power house on the wharves between Ninety-fifth and Ninety-sixth Streets on the East River. The application was referred to Commissioner Meyer and to the department's engineer for consideration and report. The proposed power house will furnish the current for the operation of many of the new lines of underground conduit road installed and to be installed by the Metropolitan Street Railway Company. The location of the power house on the river front will permit of rapid and economical handling of coal and other supplies, for which purpose special machinery will be installed.

THE QUESTION OF HIGHER TOLLS FOR TROLLEY CARS ON THE BRIDGE.—The Brooklyn trolley companies have, it is stated, finally rejected the proposition of Bridge Commissioner Shea to increase the toll for each trolley car crossing the bridge. President Rossiter, of the Heights Company, was delegated to act for the united roads, and send a communication to the company, stating the conclusions arrived at by the companies. The commissioner wants the trolley companies to pay 10 cents per car for a round trip, which is double what they are now paying under the contract made by the bridge trustees just before going out of office. It is stated that the railroad companies are willing to enter into a new arrangement that shall be made in the interests of the city, provided additional privileges are given to them. These privileges include, it is reported, some sidings in the Manhattan terminal to take care of the crowd during rush hours on two or more loops.

THE TWO NEW UNDERGROUND CONDUIT ROADS.—On July 20 the horse car traffic on Sixth Avenue and Eighth Avenue, below Fifty-ninth Street, was suspended and the work of tearing up the old roadbed for the purpose of installing the underground conduit system was at once begun. At daylight the trucks of the Metropolitan Street Railway Company were busy depositing at the street corners the heavy iron yokes which are to support the track and inclose the conduit. Notice had been sent out that workmen would be required, and before 6 o'clock in the morning nearly 5000 men had applied for work. It was necessary to call on the police to keep them in order. About 2500 men were accepted, and immediately set to work tearing up the streets. After the cobble stones had been removed the soil was stirred up by a plowshare drawn by two horses in order to loosen the earth for the shovel. The work on the Sixth Avenue line began at Eleventh Street, and is being carried northward, and at Fifty-first Street, working southward. Eighth Avenue was torn up north and south of Fiftieth Street. Below Clinton Place horse cars are still running, switching through Greenwich Avenue to Seventh Avenue. This section of the road will likely take longer to construct, as the tracks follow a winding and devious course.

A DIFFICULT PIECE OF OPEN CONDUIT RAILWAY WORK.—Since the Amsterdam Avenue and Fifty-ninth Street line of the Metropolitan Street Railway Company was put into service with electric cars supplied by conductors in an open conduit, the cars have been pushed over the part the line running on Columbus Avenue between Fifty-ninth and Sixty-fourth Streets. The cars here run over the Columbus Avenue cable car tracks, and, although it was originally planned also to put in an electric conduit, legal difficulties were brought up by the lease of the tracks from the original owners, the Ninth Avenue Railway Company, which prevented, and it has been necessary to push each electric car by a cable car, the plow of the electric car running freely in the cable car slot. On account of the short distance the cars were not coupled together, and to prevent the forward car from drifting away when the cable slacked up slightly, and getting a severe jolt when the cable car again caught up with it, the electric cars were run over the line with their brakes set. During the last few weeks the company has been at work installing an electric conduit under the tracks, the cable conduit being left midway between the tram rails and the electric conduit being offset to one side between the cable conduit and one rail, the plows being free to slide across the car on a frame with sufficient distance to reach the offset conduit. New double conduit yokes have been inserted, the old single conduit ones removed, the rails transferred from one to the other, the electrical conductors put in, fastened to their insulators, the conduits completed and the paving relaid, while the tracks were in constant service with both electric and cable cars. During the past week the work has been finished, and now the electric cars run right through by their own power.

THE EDISON ELECTRIC ILLUMINATING COMPANY OF BROOKLYN.—A circular issued a few days ago announced the absorption of the Edison Electric Illuminating Company of Brooklyn by the Kings County Electric Light & Power Company of the same city. In the circular, which was issued on July 15 by President Ethan Allen Doty, of the Edison Company, it is stated that Mr. George Foster Peabody, of the board of directors, acting in consultation with the officers, has closed, in behalf of the stockholders, a proposed sale of the stock of the company to the Kings County Electric Light & Power Company upon terms which the members of the board of directors unite in thinking to be for the permanent advantage of the stockholders. Counsel is now preparing the papers in detail to carry out the agreement provided it shall be accepted by two-thirds of the stockholders. The deal, it is thought, will be consummated by October 1. The result to the stockholders will be, in substance, that the right to subscribe to 25 per cent. additional stock at par will be secured to them, and that for the whole amount of stock they will then be offered par in ninety-nine-year 6 per cent. Purchase money mortgage bonds to be secured by the deposit of the Edison stock so sold and additionally by a junior mortgage of the Kings County Company upon its property and further by the deposit of a mortgage fund of $1,000,000. In this connection a brief historical outline of the Kings County Company and its career may be of interest. Between three and four years ago a franchise was granted to the Kings County Electric Light & Power Company, but for two years or more nothing was done toward making use of the franchise. Last year it became publicly known that a very strong syndicate had been formed in which ex-Governor Roswell P. Flower, Vice-President Garret A. Hobart and several well-known Brooklyn men were heavily interested. The company purchased the site for a power house and began active work laying conduits. It announced that it intended to enter into active competition with other electric light companies in the city, and cut prices heavily to secure business. This spring when the bids for city lighting were opened it was found that this company was the lowest bidder. It did not, however, have its plant sufficiently completed to carry out the contract, and negotiations were opened with the Municipal Electric Light Company, looking to the lease of the property of that corporation, so that it could have a plant and a system in the Eastern District. At the same time the officers of the Edison Company opened negotiations with the Municipal Company, and finally the stockholders of the latter agreed to sell out their stock to the Edison Company. When this deal was completed negotiations were opened between the Edison and the Kings County Companies to bring about some sort of a combination which would prevent a disastrous rate war. The negotiations have been conducted principally through Mr. Peabody, and the results are indicated in the circular above referred to.

NEW ENGLAND NOTES.

Branch Office of THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., July 23, 1898.

MR. J. Y. BRADBURY, of the Electric Storage Battery Company, Philadelphia, has been a recent visitor to Boston, and was warmly welcomed by his many friends. Mr. Bradbury is one of the "old timers" in the electrical business, and has hosts of friends who wish him continued success.

MR. G. A. NISBET, general manager of the Electrical Appliance Company, New York, was a Boston visitor this week, looking as happy and contented as ever. The gravity motor controller, he says, continues in good demand, and L. A. Chase & Co., New England agents, are still winning honors for this excellent specialty.

THE ELECTRIC GAS LIGHTING COMPANY, Boston, reports gratifying success in the introduction of a specially constructed battery, which it styles "The Samson-Dry." It is made for portable use and where frequent and continued operation will exhaust the strength of the No. 2 Samson battery, which has been this company's largest size of this well-known cell.

THE UNITED STATES ELECTRICAL LEATHER PROCESS COMPANY has just been incorporated, with offices and factory at 138-144 Lincoln Street, Boston. The officers of the company are George D. Burton, president; Charles Williams, Jr., vice-president; George Wallace, treasurer; Lester H. Williams, secretary, and Clarence Hale, clerk. It has also a strong board of directors. This company will represent particularly the Burton Electric Liquid Process for the tanning of leather by electricity, which has received the indorsement and approval of the leading tanners and leather manufacturers of the United States.

THE ANCHOR ELECTRIC COMPANY, Boston, reports unusual activity in the sale of general electrical supplies, which fact, together with the demand for its own specialty manufactures, is a matter of considerable gratification to its management and executive head, Mr. Norman Marshall. It is introducing to the trade a new conduit, known as the Anchor Armorduct, which is said to never split or bend, and which has the approval of the Boston Board of Underwriters and city electrician of Boston. The Anchor Company, as New England agent of the Helios arc lamps, is equipping the subways with these lamps, which have been adopted after competitive tests.

THE RELIABLE ELECTRIC MANUFACTURING COMPANY, Worcester, Mass., is now nicely housed at 86 Foster Street, that city. It has just issued a handsome illustrated catalogue of its various telephone manufactures, supplies and electrical specialties, which alone should command consideration and quick business. This company makes a specialty of high-grade telephone apparatus, and its telephone instruments built upon correct mechanical and electrical principles, are claimed to be perfectly up to date, and are furnished at the lowest possible prices consistent with first-class material and workmanship. The Reliable Electric Manufacturing Company will be glad to send a copy of this catalogue to any address on application.

BUFFALO AND NIAGARA FALLS NOTES.

BUFFALO, N. Y., July 23, 1898.

THE BUFFALO STREET RAILWAY COMPANY is laying an eight-section conduit in Pearl Street for the accommodation of feed wires.

THE NEW TRANSFORMER HOUSE to be built on the Niagara power transmission line for the accommodation of the manufacturing district of lower Black Rock is to be built on the new underground line some distance south of Ontario Street. The work will begin soon.

THE ESTABLISHMENT of a new button factory at La Salle is announced as a new acquisition to the many manufactories that are to gather about the Niagara power line to Buffalo. The power company has agreed to build a transformer station there for the benefit of the company.

THE FUTURE of the Smith trolley line, as that on the riverside of the Niagara frontier, between Buffalo and Tonawanda, is called, appears to be assured, arrangements having been made for paying the back taxes and the proceedings to annul the charter of the company having been suspended.

THE BUFFALO GENERAL ELECTRIC COMPANY is making a test of a new style wattmeter of Westinghouse make, with the alternating current. So far it is doing satisfactory work. The company will use it for supplying customers who wish to run incandescent lights and motors on the same circuit, the number of these being constantly on the increase.

PITTSBURG NOTE.

PITTSBURG, Pa., July 23, 1898.

FLAG RAISING AT MR. WESTINGHOUSE'S HOME.—On July 4 a silk flag, 20x30 feet, was raised on a new staff 135 feet high on the grounds of Mr. George Westinghouse, at Erskine Park, Pa. The flag was raised at 8 o'clock in the evening, the extensive grounds being illuminated by electric lights, which were supplied with current from Mr. Westinghouse's private plant. The lamps were arranged in many ingenious designs, including shields and flags in red, white and blue. On the top of the flag pole glowed a large cluster of lights in the national colors.

CHICAGO NOTES.

Branch Office of THE ELECTRICAL WORLD,
936 Monadnock Building,
CHICAGO, Ill., July 22, 1898.

PLANS have been prepared for the reorganization of the Metropolitan West Side Elevated Railroad Company, which went into the hands of a receiver in January, 1897. The company was bonded and stocked for $15,000,000, a capitalization which was too great to warrant the payment of interest, to say nothing of dividends, while its territory still remained in an undeveloped state. The plan now formulated is to scale the $15,000,000 40 per cent. and 1 per cent. in interest, holders receiving 50 per cent. of their amounts in the issue of preferred stock, of which payment 40 per cent. is for scaling and 10 per cent. for the unpaid coupons since August 1, 1896. The stock is to be assessed 4 per cent., and for this $600,000 of bonds will be given.. This will dispose of all but $400,000 of the new bond issue authorized. The road was expensively and well constructed, but the business in sight hardly justified such an expenditure until a larger traffic could be obtained.

FLAG RAISING.—The employees of the Fort Wayne Electric Corporation, Fort Wayne, Ind., on July 16 raised what is said to be the largest flag and dedicated the largest pole and equipment in the State, at the factory of the corporation. About 15,000 people assembled about the works, and the crowd was so dense that the street cars were unable to get through until after the road had been cleared by policemen. It was, however, a patriotic crowd. The [illegible] number of search-lights were used with excellent effect, and connecting the office and factory building was a large [illegible] the words "Fort Wayne" being wrought in large letters. Upon the north side of the building was a small light, and under it hung the effigy of a Spaniard. The ceremonies were conducted by Mr. J. J. Wood, electrical engineer and superintendent of the company. Mr. [illegible] absent, and [illegible] in the [illegible] the pre- [illegible] [illegible]

ST. LOUIS NOTES.

ST. LOUIS, MO., July [illegible], 1898.

[illegible]

[illegible]

THE OPENING of the new plant of the Imperial Electric Light, Heating & Power Company will greatly intensify competition. The new company will start business with 6000 horse-power, and has secured a large number of contracts for the introduction of a new arc light, which will burn 150 hours.

THE SOUTHERN ELECTRIC RAILWAY COMPANY has purchased twenty new cars of the most modern make, and six of them have already been received. Extensive improvements are being made on the company's plant. A new office building will cost $30,000. A new 1500-hp engine, a 1500-hp generator and a battery of Heine safety boilers will be installed. These improvements will cost $130,000. The company's repair shops are also being enlarged.

OUTWITTED.—The Kinloch Telephone Company stole a march on the Terminal Railway Association between midnight last Saturday and midnight Sunday, it is said, and laid three cables across the Eads Bridge. For some time the Kinloch Company has been endeavoring to come to an agreement with the Terminal Association, but as none could be reached it is said the Kinloch officers decided upon the bold piece of work and executed it with rapidity.

CANADIAN NOTES.

OTTAWA, Ont., July 21, 1898.

THE FIRST electric car traversed the streets of the city of St. Thomas, Ont., on July 15. This electric street railway was begun on March 24, and was opened for public travel on July 16. The road is 6 miles long and it cost $80,000.

THE WORKS of the Ottawa Carbon & Porcelain Company are very busy at present. This is the only factory in Canada for the production of electrical porcelain and carbon goods. Ever since its establishment at the capital city it has made steady progress.

HON. JOHN HAGGART, of Perth, Ont., and others have incorporated a company under the name of "The Canadian Electric & Water Power Company," with a capital stock of $150,000, to produce and distribute electricity in Perth, as well as in other towns in the Dominion.

MR. R. ANDERSON, Ottawa, Ont., has moved his office to 150 Canal Street. Mr. Anderson has installed several buildings in Ottawa with iron-armored conduit throughout. These are the first buildings in the city to be so equipped. They include the Russell Theatre, with 1500 lights.

THE OTTAWA CITY COUNCIL has decided to submit the Sunday street car question to the popular vote next January. There are two obstacles in the way of the operation of street cars on Sunday here: One is the prohibitive act of the Ontario Legislature, and the other is a clause in the street railway company's charter forbidding Sunday cars.

A NEW electric power company has been formed here. It will have a capital of $1,000,000. The promoter, Mr. Thomas Lindsay, says: "The company has practically unlimited water power at its disposal. Of course, I cannot disclose the source of power at present, but we have 2000 horse-power to begin with and can easily obtain 5000 more whenever we need it. We intend to supply Ottawa with electricity for light, heat and power. In addition to water power we will have a steam auxiliary."

THE GRAND FALLS POWER COMPANY, of Grand Falls, N. B., in which Sir William Van Horne, Senator Proctor, of Vermont, and Secretary of War Alger are largely interested, have secured additional properties at the falls, necessary to carry on operations, and the announcement is now made that the work of harnessing the falls for saw and pulp mill, electric light and other purposes will begin at once. The company expects to transmit electric power as far as Woodstock and Riviere Du Loup.

THE CARBORUNDUM COMPANY, of Niagara Falls, has commenced the manufacture of its product in Canada under the patent which it holds. It has just erected a new factory building at Niagara Falls, Ont., but the electrical apparatus not having arrived in time for the plant to be utilized in accordance with patent provisions in order to maintain its rights, the company, with considerable enterprise erected a furnace in the power house of the Niagara Falls, Park & River Railway Company, and there made the first carborundum produced in the Dominion.

General News.

THE TELEGRAPH AND TELEPHONE.

CHARDON, OHIO.—The Bainbridge Telephone Company will extend its line to Geauga Lake and Aurora during the present season.

GROVELAND, N. Y.—The Bell Telephone Company has been urged to establish a station in this place. The company asks a guarantee of $300, and it is likely that the merchants will agree to the terms.

ORION, ILL.—The Orion Mutual Telephone Company has completed its lines. Several instruments have been placed in Cambridge, and connections have been made with Orion, Cable, Morristown, Geneseo and other places.

CHRISMAN, ILL.—The [illegible] & [illegible] Telephone Exchange Company has outgrown its present switchboard capacity, and has placed an order with the Sterling Electric Company, of Chicago, for a [illegible]-drop board metallic circuit, of the Bell type.

PLYMOUTH, IND.—The managers of the Plymouth Telephone Company have contracted with the Sterling Electric Company, Chicago, to replace its [illegible] apparatus with two sections of the Sterling Company's standard metallic board, of the Bell type.

LANCASTER, PA.—The City Council has granted a franchise to the Independent Telephone Company, of Lancaster County. The new company will charge $[illegible] a year for a telephone placed in a business house and $18 for private residence instruments. The new company promises to be ready for business in [illegible].

BRIDPORT, VT.—The Champlain Telephone Company has opened an exchange in this place. It has built a telephone line from the lake shore opposite Crown Point to Bridport village, and expects to lay a four-wire cable across the lake and connect with the local exchange at Crown Point. The company will build a line to Middlebury in the near future and connect with the system of the Bristol Telephone Company.

WASHINGTON, D. C.—The War Department received information from the Army Signal officers in Cuba that cable communication is about to be opened in Santiago de Cuba. The French cable office in the city has been closed for some time, the line being under the control of the Americans at the immediate points of Playa del Este and Aguadores. Now that the city has surrendered and the American troops are about to move in and take possession, the army administration recognizes the advantage of establishing cable communication with the city itself.

PASSAIC, N. J.—The Paterson, Passaic & Suburban Telephone Company has begun active preparations to extend its wires to this city, and has leased the old post office building in Passaic Avenue as its headquarters. The company has secured the right to string wires and put up poles in nearly every street in the city, and claims that it will be able to supply patrons with telephone service at a rate cheaper than is now charged by the old company. The city will get the free use of eighteen telephones in exchange for the franchise, besides an annual rental for the use of the streets.

ELECTRIC LIGHT AND POWER.

McARTHUR, OHIO.—The Council has voted to issue $5000 in bonds for an electric light plant.

HOLLAND, MICH.—The municipal electric light plant of this place will be extended at an expense of $3,361.

SHENANDOAH, PA.—The dam on the Susquehanna River at Wrightsville, York County, Pa., has been leased by an electric power company for $75,000.

YPSILANTI, MICH.—The Council has authorized the Board of Public Works to buy a new 50-light dynamo to displace the old one, appropriating therefor $300 and the old machine.

WINNEBAGO CITY, MINN.—At a special election held on July 2 the proposition to issue $8000 in bonds to defray the cost of an electric lighting system was carried by a large majority. The Council will at once take steps to build the plant.

COLUMBUS, GA.—The Columbus Power Company has signed contracts for the erection of a plant which will develop 40,000 horse-power by water power. Mr. H. M. Comer, of the Southern Railroad of Georgia, is at the head of the enterprise.

MERCUR, UTAH.—The transformer house of the Camp Floyd Electric Light Company was totally destroyed by fire recently. It is supposed that the fire was started by lightning. The building was situated close to the Golden Gate power house. The latter, however, was uninjured.

WEST SUPERIOR, WIS.—The Great Northern Elevator system will in the near future operate the machinery of elevators A and X in this city by electric power instead of steam. A power house is being built. It will be 84 x 64 feet in dimensions. The new boiler house will be 77 x 44 feet.

ROCKFORD, ILL.—The real estate, property and franchise of the Rockford Electric Power Company has been purchased by the Rockford General Electric Company, which has the contract for lighting the city. The latter company thus becomes possessor of 2200 additional parts of water, which was much needed.

LONDON, ONT.—Tenders for dynamos, lamps, poles, wiring and all necessary electrical apparatus for the complete equipment of the 350 2000-cp arc light plant, together with the necessary engines, boilers, etc., will be received at the office of Ormsby Graydon, city engineer. Specifications and form of tender can be obtained of Mr. Graydon.

THE ELECTRIC RAILWAY.

BOSTON, MASS.—It is stated that the plans for the structure of the Boston Elevated Railroad Company have been approved by the Massachusetts Railroad Commissioners. Working plans will be prepared at once, and contracts, it is stated, will be let some time within the next thirty days.

PHILADELPHIA, PA.—The statement of the Union Traction Company for the year ending June 30, 1898, shows gross receipts for $10,971,437, an increase of $490,791, as compared with the same item the year previous. Net earnings, $6,515,062, an increase of $284,266. Charges, $6,490,411, an increase of $107,711. Surplus, $24,620, an increase of $876,550.

NEW YORK, N. Y.—"The Railway Age" gives a brief account of a rather interesting episode which occurred at Bordentown, N. J., recently. There was a fight between the Monmouth Traction Company and the Pennsylvania Railroad Company over the erection of a trolley pole. It was claimed that the place where it was intended to raise the pole was on ground belonging to the railroad company. When the pole was raised alongside of the hole the railroad men jumped into the hole, but were promptly yanked out by the trolley men. During a cessation of the hostilities, occasioned by the arrest of several participants, the pole was dropped into place, and a quick-witted trolley employee climbed to the top and unfurled an American flag, which he defied any man to pull down or knock down. Under this protection the post was held for three hours, until legal proceedings determined that it should be erected elsewhere. The flag was then honorably lowered in the same manner in which it had been raised, but while under this protection it is said that no one attempted to lay hands on the pole.

NEW YORK, N. Y.—The directors of the Kings County Traction Company sold at auction a few days ago the entire assets of the company. They were bought by Mr. Harriman, agent of the syndicate formed to purchase them, the price paid being $2,100,000. In 1893 a syndicate bought the old Atlantic Avenue railroad, and organized it to operate what is known as the Brooklyn Traction Company. That company became involved financially, and in 1895 was reorganized as the Kings County Traction Company. On April 4, 1896, the Nassau Electric Railroad Company leased the property owned by the Kings County Traction Company, the capitalization of which was $4,500,000. A syndicate was organized about a year ago to buy up the securities to enable the Nassau Company to obtain complete control of the Kings County Traction Company, and the [illegible] [illegible], interest charges, etc. A minority of the stockholders objected and took the matter into the courts, and delayed the carrying out of the readjustment plans which the Nassau Company had in view until early in June this year, when a compromise was effected. A majority of the stockholders of the Kings County Traction Company decided to dissolve the corporation and sell its assets at public auction. The assets consisted of all the capital stock of the Atlantic Avenue Railroad Company and the Brooklyn, Bath & West End Railroad Company. The Nassau Railroad Company by this purchase obtains control of all the assets of the Kings County Traction Company, and will no longer be compelled to pay $180,000 yearly rental for the same.

LEGAL NOTES.

SPRAGUE ELECTRIC RAILWAY & MOTOR COMPANY V. THE STEEL MOTOR COMPANY.—Following is the opinion of Judge Buffington in the Circuit Court of the United States, Western District of Pennsylvania, in the case of the Sprague Electric Railway & Motor Company v. the Steel Motor Company, asking for a preliminary injunction, which opinion is in favor of the complainant. "The complainant, the Sprague Electric Railway & Motor Company moves for a preliminary injunction against the Steel Motor Company to enjoin infringement of claims two and six of letters patent No. 324,892, issued August 25, 1885, to Frank J. Sprague, for an electric railway motor. These claims were adjudged valid by the Circuit Court of the Second Circuit, and its decree, affirmed on appeal. The validity of the patent having been sustained, an injunction must issue, as the respondent company concedes that exhibits Nos. 1, 2, 3, 5, 6 and 7 infringe the second claim. As to the sixth claim, respondent alleges that the present proofs fail to show in said exhibits the use of all the elements of said claim. We will not pass on that question, as the complainant asks leave to withdraw so much of its motion as seeks for an injunction based on infringement of said claim. Such leave will be given without prejudice to complainant's right to aver and maintain such charge of infringement hereafter. The foregoing enjoined types are what are known as nose-suspended motors. The respondent manufactures motors with side-bar suspensions, and has produced plans and models of two such, known as Nos. 4 and 8, respectively, has submitted them to the inspection of the court and parties, and has urged the court on this present motion to pass on the question whether they infringe. Counsel for respondent allege that complainant's moving papers charge that respondent infringes in the manufacture and sale of said side suspended motors. A careful consideration of the record satisfies us that such charge has not been made on the motion before us by complainant, and that the respondent, not the complainant, has sought to raise that issue. Against action thereon by the court the complainant protests, alleging that, while it regards said types as infringing the patent in suit, it is not willing to have that question passed on in the present motion or presentation by the respondent, and on its models and drawings. We must therefore regard the question as before us wholly and solely at the respondent's instance. Such being the case, we must decline to pass upon it. The practice to the contrary is settled in this circuit—Edison Company v. Westinghouse Company, 54 Fed. Rep., 504. Let an injunction as indicated above be drawn and submitted."

STERNE V. THE METROPOLITAN TELEPHONE & TELEGRAPH COMPANY AND NEW YORK TELEPHONE COMPANY.—The New York Supreme Court handed down on July 18 two opinions in the suit of Simon Sterne against the New York Telephone Company, both in favor of the defendant. It will be remembered that some years ago, when the Metropolitan Telephone Company reconstructed its system and made metallic circuit working the rule, Mr. Sterne refused to allow his telephone line and instruments to be changed to metallic circuit, and when the telephone company proceeded to act upon its right to terminate its contract with Mr. Sterne, the latter secured an injunction restraining the company from interrupting his telephone service, and brought suit to compel it to furnish him service at a rate to be fixed by the court. The injunction was continued pending the trial of the suit, the Metropolitan Company being authorized to change Mr. Sterne's line and instruments to metallic circuit, and he giving a bond to pay the full rate in the event of the case going against him. Some time later the Metropolitan Telephone & Telegraph Company went out of business and sold its plant to the New York Telephone Company, a concern organized to furnish telephone service in a much larger area than that served by the Metropolitan Company. Mr. Sterne subsequently secured an order to bring in the New York Telephone Company as defendant, and it was to that company's motion to vacate the order that one of Judge Kellogg's decisions referred. The opinion states that this was the first opportunity the New York Telephone Company had to be heard in the matter, and that company had the right to expect that its present motion would be considered unprejudiced by any previous determination of the court had in its absence. "The order and the supplemental complaint obviously regard this defendant as a corporate body separate and distinct from the other defendant. It is not the same body under a new name or changed name. It must be regarded as having no legal relations with the other defendant or with the acts of the other defendant except those created by contract with it." The opinion points out that while Mr. Sterne alleged that the New York Telephone Company assumed all debts, contracts and liabilities" binding upon the Metropolitan Company, it is not alleged that there existed any contract with Sterne binding upon the Metropolitan Company. Even construing "liabilities" as the alleged legal liability to furnish telephone service to the plaintiff, the case is no stronger, "for one cannot make more binding his burden by declaring upon paper his intention to perform what the law directs. In no way can it be reasoned that this is a contract liability. If this defendant owes any duty to the plaintiff it is because the law imposes it." After stating that there is no precedent in support of any other contention, the opinion concludes as follows: "The law does not hold this defendant responsible for any alleged wrongful threats of the Metropolitan Telephone & Telegraph Company. That is the cause which enabled plaintiff to bring this action in a court of equity. The cause of action does not in law follow the property; the duty to furnish the service may; when a similar case arises against the new owners it may be held to answer, but I see no ground whatever for the contention that it must answer for the threats of its predecessor in ownership. The motion to vacate is therefore granted, with costs." The second opinion of Judge Kellogg relates to a motion to vacate an order permitting the examination of the officers and books of the Metropolitan Telephone Company to procure testimony, an order in which, by a supplemental complaint, it was sought to bring the New York Telephone Company as successors. The motion to vacate was granted for much the same reason as those given in the previous opinion. The original defendant has gone out of business, and no issue remains between it and the plaintiff. There was no contract between them, and the defendant, therefore, can owe the plaintiff nothing, and does not seek to recover anything. The relief sought by the action is now impossible. The opinion goes on: "By the supplemental complaint the plaintiff seeks to create a living issue with the defendant, the New York Telephone Company, to obtain a substantial judgment, viz.: The judgment he originally claimed against the Metropolitan Telephone & Telegraph Company on the ground that it has succeeded to the property and duties of the last-named company. The fact that plaintiff by order of the court deemed it necessary to bring in this party as a defendant is a sufficient admission that it has a separate entity and is to be treated as a separate and distinct party; as a new party it has a right to be heard on all motions affecting the trial, and especially in motions to examine books and officers to procure testimony to be used at the trial. The order here sought to be vacated as to this defendant is a nullity. The testimony procured under this order could not be read at the trial under any issue formed with the supplemental complaint, and for that reason, in my judgment, the order should be vacated. If the Court of Equity will exercise the right to fix in advance the annual rentals of telephones at the instance of an individual desiring to have his premises equipped with these mechanical facilities it will fix such rentals on a basis of reasonable profits to the company or individual directed to render such service, and this necessarily involves an inquiry into the affairs and business of that particular company or individual. The books of any other company or individual are not competent evidence on such an inquiry; they are not admissions to the party and possess no higher grade in testimony than hearsay. For such reason the testimony sought by this order, even though the order were made on notice, could not be made available as against the New York Telephone Company. I am of the opinoin that the order should be vacated, with costs, and it is so directed."

WESTERN ELECTRIC COMPANY V. MILLHEIM ELECTRIC TELEPHONE COMPANY, ET AL.—Judge Buffington in the United States Circuit Court, Western District of Pennsylvania, has handed down an opinion in the case of the Western Electric Company v. Millheim Electric Telephone Company, et al., in favor of the complainant. The opinion follows:

This is a bill filed by the Western Electric Company against the Millheim Electric Telephone Company, et al., for alleged infringement of letters patent No. 449,106, issued March 31, 1891, to John J. Carty for telephone circuit and apparatus and now owned by complainant. The defenses are lack of novelty and patentability. These defenses failing, infringement is conceded. The apparatus in question was designed primarily for use on a multiple line. Prior to this patent it was customary to connect the call bell magnets at the several stations in series in the main line circuit, together with a normally shunted call sending generator, and at each station to provide a switch, which, when at rest, maintained the continuity of the main circuit through all the call-bell magnets and kept the circuit of the local transmitter battery open. When, however, the switch was changed—which was done when the receiver was taken from the hook for use—it disconnected or short circuited the bell magnet or generator from the line and introduced in place thereof the telephonic transmitting and receiving instruments and closed the local battery circuit of the former. Though this switch change at the two communicating stations removed the bell magnets at such stations from the circuit, no such action took place at the other stations. Consequently the voice current had to [illegible] in the line, and was much weakened, not only by the resistance of such magnets, but also by the counter electro-motive forces or inductive resistances developed in each. These were so active and energetic as to hinder conversation, yet it was necessary that all bell magnets should be connected with the circuit, otherwise the several stations cannot signal each other. It will be noted that in this system, which is called a series circuit, the component parts are so arranged that the current must pass through all its parts, one after another. It is so styled in contradistinction to a multiple circuit, which is one having two or more of its parts so arranged that the current [illegible] the several [illegible]. When incandescent lights are connected in multiple circuit, the current passes to one terminal of each [illegible] and then divides up, [illegible] to the other side of the circuit, where all [illegible] are connected in series, all the [illegible] and out at the other, and [illegible].

[illegible] inductive balance in a metallic [illegible] connected in series, [illegible] generally in [illegible]. Now, it would [illegible] call magnets and [illegible] the manner of the [illegible] The [illegible] third, or telephone bridge circuit, was open when not in use, but closed in multiple arc with its own bell magnet, and, of course, with all others in the line, when in use. When the call generator is used at a station it forms a second bridge or cross connection between the wires in parallel circuit with the permanently closed bridge circuit of its own bell and all other bells on the line. Now, the natural tendency of the ringing current would be to short circuit through its home call-bell bridge and possibly through the nearest other call-bell bridges. This, of course, is highly undesirable, as it is necessary that all of the call bells of the system should be operated by the call generator of each station. The tendency of the current to thus short circuit is counteracted in Carty's system by the high self-induction and impedance of the bell magnet which opposes the passage of the call current and effects a more even distribution of it through the bell magnets of the system. By virtue of numerous windings of the wire in the bell magnets the small portion of the call current passing exerts a marked magnetizing effect on the cores, and thus secures a more spirited working of the call signal. The means employed in the device and the mode of operation is clearly stated by respondent's witness, Mr. Miller, who says:

"I am acquainted with this patent. It shows and describes a method of attaching telephone instruments in multiple between the two sides of a line, whether this line be a metallic circuit or a grounded line. The call bells are each permanently bridged between the two sides of the line, and are made of high resistance and retardation. The generator at each instrument is in a separate bridge circuit, which is normally open, but closed when the generator is operated. The telephonic apparatus proper is in a third bridge circuit, which, like the generator circuit, is normally open. The telephone circuit of each instrument is automatically closed when the receiver is removed from its hook for use, and this operation also closes a local circuit containing the primary of the induction coil, the local battery and the transmitter. In order that there shall not be an undue leakage of the voice currents through the permanently bridged call-bell circuits, the magnets of these call bells are wound to a high resistance (usually a thousand ohms), and are also constructed in such manner that they will have a high co-efficient of self-induction. When a generator at any one station is operated it is connected across the two sides ot the line in parallel with all of the call-bell magnets on the line. Part of the currents in this generator will, therefore, pass through each of the call-bell magnets on the line, thus causing them all to operate if the amount of the current generated is sufficient to accomplish this result. The successful operation of this system depends on the fact that a coil possessing a high co-efficient of self-induction will transmit with comparative ease alternating or pulsating currents of low frequency, while it will form a practical barrier to similar currents having a very high frequency. The currents generated by the calling generator at any station are of sufficiently low frequency to pass with comparative ease through the call-bell magnets arranged along the line, while the rapidly alternating voice currents impressed upon the line by the telephonic apparatus at any station will be compelled to pass over the main line to the receiving station without being materially weakened by leakage through the call-bell magnets. At the receiving station these voice currents will pass through the telephone receiver and secondary coil of the induction coil, these being connected across the line at that station by virtue of the receiver being off the hook. This path through the receiving instrument is of comparatively low resistance and retardation, and thus practically takes all of the current from the distant station."

As we have stated, the patent is assailed as lacking novelty and patentability. The grant of this patent is prima facie proof of the novelty and patentability of the invention therein disclosed (see Seymour v. Osborne, 11 Wallace, 516, and cases in note to 3 Robinson on Patents No. 1016), and in absence of countervailing proof to the contrary its prima facies must prevail. An examination of the many alleged anticipations does not disclose the particlar combination here shown, or overcome such prima facies. If any or all of them might have suggested a combination of means and the placing of them in the relation shown in the device it is not proven that any one so placed them. None of the elements composing the combination are in themselves claimed to be new. It is the combination of them in new relations and the securing a new and useful result thereby that constitutes the basis on which the patent rests. It goes without saying that if each element of the combination can be found in the old art, if all of them abstractedly and separately considered perform the same function they did in the old art, this will not tend to defeat the patent if the old individual elements are here brought into novel combination with each other and their conjoined functions produce a new result. Such novelty, if the change involves patentability, constitutes ground for a valid patent. It follows, therefore, that to find in the prior art each element in isolation is not to anticipate the work of a patentee who, by the inventive act first evolves combination out of isolation. In discussing the prior art, Mr. Miller, after describing the working of Carty's device, as we have quoted, says: "I find the principles governing the effects of coils having a high co-efficient of self-induction upon currents of high and low frequencies to be very clearly stated in various text books and patents prior to the filing of Mr. Carty's application. The critical and intelligent analysis of the prior art by Mr. Miller warrents that conclusion, but it by no means follows that knowledge of those principles is an anticipation of a combination wherein those abstract principles are used in new concrete relations and thus made to produce new results.

After discussing the alleged anticipations and concluding that none of them covers the device of Carty, the decision concludes as follows.

Being therefore of opinion that the defenses alleged have not been made good a decree should be prepared in favor of the complainant.

[illegible] & Brown for complainant.

Stanley S. Stout for defendant.

OBITUARY NOTES.

DR. A. EVERETT, well known in connection with street railway interests in Cleveland, Ohio, died at his home in that city on June 17. Dr. Everett was born in Liberty Township, Trumbull County, Ohio, on November 24, 18[illegible]. He acquired control of the East Cleveland Railway in 18[illegible], and remained closely identified with the company until 1893, when it was consolidated with three other companies, forming the Cleveland Electric Railway Company.

MR. ALBERT VICKERS, well known to the readers of THE ELECTRICAL WORLD through his contributions published in that journal within the past two or three years, died suddenly at Punta Arenas, Chili, on May 17 last. Mr. Vickers was born in Brooklyn, N. Y., on August 30, 1868, and removed to Baltimore eleven years later. He graduated from the Baltimore public schools and entered Cornell University, graduating in 1889. He was electrical engineer for the Syracuse Consolidated Street Railway Company, which position he held until that company was merged in the present railway system in that city. He afterward engaged in general electrical engineering and constructing on his own account. In 1897 he was in charge of an electric railway in Tonawanda, N. Y., afterward becoming electrical engineer of the Great Northern Elevator at Buffalo, N. Y. Mr. Vickers sailed for Chili in March, 1898, having been engaged to construct a lighting and hydraulic plant for the Punta Arenas Electric Lighting Company. Shortly after his arrival there (on April 29) he was taken ill with congestion of the liver, from which he died. His wife and two children survive.

EDWARD DEXTER BROWN.--Corporal Edward Dexter Brown, of Troop C, National Guard of New York, died at the Post Hospital at Fort Meyer, Va., on July 2, of typhoid fever. Mr. Brown was widely and well known in electrical circles. He was born at Reading, Mass., August 26, 1868. After his graduation from the Massachusetts Institute of Technology in 1890, he entered the engineering department of the American Electric Telephone Company, where he distinguished himself by his fertility of ideas and close application to business. In September, 1891, he entered the employ of the American Telephone & Telegraph Company as a special inspector, passing thereafter through the positions of New York manager, district inspector, to that of general inspector, which position he held at the time of his resignation to enter the service of the United States Government. Mr. Brown was one of the most expert telephonists of his time, and was a member of various technical societies and social clubs. He enlisted in Troop C, National Guard of the State of New York, as private in 1897, and was one of the first to answer the first call for volunteers for service during the present war, being mustered in on May 22 last. He was made a corporal shortly before his troop left for Camp Alger. On June 29 he was stricken with the disease which caused his death. His widowed mother, a brother and sister survive him.

Trade and Industrial Notes.

MESSRS. J. JONES & SON, 66 Cortlandt Street, New York City, report the receipt of a large foreign order for goods of their manufacture, which will keep their factory busy for some weeks to come.

THE CENTRAL ELECTRIC COMPANY, Chicago, reports a brisk trade in lightning arresters. It is issuing some very attractive circulars on the Wurts arrester, also the Garton arrester.

MESSRS. HUEBEL & MANGER, Brooklyn, N. Y., have in preparation a new catalogue which they expect to issue soon and which will show all the late additions to the firm's well-known line of manufactures.

THE FITCHBURG STEAM ENGINE COMPANY, Fitchburg, Mass., has recently completed the erection and put into operation a very heavy 600-hp cross-compound engine for the Fitchburg & Leominster Railroad Company.

THE STERLING ELECTRIC COMPANY, Chicago, Ill., is working overtime to complete its order of 1000-drop equipment for the Lafayette Harrison Telephone Company of Lafayette, Ind. This equipment includes the switchboards, distributing boards, cable terminals and protectors.

THE BALL ENGINE COMPANY, Erie, Pa., has recently received an order from the Carolina Light & Power Company, Aiken, S. C., for a 250-hp cross-compound engine, and one from the city of Elkhorn, Wis., for a 135-hp compound condensing engine for the electrical plant. The engine for the Carolina Company is to be added to the present power plant.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is very proud of the fact that it will soon complete the seventh year of its electrical supply business. The company claims that after confining itself strictly to the electrical supply business during this period, it should be in the best possible position to make a success of it. It is apparent from the volume of business it is now doing and its position in the electrical field that it has been very successful thus far in its career.

THE BERLIN IRON BRIDGE COMPANY, East Berlin, Conn., is to construct for the New Haven Gas Light Company, New Haven, Conn., in connection with its station, a fire-proof coal shed 500 feet long and 60 feet wide. The framework of the building is to be steel throughout, and so arranged that the coal cars may be brought into the building on a track supported by the roof trusses. By so doing maximum storage room will be provided with the least possible expenditure of power and space.

IMITATING PACKINGS AND PACKAGES.—Many engineers have complained to the Garlock Packing Company, Palmyra, N. Y., that various manufacturers are not only imitating its packings, but also the boxes and labels. Some of these cases of imitation are flagrant, and they testify that either the goods or the packages they imitate are superior to their own. All Garlock packings are packed in boxes and have a yellow label with the trade-mark printed in red. The Garlock Company has always maintained a high standard of excellence in the manufacture of its sheet and piston packings, gaskets, etc. All of these packings are of high grade, and have been favorites with engineers for the past eighteen years.

THE MOTOR SUSPENSION CASE.—The Walker Company is sending out a circular letter in which it makes a statement in reference to the letter of the General Electric Company, concerning the recent decision of the United States Circuit Court of Appeals on the motor suspension patent issued to Frank J. Sprague. The Walker Company states that the motor suspension now used by it is not the suspension that came to trial, and that the statement that practically every form of motor suspension now in use is an infringement of patents controlled by the General Electric Company, is erroneous. In its circular the Walker Company briefly indicates the points of difference between the two methods of suspension.

THE LEATHER PRESERVER MANUFACTURING CORPORATION, 27 West Monroe Street, Chicago, Ill., has a method of extracting every particle of oil, dirt and grease from leather belts without injuring the leather or cement. It is a well-established fact that if a belt can be freed of these undesirable substances and kept clean it will last much longer and give better satisfaction than it would if not so treated. In use a belt naturally becomes clogged with grease, dirt and compound applied to prevent slip. When the pores of the belt become clogged, the leather itself naturally becomes hard and eventually cracks and breaks. By the system of this company all of these foreign substances may be extracted from the belt, and its life extended.

THE AMERICAN IMPULSE WHEEL COMPANY, New York, states that it is making steady headway with its improved water wheel, and that it is attracting considerable attention in this and foreign countries. Beside wheels shipped to various parts of the United States and reported giving most favorable results the company has wheels installed in Japan, France, Sweden and Scotland. Among contemplated large power and transmission plants in Utah, Canada, Montana and Minnesota, this company's wheels are being given serious consideration, and the company has reason to confidently expect their adoption in several instances. The company claims to give particular attention to the mechanical design and construction of its wheels to secure the highest efficiency, giving special attention to regulation. Mr. Thorburn Reid is consulting engineer of the company.

THE STOREY MOTOR & TOOL COMPANY has moved its main office and factory from Philadelphia to 464 South Broad Street, Trenton, N. J. This change has been made necessary by the greatly increased demands for the electrical machinery of this company's manufacture, particularly its multipolar, entirely inclosed, dust and moisture proof motors. The motors manufactured by the Storey Company have been improved both mechanically and electrically. They are of light weight, high efficiency, slow speed, and their special form makes them particularly adapted to all classes of direct connection to machine tools, hoists, cranes, etc. With its increased facilities the company will place upon the market its open-type machines for all classes of standard work, together with several lines of specialties which up to the present time it has been unable to bring out. Within a short time the company expects to have everything running in proper order, and will be pleased to hear from any of its old customers or give any information regarding its machines.

THE AMERICAN STOKER COMPANY, New York, has issued a very handsome catalogue describing and illustrating very completely the American stoker. This company started three years ago with what it thought to be a good thing. It has since proved to be good, and that the company's customers are well aware of this fact is substantially evidenced in the pamphlet. The construction and operation of the stoker is very clearly described, and its application to steam boilers of every type is very artistically illustrated. The practicability of any stoker, after all, depends upon its cost of maintenance, and it has been found that the steam used in actuating the motor on the American stoker is less than 12-100 of a horse-power, and adding to this the steam used in the operation of the blower, the charge for the operation of a stoker equipment can be estimated at about 1½ per cent. of the steam made. To this add the reduced cost of firemen for hand firing, and the total cost is claimed to be far less than that of ordinary hand firing.

Business Notice.

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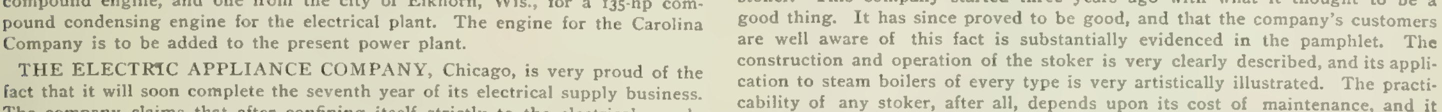


UNITED STATES PATENTS ISSUED JULY 19, 1898.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

607,451. ELECTROMAGNETIC MOTOR; A. B. McMillan, of New York, N. Y. App. filed July 7, 1897. The combination with a motor having an armature and field magnet, of a secondary armature with closed circuit in a rotary field of force produced by the rotating element of the motor.

607,540. ELECTRICAL RESISTANCE; H. S. Chase, of Boston, Mass. App. filed Jan. 11, 1897. In an electrical resistance device, the combination of a resistance loop having its ends secured to terminal leads, which are bound together but capable of easy separation, and an enamel envelope surrounding and insulating the resistance loop.

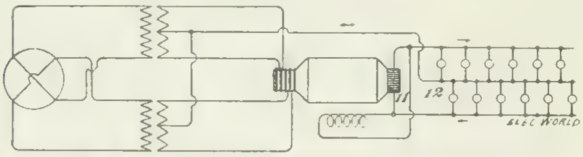
607,551. ELECTRIC REGULATOR; J. A. Powers, of Lansingburg, N. Y. App. filed Oct. 28, 1897. A fluid rheostat or variable resistance, comprising in combination two receptacles containing a conducting solution and communicating at different levels, means for cooling the solution in one receptacle, separable plates in the other, and a solenoid and core for varying the distance between said plates.

[illegible]. ELECTRIC ARC LAMP; J. H. Haines, of New York, N. Y. App. filed Oct. 29, 1896. In an electric arc lamp, a tilting clutch provided with a raceway on its inner periphery, and a series of balls located in said raceway.

607,590. GALVANIC CELL; A. Heil, of Frankisch Crumbach, Germany. App. filed Dec. 1, 1897. A galvanic cell, comprising a carbon electrode surrounded by about equal parts of volume of graphite, manganese peroxide and lead peroxide, a zinc electrode and an absorbent filling holding an electrolyte of zinc sulphate containing flocks of hydrate of zinc evenly distributed throughout the mass of said electrolyte.

607,593. DYNAMO ELECTRIC MACHINE; W. B. Sayers, of Glasgow, Scotland. App. filed Dec. 21, 1897. In a dynamo electric machine, the combination with an armature and field magnet, having two or more poles of a corresponding number of pairs of reversing pole pieces, the pole pieces of each pair being arranged at opposite sides of the corresponding field magnet pole, and arranged in proximity to the armature core, so as to be magnetized thereby when a current is flowing through the armature winding.

607,608. RHEOSTAT; M. J. Schiels, of Westfield, N. J. App. filed Jan. 7, 1898. In combination in a rheostat, the coils thereof, a casing within which the said coils are contained and supported, part of the said casing consisting of a plate or body of insulating material and the remainder of heat conducting material, a plurality of switch contacts mounted on the said body or plate, a plurality of terminal connections from the said coil to said contacts, insulating cement within the said casing embedding the said coils and extending between the said coils and the said casing, and a movable contact arm and connections.

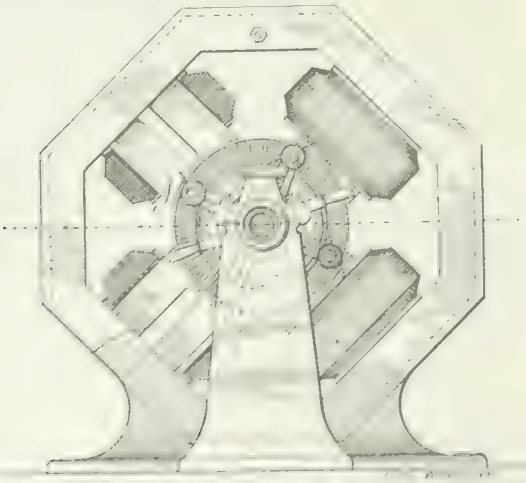


No. 607,621.—System of Electrical Distribution.

607,609. FIELD MAGNET FOR ELECTRIC MACHINES; S. H. Short, of Cleveland, Ohio. App. filed May 4, 1896. In an electric machine, cores or supports for the field magnet windings, each comprising a series of plates or laminations, whereby the continuity of the end surface of such cores is broken, in combination with a ring of magnetic material arranged to surround the armature end of each of said cores or supports.

607,610. ELECTRIC RAILWAY SYSTEM; S. H. Short, of Cleveland, Ohio. App. filed May 24, 1897. In an electric railway system, a normally open main supply circuit extending throughout the length of the road, a normally open auxiliary circuit also extending throughout the length of the road, a series of contacts arranged in the roadbed, adjacent contacts of said series being respectively connected to the positive and negative wires of the auxiliary circuit, and means arranged solely in said auxiliary circuit connections and actuated by the closing of the circuit between adjacent contacts of said series for closing said main circuit.

607,611. ELECTRIC RAILWAY SYSTEM; S. H. Short, of Cleveland, Ohio. App. filed July 9, 1897. In an electric railway system, a roadbed, a sewer or drain pipe, a box or casing arranged in said roadbed and in communica[illegible] said box or casing having an opening therein, a contact of smaller size than said opening arranged to



No. [illegible].—Dynamo Electric Machine.

[illegible]

[illegible]

[illegible]

607,621. SYSTEM OF ELECTRICAL DISTRIBUTION; B. G. Lamme, of Pittsburg, Pa. App. filed Jan. 28, 1897. The method of supplying three-wire direct current systems of distribution with energy from alternating current transformers, which consists in transforming the alternating currents into direct currents for the main direct current conductors and effecting the transfer of energy necessitated by inequality in loads to and from the middle point of the secondary of the alternating current transformer.

607,638. ELECTRIC LINE SWITCH; A. B. DuPont, of Detroit, Mich. App. filed Aug. 12, 1897. In a switch for electric conductors, the combination of a pivoted tongue, a magnet and spring for controlling the position of the tongue, a ribbed section, connected through the magnet coil with the main conductor, at each end of the tongue and roofs protecting the tongue, ribbed sections and magnet.

607,672. CONTROLLER; T. von Zweigbergk, of Cleveland, Ohio. App. filed April 8, 1898. In a controller, in combination, a suitably supported vertical strip having slots through it, a plurality of horizontal boxes carried by said strip on one side and near said slots, coils of metallic ribbon within said boxes having their ends passing through said slots and connected up on the other side of said strip.

607,697. ELECTRIC RAILROAD; C. A. Myers, of Atlantic City, N. J. App. filed Nov. 18, 1897. A track rail, comprising two sections spaced apart and forming opposite walls of a conduit, the tread of one section being below the plane of the other section tread, an insulating material arranged in a groove in the under side of each section tread, and conductors for electricity, supported by the insulating material.

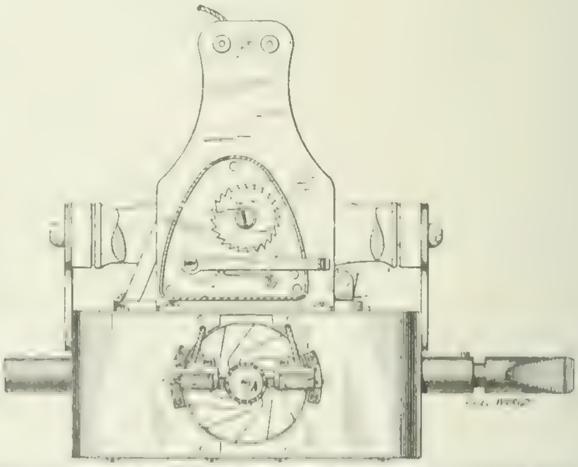
607,715. VOLTMETER; J. F. Stevins, of Philadelphia, Pa. App. filed April 22, 1897. The combination in a voltmeter of a working coil, and a resistance coil connected in shunt across the terminals of the working coil, said resistance coil being provided with means for increasing the impedance in greater proportion than the resistance.

607,737. DYNAMO ELECTRIC MACHINE; A. G. Eigner, of St. Petersburg, Russia. App. filed May 7, 1898. A field magnet for dynamo electric machines, said field magnet being formed of separate complemental members joined together, each of said members having projections adapted to co-operate with similar projections on another member to form complete polar projections, said complemental members being magnetically separated from one another.

607,745. ELECTRIC BUOY; E. W. Gustav C. Hoffmann, of Charlottenburg, Germany. App. filed May 28, 1896. The combination in a submersible marine appliance, with a water ballast chamber, of a pump associated therewith, a reversible electric motor actuating said pump and adapted to effect the entrance of water to or the expulsion of water from said chamber, according to the direction of rotation of said motor, and means controllable from without the appliance for effecting the actuation of the motor and pump.

607,746. BOND FOR ELECTRIC CONDUCTORS; S. W. Huff, of Baltimore, Md. App. filed Aug. 29, 1896. A bond for making electrical connections formed of flat metal and comprising a body portion and an integral external extension bent about an axis transverse to the body portion into a tubular attaching lug projecting laterally from the flat body portion.

607,760. CIRCUIT ARRANGEMENT FOR ELECTRICAL APPARATUS; J. Miesler, of Vienna, Austria-Hungary. App. filed Dec. 13, 1897. In a system of electric lighting, the combination with common mains or con-



No. 607,7[illegible].—Apparatus for Cleaning Paint from Ships.

[illegible] lighting circuits connected in multiple [illegible], each of the [illegible] being provided with a group of lamps, and [illegible] connected in series therewith, like [illegible] being connected with a common main, and a plu[illegible] connected in said system and adapted indi[illegible] circuit of the apparatus connected between the [illegible]

[illegible]. APPARATUS FOR CLEANING PAINT FROM SHIPS; W. P. [illegible], of New York, N. Y. App. filed [illegible]. In combination, the [illegible] therefor, the said tool [illegible] of the said motor through the tool [illegible]

[illegible] D. [illegible], of London, [illegible]. In a [illegible], the combination [illegible], of an attached lining of [illegible]

The Electrical World.

VOL. XXXII. NEW YORK, AUGUST 6, 1898. No. 6.

PUBLISHED EVERY SATURDAY BY

THE W. J. JOHNSTON COMPANY,

9 Murray Street, New York.

Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York.

New England Office, 620 Atlantic Ave., Boston.
Western Office, 936 Monadnock Block, Chicago.
Philadelphia Office, 929 Chestnut Street.

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THE ELECTRICAL WORLD,

9 Murray Street, New York.

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ELECTRICAL SWINDLES.

One of the most astonishing things in the world is the gullibility of people who ought to know better. Periodically the newspapers are filled with accounts of the sharp practices of swindling concerns, but despite the warnings contained in so many exposures the public continues to furnish victims and the confidence men keep on fattening upon them. Most unfortunately the electrical field has been chosen of late as the favorite theatre of operations for a class of swindlers whose victims are too frequently the last people who would be supposed to lend ear to their tales. This has been notably illustrated by the class of persons defrauded by the "electric sugar refining" steal, of unsavory memory, and those who are to-day finding themselves victims of the latest ingenious confidence game—the electrolytic extraction of gold from sea-water.

The history of this scheme is somewhat interesting. It has been for a long time a matter of common knowledge that sea-water contains gold, in the proportion of about one-half grain to the ton. This fact has been regarded as a curiosity of statistics, since it is obvious that no process for the extraction of the gold could possibly pay for the handling of the vast masses of water in which it is dissolved, until a clever swindler conceived the idea of combining this piece of information with the general faith in the ability of electricity to do anything difficult and uncommon, and to float the shares of a corporation for the extraction of the gold from the bulk of raw material in easy reach. It is needless to say that the company was capitalized for an enormous sum, that the shares were of small face value so as to attract small investors, and that the "process" was secret. A factory was erected at a small town on the coast of Maine, "so that the fall of the tide might be utilized," and operations commenced. Weekly a "gold brick" was sent to the offices of the concern in Boston, and subscriptions to the stock increased apace until the sudden flitting of the chief promoter and head charlatan with the available funds of the concern one day last week.

There are just two points about this sort of thing that merit close attention. The first is that the people who lose by such swindlers have no one but themselves to blame. The trouble with most people is a prodigal sense of self-sufficiency. While very few people would embark upon litigation without a lawyer, or fail to send for the doctor if they fell sick, nearly every average man is willing to go into a speculation in some "electrical" scheme without the advice of a competent engineer. The small fee required for the examination of the prospectus of this last swindle by an engineer—for his examination would have extended no further—would have saved many investors their fortunes and many perfectly innocent and honest people, who were beguiled into appearing in various responsible capacities in connection with the electric sea-water business, their reputations. The most evident moral of the totally immoral proceedings of the sea-water-gold concern is that it pays to consult an engineer before embarking upon an electrical business.

The second point is that the continual appearance and exposure of electrical frauds is detrimental to every honest and respectable electrical enterprise. The majority of these fraudulent schemes are self-evidently such, as, for example, the power-multiplying device recently exploited and [illegible] that not only the technical press, but those engaged in any branch of the industry, should wage unceasing war. They should be exposed before the harm is done, not afterward. There is no public service that can be rendered by the members of the electrical fraternity greater than the stamping out of the charlatans who bring it into disrepute and the swindlers who use the legitimate triumphs of science to mislead and rob the public. The public cannot protect itself from these thieves, because it does not know how; those of us who do know how can protect not only the public, but ourselves as well, by combining for the exposure and prosecution of all sorts of electrical fakirs. There are some shining marks for preliminary target practice.

SWITCH CONTACTS.

With the small powers used in earlier electrical work, almost any sort of a contact in the circuits would serve and its disadvantages would not be recognized by the crude means of measurement then available, but with the enormous machines of the present day, even at comparatively high voltages, it is found to be a difficult matter to get contacts which are frequently opened and closed to carry their heavy loads satisfactorily. As with many other types of electrical apparatus, the heat radiating surface of switches does not increase in proportion with the amount of material in the instrument, while, on the other hand, the heating effect tends to increase as the square of the current used. The maintenance of a good firm contact over the whole surface of switch blades, clips and hinges becomes more difficult as the size increases, owing to the greater stiffness and inelastic rigidity of the parts.

The experiments of one prominent construction house in this particular field have shown a most surprising opportunity for improvement over the standard form of switch blade and clip of American practice. The simple substitution for flat clips and hinges of dished washers split radially at several points with their concave side pressing against the switch blade has reduced the heating effect and consequently increased the capacity of switches of given weight surprisingly, and this improvement is apparently not a very near approach to an ideal construction. The ordinary switch blade, after being opened a few times under load, becomes burned, the resulting burr holding the clips away from the blade by a very small distance perhaps, but sufficient to reduce the conductivity greatly. The independent sectors of a washer split as described can each bear upon the blade of the switch independently, and but one of them is likely to be seriously burned. An ideal construction would be, if it were possible, one similar to a contact universally used in one prominent type of circuit breaker, namely, from a solid copper plate to the tips of a large number of thin, hard rolled copper leaves, each one of which is brought to bear by its own natural spring. Switches approximating such a construction are quite widely found on English switchboards, although practically unknown in this country.

THE GROWTH OF THE ACETYLENE INDUSTRY.

In spite of the hue and cry raised by its opponents as to its danger--a case in which "history repeats itself"—the new illuminant, acetylene, is developing a field for itself with surprising rapidity. [illegible] production would give a paying day load to central stations, is apparently of no practical application, the extremely high cost of central station power, even under this favorable condition as compared with power generated in large quantities at water falls, necessitating the location of carbide works at the latter points. The [illegible] Niagara Falls, was not considered a small one at the time of its construction, but the new one of the Union Carbide Company at [illegible]

As with most new industries, and noticeably with the production of new illuminants, the processes are found quite dangerous at first until experimental work has developed means for avoiding the dangers. The National Board of Fire Underwriters has approved a new set of rules relative to acetylene gas, the most strict of which appears to be one requiring the location of the generating and gas-holding apparatus, when installed for the lighting of buildings in districts closely built up, in separate fire-proof buildings. No distance between these and other buildings is required, and conformity with the few simple rules eliminates all extra risk and consequent increase of insurance rate. The ability to use a local generator for each installation was advocated as a great advantage at first, but from present appearances will not find any general application, except in the cases of isolated premises separated long distances from their neighbors. It appears that acetylene is more likely to be centrally generated and distributed, just as ordinary illuminating gas is at present. In fact, one town in Connecticut has already commenced the distribution of acetylene in its existing gas mains, and others are about to take the same step. Small generators are, however, applicable, as shown by the extreme case of bicycle lamps, which are already highly successful and widely used, some 60,000 being already in service.

As a competitor in the illuminating field acetylene will probably be a greater rival of illuminating gas than of electric current, and it is possible that its success will be of more benefit than harm to the latter. It is the old story over again of one rival stimulating another in competition, and by means of improved service and reduced cost increasing the demand by an amount greater than its own supply. Illuminating gas, electric lighting and acetylene all have their own individual advantages which to a certain extent outline certain fields of application of each in which the others cannot compete. For vehicle lighting, including train lighting, and for gas distribution where but a small percentage is used for fuel, acetylene will probably show advantages over other forms of gas; while for combined heating and lighting service frone one system, illuminating gas cannot be met by either acetylene or electric current, but for isolated plant service, theatre lighting and all cases where ease of control from a distance, or convenience of ignition, or adaptability to special decorative effects, are of any importance, the electric current has the advantage. It cannot be met by its competitors in the qualities of safety, neatness, cleanliness, convenience and elegance.

An odd reversal of conditions in the central station field is likely to be caused by the competition of this new illuminant. Heretofore the distribution of power has been taken up as an accessory to the distribution of light from the same installation and preferably of late from the same machines and lines. The convenience of this combination may soon be recognized as a strong advantage of the electric light over the acetylene light.

The acetylene flame, like that of the Welsbach incandescent gas burner, has a high intrinsic brilliancy and its general use will bring into contempt the red gas flame and incandescent electric light of low efficiency and consequently of low brilliancy. The public will demand all the more a white hot filament, and central stations should look closely to their reputation in this regard. Those stations running with poor regulation and poor lamps looking often like red-hot hair pins will suffer most from this new competition. By greater care in construction on the part of the lamp manufacturers and in regulation on the part of central station engineers, combined with [illegible] where they show [illegible] new competitor can [illegible] more good than harm.

The New Plant of the Union Carbide Company at Sault Ste. Marie, Mich.

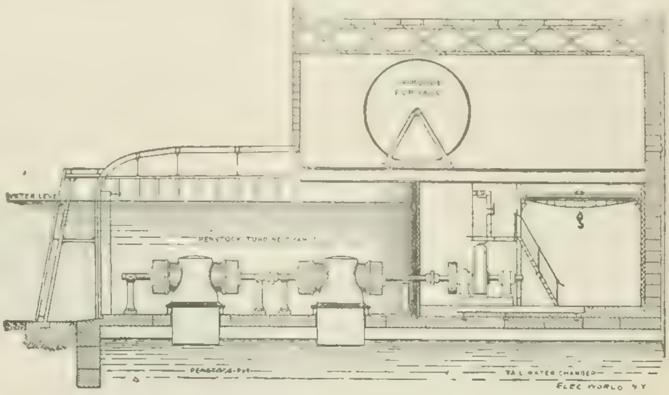
THE demand for acetylene gas and hence for its essential material, carbide of calcium, has increased during the last year at such a surprising rate that the Union Carbide Company has started the construction of a new plant, of which the part now under way will have a capacity many times that of all existing plants in the United States. Before taking up a description of this new equipment it may be well to describe the relationship of the different companies promoting the acetylene industry in this country, these companies having been reorganized a few months ago.

The Electro Gas Company, with offices at 45 Broadway, New York City, is the parent company, owning the fundamental patents of Bradley as well as those of Willson, but this company does not itself engage in the industry, licensing the sub-companies mentioned below. The officers of the Electro Gas Company are Charles F. Dieterich, president; A. B. Proal, secretary and treasurer; and E. Stein, general manager.

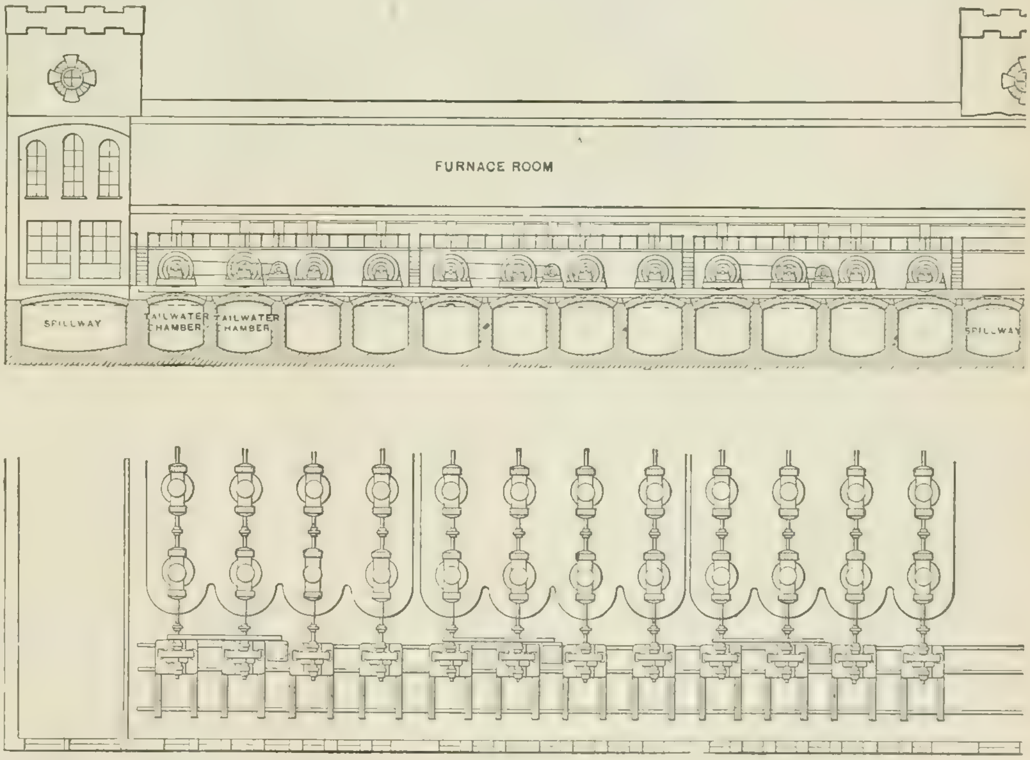
The Union Carbide Company, New York and Chicago, controls exclusively the manufacture of calcium carbide in this country, having purchased the licenses and works of the Acetylene Light, Heat and Power Company (these being the famous works at Niagara), those of the Lake Superior Carbide Company at Sault Ste. Marie, Mich., and also those of the Illinois Acetylene Company at Appleton, Wis. The president and secretary and treasurer of the Electro Gas Company mentioned above also occupy the same positions with the Union Carbide Company, Mr. Stein being the manager of the Eastern and Export Sales Department of the latter. Beside these two companies there is the Electro Lamp Company, which manufactures portable acetylene lamps and controls the sale of carbide for such lamps.

The manufacture of the carbide has heretofore been largely carried on at Niagara Falls, the plant there being capable of an output of 10 tons of carbide each twenty-four hours. This output is not nearly sufficient to supply the growing demand, and the Union Carbide Company, finding itself many months behind its orders, has contracted for a plant at Sault Ste. Marie, whose initial output will be ten times that of the Niagara plant and which will be capable of an extension to several times that size, as the demand for carbide becomes greater. The present plant at the "Soo," which was described in these columns,* consists of a small plant equipped with five of the carbide furnaces designed by Mr. W. S. Horry. This plant is on the American side and is supplied with power from turbines driving Horry generators in the pulp mill of the Lake Superior Power Company on the Canadian side. The new plant, the hydraulic part of which is being built for the Carbide Company by the Lake Superior Power Company, under the supervision of Mr. F. H. Clergue, will be located entirely on the American side, the furnaces being immediately over and within a few feet of the generators, so that there is no necessity of any transformation to and from high voltage for transmission purposes.

The plant will be situated on the shore of the St. Mary's River, through which Lake Superior empties into Lake Huron, and about 3000 feet below the foot of the rapids over which the enormous discharge of water tumbles with a fall of 19½ feet. The power canal is about 11,000 feet long, taking its water about 1000 feet above the rapids and above the opening of the American ship canal immediately beside the rapids, through which the enormous tonnage passing from one lake to the other is locked. The canal is designed for an ultimate development of 40,000 horse-power, with an effective head of 16.2 feet at the power house. The built-up nature of the adjoining property making the use of a very wide canal out of the question, a canal velocity at full load of 7.5 feet is being planned for. This requires a cross section of 4200 square feet. For 2800 feet the canal is in rock with a rectangular prism 200 x 22 feet, the sides being channeled. The rest of the canal is in sand, gravel and clay, with a trapezoidal prism 22 feet in depth, 175 feet wide at the bed and about 220 feet at the surface, with bed and slopes protected by a timber revetment, the whole closely floored with planking. Above the water surface the slopes will be stone paved. The canal will be widened out at its lower end to a forebay 1400 feet in width, its long side shut off from the river in front of it by the long power house described below. The depth of the forebay back from the power house will be from 150 to 300 feet. The sloping banks will be timber revetted, as will those of the canal.



Cross-Section of Power House.



Plan and Elevation of Three Sections of the Power House.

The portion of the power house now in course of construction will be capable of containing forty generators and sixty electric carbide furnaces, eighty turbine wheels and the necessary supplementary electrical machinery, switchboard facilities, etc. The building will consist of two stories above the tail water chamber. The lower story, which is below the upper water level, contains the penstock turbine chambers, the generators, exciters and switchboard gallery. The upper story is devoted entirely to the carbide furnaces.

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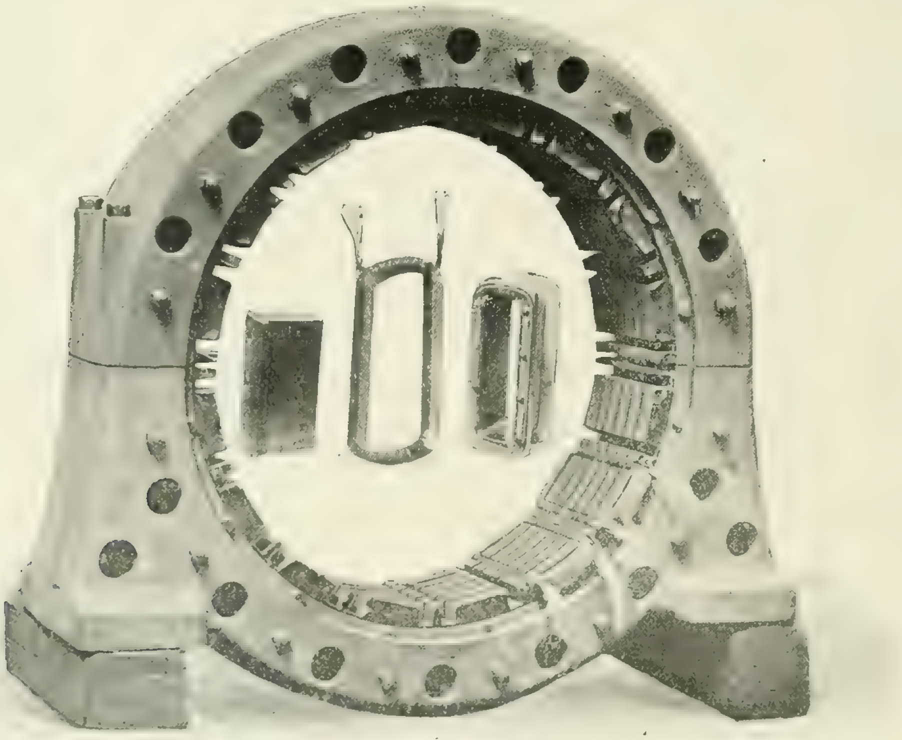
*See The Electrical World, June 25, 1898, pp. 770 and 781.

The turbines are arranged in groups of four sets in each chamber. Each of these sets consists of two pairs of wheels, with central discharge direct coupled to a generator by a horizontal shaft passing through the bulkhead. The arrangement may be easily seen from the drawings accompanying this description.

The generators are arranged in groups of four, each group having a 100-hp direct-current generator as exciter, driven by a belt from a pulley on one of the main shafts. Above the generators is the switchboard gallery, each generator having immediately over it its own panel, which is fitted with a voltmeter, ammeter and integrating wattmeter, so that the total electrical output of each machine may be read at any time.



Stationary Armature Ring and Detail Views of Field Core, Armature Coil and Field Spool.

The leads from each generator are carried directly up to the corresponding switchboard panel, and the panels are connected together by massive bus bars of 2½ inches by 2 inches copper, in order to carry the enormous current which is used in the furnaces. In practical operation the generators will be connected up in sets of four in multiple, and the combined output of these four machines is sent directly from the bus bars at the back of the switchboard up into the furnaces on the floor above.

The arrangement of the furnace room corresponds to that of the generator room below it. For each four generators there are six furnaces, but four being in operation at one time, the other two being reserve. These "Horry" furnaces, so called from their inventor, W. S. Horry, are of the continuous type. Each consists of a huge short cylinder, mounted to revolve slowly on a horizontal shaft. The periphery of this cylinder is closed by a number of cast iron slats, which are readily removable, so that the upper part of the furnace may be left open. The drum thus formed, a view of which is shown in the initial illustration, has [illegible]

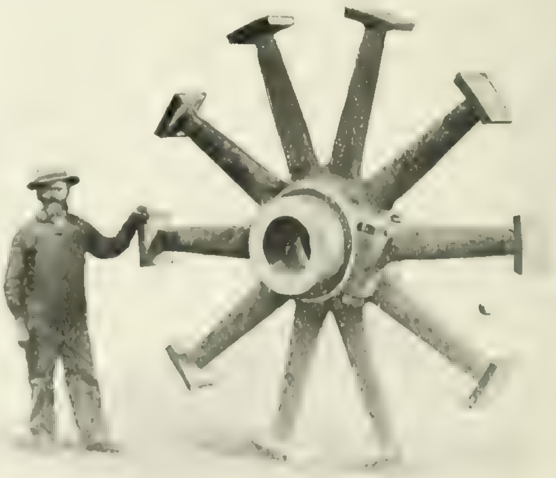
[illegible]

[illegible]

point of view is the battery of Walker alternating-current dynamos, which will generate the current. The machines themselves form, it is said, the largest single order for alternating machinery ever placed. The generators are of 500 horse-power, or 375 kilowatts each. They are of the single-phase,unitooth, 60-cycle, internal revolving field type, and are to run at 240 revolutions per minute. Each machine will deliver about 2000 amperes at 200 volts pressure.

It should be noted that they differ from the type previously used by the Walker Company, which comprised a field ring excited by a single-coil concentric with the shaft, this style being generally designated by the name of the company which first developed it for the now classical Lauffen-Frankfort experiment—namely, Messrs. Brown, Boveri & Co. The new type follows closely standard American practice, each pole having its own exciting coil.

The leads from these machines go directly to the switchboard without a sliding contact of any kind, the fields being excited by



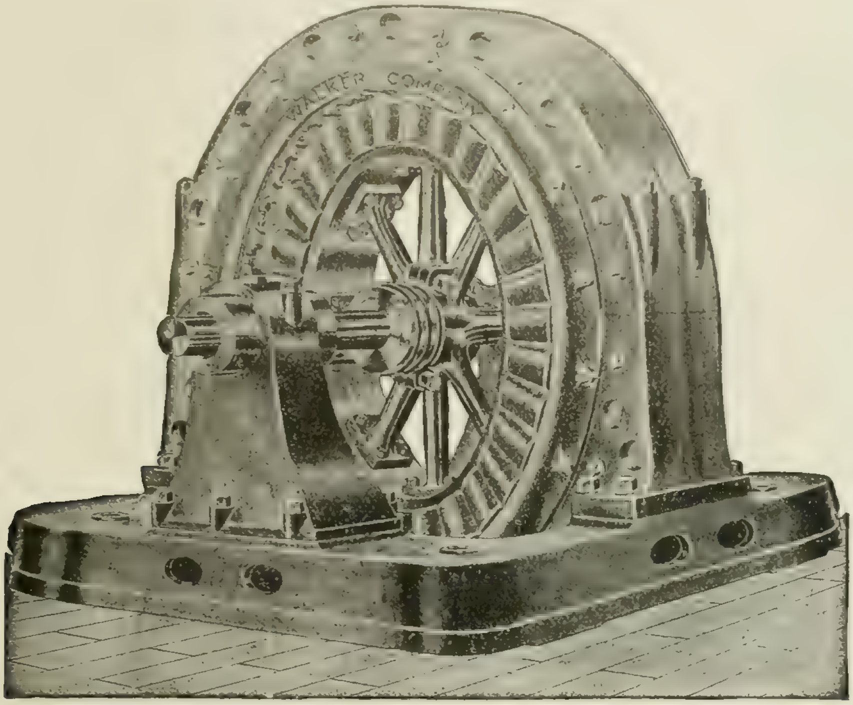
Spider of Revolving Field.

[illegible] taken through the collecting [illegible] in the illustration.

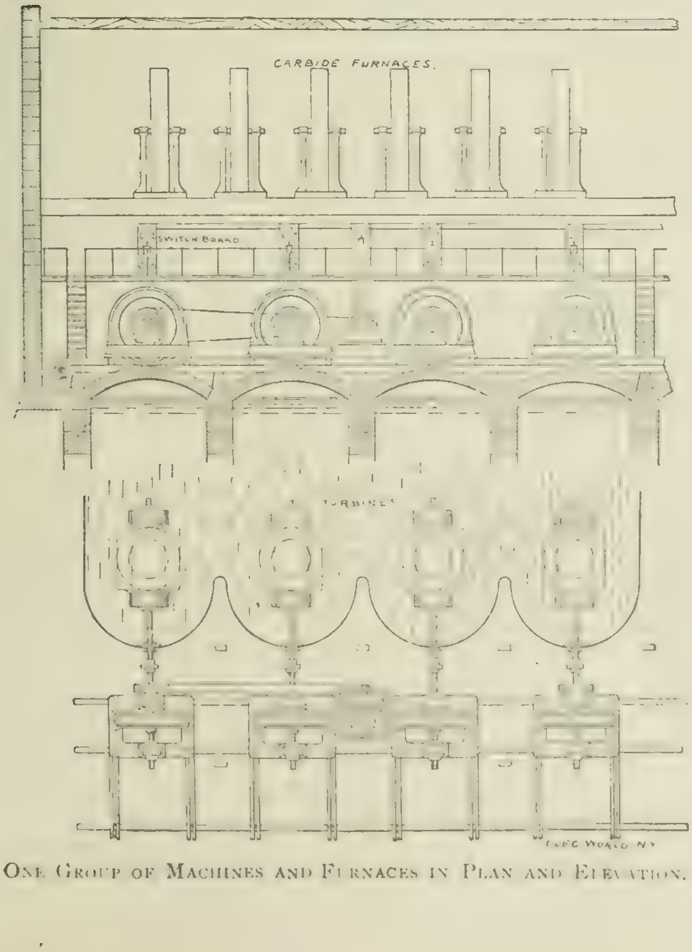
The stationary armature ring consists of two halves containing the toothed and laminated core, which is thoroughly ventilated. [illegible] holding between them the laminations of the core, and the halves themselves are bolted together in much the same manner as the field magnet of a direct-current machine. The arrangement of the armature slots is of interest, there being a narrow tooth between the near sides of adjacent coils. The armature coils are formed before being placed in position between the teeth of the core. A photograph of the armature ring, with two of the coils in place, is shown herewith, the armature coil itself formed ready to be placed in the slots and a laminated field core and unwound exciting spool being separately shown.

The revolving field is built up on a spider, shown in one of the illustrations. On the arms of this spider is bolted a steel ring completely surrounding it, and on this ring in turn are bolted the laminated poles or cores of the field coils. The capacity of each generator in carbide will be from 3 to 4 tons in each twenty-four hours.

The machines just described are, of course, built for low tension and a very large amount of current. Slight modifications, however, serve to adapt them for power and lighting; in fact, several thousand horse-power of generators of precisely this type are now being built for railways and lighting stations at the Cleveland works of the Walker Company.



Assembled Machine



One Group of Machines and Furnaces in Plan and Elevation.

The plant of the Union Carbide Company will undoubtedly become one of the most interesting of all those now building in the new manufacturing centre at the "Soo." The presence of unlimited water power in these days determines more than shipping advantages the direction of new industrial growth, and the Union Carbide Company seems to have chosen its location with a happy combination of both shipping and manufacturing facilities.

Electrical Equipment for the Volunteer Engineers.

The first of the three regiments of volunteer engineers has already enlisted about 1100 men and is at the time of this writing in camp at Peekskill, N. Y. The first battalion will probably be ordered to the front before this paper reaches its readers. It has been proposed by some of those interested in the welfare of the regiments that they be equipped with several engineering appliances new to the army and for which therefore no Government appropriations are available. It is especially desired that the brigade be provided with portable electrical searchlight equipments. One such piece of apparatus can be procured complete in a self-contained unit for about $3000. The employment of a searchlight in the army would be a novelty, but if of any use at all its success would be assured in the hands of competent engineers. It is argued that its field of application would be wider than in the navy, as it could be used in bridge and track construction and destruction, earth work, road making, repairing, searching the field for the wounded, hospital and headquarters work, etc., wherever such work was done at night. It is proposed that a fund be started for the purchase of such an equipment, and for any other apparatus by which the application of modern engineering science to the execution of military work can be tried in actual service under the most favorable conditions for a valuable test. Mr. O. F. Nichols, the secretary of the Volunteer Engineer Committee of the Engineers' Club, 374 Fifth Avenue, New York City, will receive subscriptions for this purpose. The Engineers' Club has also voted to tender to the regiment under the command of Col. Eugene Griffin, a stand of colors, the flags to be paid for out of the treasury of the club.

Electric Torpedo Boats.

BY CHARLES T. CHILD.

THE very interesting problem of the electrical operation of torpedo boats has been briefly discussed in these pages, but without bringing out fully the very great advantages of such a method for the operation of these terrors of marine warfare or the enormous difficulties in the way of a successful solution of the problem. To fully understand the necessities of torpedo boats it is necessary to give some account of the history of their development and the tactics prescribed at present for this use.

The first craft that can be called torpedo boats were used in the American civil war, both parties to that struggle making use of them with such success that they became recognized as offensive naval weapons on all sides, and their development as legitimate naval accessories was begun simultaneously in the shipyards of several of the maritime powers of Europe. The torpedo of that day was the "spar torpedo," a quantity of explosive attached to a spar and fired by contact with the hull of the enemy's vessel or by electrical means when brought sufficiently close to accomplish its purpose. Before the days of rapid firing guns this method of attack was much more often successful than now seems possible, as many instances in the war of 1861-65 attest. Even rowboats were used, and under cover of darkness or fog these small steam launches acounted for many vessels of the belligerents in that conflict. No less than thirty vessels belonging to the Federal authorities were destroyed or disabled by torpedoes during the four years of the civil war.

It was not for several years that the torpedo boat as a separate type of naval construction was seriously undertaken. The first steps taken in this direction were in England, where two famous builders, competing with each other ,turned out craft of about 7½ tons, with speeds as high as 15 knots. This was in 1873, and in 1878 boats of 75 feet length and 18 knots speed were the standard.

The automobile torpedo was introduced and developed simultaneously with these early types of torpedo boats, and in the course of a few years had made such progress as to find advocates in several navies. Still the spar torpedo held its ground, however, and it was not until the introduction of rapid-fire guns of great accuracy demonstrated the impossibility of a successful torpedo attack of this sort that the spar gave way to the launching tube for the automobile torpedo as the proper equipment for this class of vessels.

For twenty years the progress of torpedo boat construction has been marked by a gradual increase in the size of the boats and an enormous increase in their speed, and has been attended by the development of at least three types of these boats, differing in size, speed and armament, and intended for widely different uses. The engines of 90 horse-power and locomotive boiler of the early types have given place to the water-tube boiler and high-speed, triple-[illegible] of the modern "destroyers." An almost equally great development has brought the torpedo itself [illegible] of great perfection.

The conditions of torpedo warfare are best summarized as the attack upon a large costly vessel by a small and inexpensive one, and the risking of a relatively small amount of property and lives in the effort to destroy a relatively large amount. The fear of such [illegible] torpedo boat adapted to attack and destroy other torpedo boats, and called in the [illegible]

All these types of vessels are necessarily of the highest attainable [illegible] nearly all defensive weapons. They are practically certain of destruction if discovered, but their protection is in their small size [illegible] boat is useless and helpless and foredoomed to destruction in a daylight attack.

The reason for the high speed demanded of these boats is that they may overhaul their prey, and that they may escape if detected. It is, however, very much to be doubted if speed attained by the sacrifice of invisibility is desirable. For harbor boats, or those whose function is to attack blockading vessels or vessels under ordinary way, the highest speeds are not necessary for purposes of attack. For flight, the higher the speed the better the chances of the boat and its crew, of course, but if the higher speed is attained by the use of a larger and more readily discovered hull it will avail the boat little in these days of searchlights and rapid-fire guns. It seems, therefore, that all the considerations point to the necessity of keeping the size of the boats small and doing this even at the sacrifice of some speed. It must not be forgotten that these boats have nothing to fear as long as their movements are secret, but that as soon as they are discovered they become targets for the fire of machine guns and other quick-firing small pieces, whose ranges are far greater than the striking distance of a torpedo.

Outside of the "destroyer" type there have been developed two types of boats, sea-going and harbor-defense boats, whose names sufficiently indicate their differences. The sea-going boats are larger and of deeper draught than those intended for harbor and coast line defense. The latter need not go far from their base of supplies, and hence have no need for a large coal carrying capacity. The sea-going boats must be heavy enough and large enough to withstand rough weather at sea, and must contain sufficient fuel capacity for any ordinary cruise. While there is no very sharp line of demarcation between the two, it is generally recognized that boats smaller than about 140 feet over all and about 110 tons displacement are not fitted for long voyages.

The necessities for a harbor defense boat are good manœuvring qualities, fair speed in deep and shallow water, the smallest possible draught and a sufficient armament. The gun armament of such a boat may be reduced to very narrow limits, the only antagonists for which it is provided being small boats or other torpedo boats. A battery of two or three machine guns fulfills all the requirements. The advantage of shallow draught is the ability of the boat to elude pursuit by going into shoal water where the enemy cannot follow.

These considerations have been carefully worked out by the designers of steam-driven torpedo boats, and the results that have been attained challenge the warmest admiration. The table below gives some data of typical modern boats.

Name.	Navy.	Length		Displacement.	Speed	I. H. P.	Weight of Hull.	Weight of Machinery
		Ft.	In.	Tons.				
Cushing.......	United States.	[illegible]	[illegible]	[illegible]	22	[illegible]	33.7	54.5
Farragut.....	United States.	[illegible]	[illegible]	240	[illegible]	[illegible]	85	[illegible]
Porter........	United States.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	56.5	76.8
Aluminum.....	France	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4.5
Forban.......	France	144	3	124.8	[illegible]	[illegible]	45.39	62.67
Sokol.........	Russia........	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	....	....
Virago........	England	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	....	144.3

It will be seen that a performance as good as one indicated horse-power from 5 pounds of propelling machinery has been attained—propelling machinery including boilers and water, piping, engines, pumps and condensers. The weights of stacks, screws and shafts are included in the weights of the hulls.

In attempting to design a torpedo boat for electrical propulsion it must be remembered that there can be little or no further reduction in the weight of the hulls. The problem resolves itself into replacing the steam machinery with electrical machinery of the same or less weight, which shall give results sufficiently better than those already attained to warrant the substitution. At the first sight this appears impossible, but the factor of visibility is the most important to consider, and with this the general effectiveness of the two types of boats.

Assuming that two boats of equal size and speed are driven respectively by steam and electricity, the electric boat will have an almost immeasurable advantage in her freedom from smoke, steam, noise and possibility of flaming smokestacks. In all the types of steam torpedo craft now in use forced draught is resorted to for the attainment of the highest speed, and this very often means that un[illegible] driven out at the stacks instantly proclaiming the presence of the boat and lighting the way [illegible] actual warfare, as at [illegible] torpedo boats in the recent Japan-China war. At that battle the attacking torpedo boats flamed under their forced draught, and in a few seconds were targets for a fire so hot that but for the incredible badness of the Chinese gunnery they would have inevitably perished.

Perfectly free from this danger the electric boat has the further great advantage of having no smoke stacks, which add to the visibility of the steam craft, and no smoke to make it evident to the eyes or noses of the watch on the attacked vessel. Having no boiler or steam pipes it cannot be put hors de combat by a single shot through its upper works, as was the Spanish Terror at San Juan de Puerto Rico recently. Indeed, all the machinery of an electric boat can be put below the water line, so that in a smooth sea the upper works of such a vessel could be riddled with shot without putting the boat out of service if enough of her crew were left to operate the machinery.

Of two vessels alike in other respects that one having the greatest manœuvring ability and the quickest response to the desires of her navigator will be best suited for torpedo purposes, and it is in this direction that the advantages and superiority of the electric boat are pre-eminent. There is no necessity for any sort of intermediate signaling between the conning tower and the helm or engine room on the electric boat, for steering and speed regulations as well as direction are in the hands of one man, through the agency of small appliances not more difficult to work than a street-car controller.

For this summary of the more apparent advantages of the electric type it is at once seen that the gain in secrecy will compensate for the loss in speed that is entailed; for it is not possible to develop a horse-power for any length of time with 5 pounds of any sort of electrical machinery now in vogue. There is also a difference in cost of construction in favor of the steam vessel, while the difference in cost of operation is largely in the same direction. The radius of action of the steam type is also much greater, but despite all these sacrifices the superior secrecy of the electric boat, its manœuvring power and instant control and its safety from annihilation by a single well-directed shot leave the balance in its favor.

After this somewhat lengthy preamble the discussion of the various types of electric boats may be condensed into comparatively small space. Taking a definite example is probably the best way to bring out the nature of the problem offered to torpedo-boat designers who attempt to supersede steam by electricity.

Of recent torpedo boats the U. S. S. "Davis" is an excellent type of the small sea-going variety. This vessel is 146 feet long, 14 feet 6 inches beam and about 5 feet 2 inches draught. Her displacement is 110.4 tons, coal capacity 40 tons, radius of action at cruising speed about 4000 nautical miles, horse-power (indicated) 1750 and speed 22½ knots. She carries two triple-expansion engines and two Thornycroft boilers. The engines and condensers, with their accessories, weigh 30.22 tons, and the boilers and their accessories weigh 26.78 tons. The hull weighs 42.6 tons. The armament consists of three 18-inch torpedo tubes and three 1-pounder rapid-fire guns. The boat has quarters for four officers and twenty men.

Suppose the motive power equipment of this boat to be replaced by electrical machinery for the same purpose of the maximum power for the allowable weight, what would be the result as to the speed, visibility and effectiveness of the boat?

There are two methods of supplying electric energy to the motors that work the screws—from primary batteries or from accumulators. It is well to look closely into the relative value of these for this purpose, of course without reference to the cost of operation. Singularly enough, for service of this sort, cost of operation is a factor not to be regarded unless so high as to be utterly out of the question. Success is what is demanded of torpedo boats, even if the cost be very high.

The motor equipment should consist of four motors of 400 horse-power each, weighing about 7000 pounds each. These motors would be of a two-pole type, having forged or laminated iron fields of simple shape, and provided with powerful ventilating devices, for it is proposed to work them at their utmost maximum. Their speeds would range up to about 1500 r. p. m., which would necessitate an arrangement of several screws on each shaft, such as experience with the "Turbinia" has shown to be desirable with very high speed propelling machinery. The aggregaate weight of these motors would be 28,000 pounds or 12.9 tons. The propelling machinery and coal of the "Davis" weigh, together, 97 tons, so that in replacing this with electrical machinery of the same weight the allowable weight for batteries, controllers and wiring is about 84 tons, or 188,160 pounds. Assume first that primary batteries are used. It is well known that of all types of primary battery the element using zinc and black oxide of copper in a solution of caustic alkali gives the largest output of energy for the total weight of materials. In such a cell the materials combine exactly when they are in the ratio represented by the following weights: Zinc, 17 pounds; copper oxide, 24 pounds; caustic (70 per cent.), 21 pounds; water, 60 pounds. These quantities are capable of giving an output of 4800 watt-hours, or 6.4 hp-hours; assuming the average e. m. f. to be 0.75 volt. The cells should be designed of the largest size consistent with easy handling, and yet not too large to reduce their number and the terminal e. m. f. to such a point that the current output becomes difficult to handle. The mean seems to lie in cells of about 30x30x26 inches size over all. If these are made up in sheet-iron composition-lined tanks, each containing eleven zinc plates and ten copper oxide plates, 18 inches square, they will weigh, complete, with connectors (aluminum) and covers of iron and porcelain, about 1500 pounds, and each cell can give 1000 amperes at 0.75 volt for 6.4 hours.

Using such cells as these it is seen that the "Davis" could carry about 116 of them, allowing about 14,000 pounds for controller and circuits. This would give only 116 horse-power for 6.4 hours, or 730 horse-power for one hour, corresponding to a speed of about 13 knots. Of course, this figure, coupled with an endurance of only one hour, makes this kind of equipment out of the question, the figures being given merely to show its fallacy.

With storage batteries the case is somewhat different. Among the various types of light batteries adapted to withstand large discharge currents which have been brought out for traction and automobile vehicles the lead-zinc-cadmium cell of Werner seems as promising as any. This cell consists of a positive plate of the usual lead grid type, and a negative plate of zinc, the electrolyte being a solution of cadmium and zinc sulphates with a little magnesium sulphate. In recent trials of electric carriages equipped with this battery thirty cells weighing 334 kilograms gave thirty amperes for six hours. This rate of discharge corresponds to about 1.5 horse-power after allowance is made for all losses in the motor and circuits. At this rate of discharge, then, the battery gives 1.5 horse-power for six hours from 735 pounds of cells, corresponding to 6.5 horse-power for one hour from the same weight, or 1 horse-power for one hour from 113 pounds of cells, these figures making allowance for the less capacity of the battery at a high rate of discharge. Assuming that the "Davis" can float 175,000 pounds of batteries, this means that with cells of this type the mechanical energy at the screws would be 1530 horse-power if the battery is discharged in one hour, corresponding to a speed of about 22 knots. This would be the rush speed for attacking. The battery could maintain an effort of 250 horse-power, corresponding to a speed of about 10 knots, for more than ten hours, thus giving the boat a cruising radius at that speed of about 100 nautical miles. It will thus be seen that the electrical equipment of the boat has cut down its radius of action from 4000 to 100 miles, left its speed unchanged and decreased its visibility by a considerable amount. If it be assumed that the distance at which the vessel become visible is that at which its area of exposed surface subtends a certain definite solid angle, this boat with its new equipment could come 1.47 times closer to the enemy than before without danger. This figure does not include the area of the smoke that is certain to be given out by the steam apparatus, nor does it make any allowance for the chance of flaming funnels.

By sacrificing so much of the cruising radius that the vessel is tied closely to its base a gain of a considerable amount is made in both invisibility and the manœuvring power of the boat, while its attacking speed is but slightly diminished. It seems therefore that the value of this boat, once in action, is much greater than when equipped with steam machinery, but that its ability to get into action is limited on account of its small cruising radius. The obvious remedy for this trouble is a tug. Such a boat if needed for service at a distance could be towed at fair speed to a point near the scene of operations, to which it could return after completing its mission. Naturally, such a boat would be useless as a dispatch boat or patrol boat, but for its purely legitimate functions as a torpedo boat there is no question at all that it is a better boat than if equipped with steam machinery.

Electricity as a Branch of Physics.

The important place which the branch of electricity has taken in the general science of physics is well shown in the June number of that excellent English publication, "Science Abstracts," which contains a large number of abstracts of articles of which all but a very small number are on electrical subjects.

The Electrolytic Production of Soda and Bleach by the Hargreaves-Bird Process.*

For many years past attempts have been made to replace the present cumbrous and circuitous methods of producing soda and bleaching powder by one in which common salt is decomposed directly into its constituents—sodium and chlorine—by means of the electric current. This done, it is easy to carbonate the former, and to make bleaching powder by passing the chlorine into leaden chambers containing lime, which absorbs the chlorine. The old Leblanc process is, of course, a very roundabout one. Solid salt is converted into sodium sulphate by means of sulphuric acid, hydrochloric acid being formed at the same time. The latter is next decomposed by means of manganese, yielding chlorine, which is absorbed by lime, to make bleaching powder as already explained. The sodium sulphate is converted into the carbonate by roasting it with coal, the salt being finally purified by crystallization. The ammonia process of producing the carbonate, which has proved so efficient in practice, labors under the disadvantage of not affording a ready means of converting the chlorine of the salt originally used into bleaching powder.

On paper nothing can be simpler than the electrolytic method of preparing soda and bleach, while in practice no operation has proved more illusive. It is essential that the sodium produced by electrolysis shall be prevented from redissolving in the electrolyte. A method of doing this is to use mercury as the cathode. The sodium dissolves in this, and can be afterward easily recovered as hydrate or carbonate. It seems, however, that for successful working pure salt is needed in the first instance, as small traces of magnesium, for example, cause sickening and consequent loss of the mercury. Other inventors have substituted molten lead for the mercury, with apparently some success.

The most original plan of electrolysis would seem, however, to be that due to Messrs. Hargreaves and Bird, in which the use of mercury, molten lead, or similar liquid cathodes, is entirely dispensed with; and we have recently had an opportunity of inspecting the working of a large cell at the works of the General Electrolytic Parent Company, Limited, at Farnworth, in Widnes. The Hargreaves-Bird cell consists in the first place of a carbon anode, placed between diaphragms, which form two sides of a cell containing the electrolyte. Outside the diaphragms, and thus out of contact with the electrolyte, are sheets of copper gauze which form the cathodes of the cell. A current of steam and carbonic acid gas is kept passing over these sheets of gauze, and the former condensing between them and the diaphragms provides a passage for the current between the diaphragm and the gauze, and thus completes the circuit between anode and cathode. As the current passes in, metallic sodium appears on the outer wall of the diaphragm, where it is converted to sodium carbonate by the combined action of the steam and the CO_2 already mentioned, and, dissolving in the condensed steam, trickles down the outer face of the diaphragm, and is collected and drawn off below. By regulating properly the steam supply, the solution can be obtained in a saturated condition, but in practice it is found advisable to work with a small excess of moisture, as otherwise solid sodium carbonate is liable to be deposited between the gauze and the diaphragms, separating the two.

The important feature of the cell is to be found in the diaphragms. These are made out of asbestos, sodium silicate and other undisclosed constituents, the method being to reduce the whole to pulp in a beater, and then, as in paper making, to flow it [illegible] wire gauze. The excess of water being drained off, the sheet re- [illegible] by 5 feet 4 inches high, the active surface of each being 10 feet by 5 feet, or 100 square feet in all, there being two to the cell; the thickness, we may add, is about one-eighth of an inch. The total width of the cell, including projecting bolts, is about 3 feet. This cell is capable in daily work of decomposing 240 pounds of salt (Na Cl) per twenty-four hours, giving in the same time about 216 pounds of soda ($Na_2 CO_3$) and 360 pounds of bleaching powder.

A pump is used to circulate the brine through the cell. The liquor entering at the bottom passes out through an overflow, taking with it the chlorine generated at the anode. This chlorine is collected in a separating tank and drawn through a line chamber of the ordinary pattern by an aspirator. Finally the chlorine escaping from this chamber is passed into a scrubber, where, meeting a solution of crude soda, it produces sodium chlorate, which is collected at the base of the apparatus. It is stated that in this cell crude brine can be used as the electrolyte. The earthy impurities, etc., are deposited on the inner faces of the diaphragms, but do not sensibly affect the proper working of these. In general a diaphragm is run about a month without renewal, though this period has at times been greatly exceeded.

The electrolytic efficiency of the cell is astonishingly high, independent reports by Professor Ramsay, Messrs. Cross and Bevan and Messrs. Norman, Tate & Co., all showing that over 97 per cent. of the current is employed in useful electrolysis. The carbonate obtained was found by these gentlemen to contain less than 2½ per cent. of impurities. The electromotive force at the cell terminals is about 4 volts, and the working current density is 23 amperes per square foot.

The construction of the anodes should also be referred to. These consist of a series of rough blocks of gas carbon measuring, say, 15 inches by 7 inches by 1½ inches, strung on a copper rod, a special cement being used to keep the chlorine away from the copper. A number of these sets of carbons connected in parallel form the anode of the cell. The company states that anodes thus made have been used without failure for periods of over twelve months.

A Meter with Valuable Properties.

The London "Electrical Engineer" describes a new alternating current meter with some remarkable features. The instrument is of the induction type with a shunt exciting circuit, giving a cross magnetization. The energy wasted therein is stated to be only about 1 watt. The cross magnetization is obtained at a phase difference of 90° from the impressed voltage by shunting the cross-magnetizing winding by a non-inductive resistance, the two being in series with an inductive resistance across the mains. The statements of the accuracy obtained are astonishing. The maximum error, with loads ranging from 2 per cent. to full load, being less than 0.6 of 1 per cent. The braking is effected by a Foucault disc working between permanent magnets, and, to obtain extreme sensitiveness on light loads, a small torque on no load is obtained by the shaping of the poles, this torque being resisted by a small piece of iron wire on the brake disc. This iron wire is attracted by one of the permanent magnets holding the disc stationary on no load, but the slightest load serves to overcome the attraction which obviously, once the mechanism is in motion, gives no retarding effect as would mechanical friction.

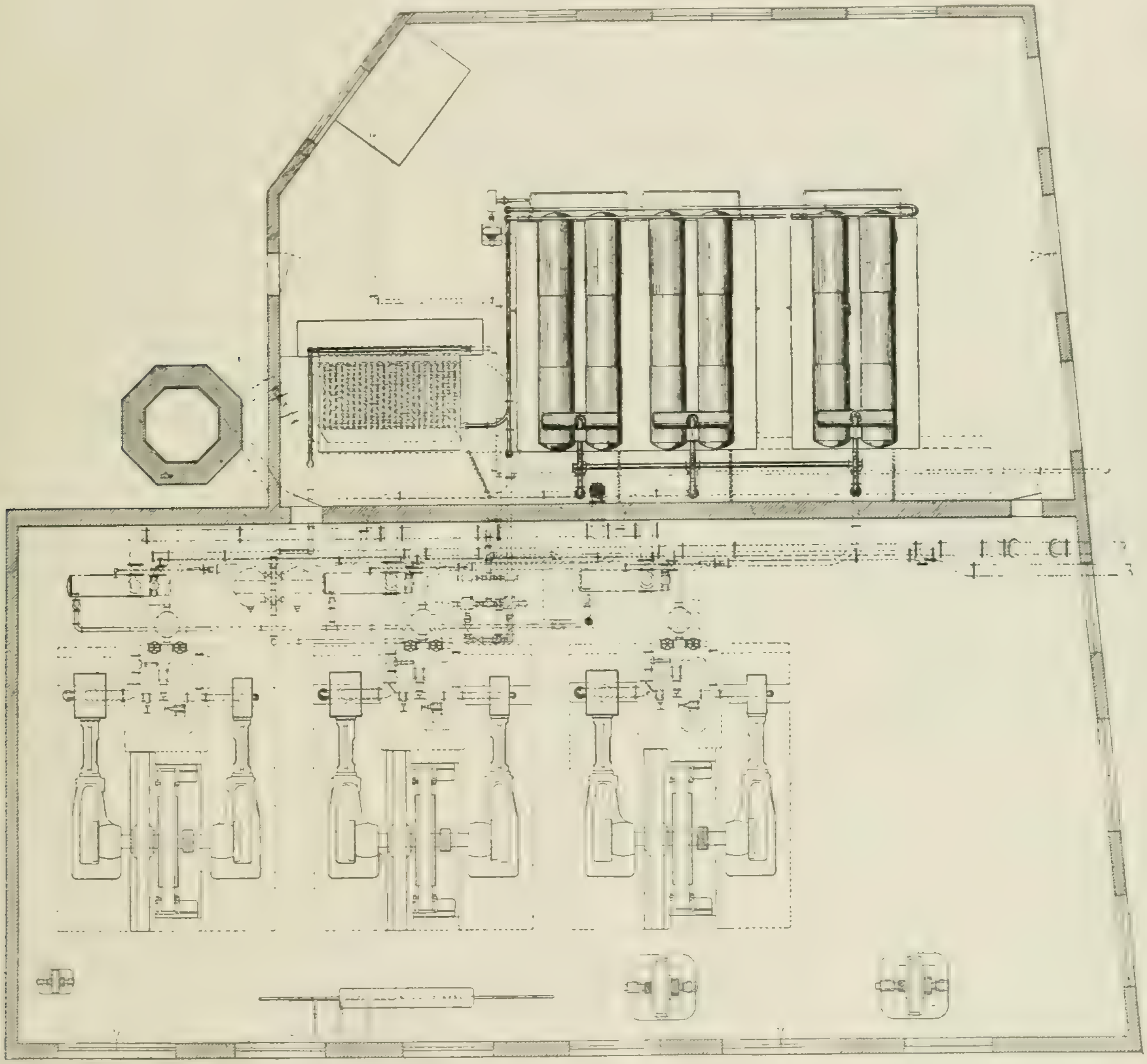
Vacuum Drying.

The English electrical journals briefly describe an apparatus said to be quite widely used by the leading electrical firms in Germany for the drying of the insulation of electrical coils, dynamo armatures, etc., at low temperatures, by means of a vacuum. The apparatus consists simply of a cast-iron chamber closed by doors hermetically sealed with india rubber gaskets, and arrangements for obtaining a vacuum of 28 inches of mercury or more and for heating the chamber proper by steam or hot water. At a very [illegible]

[illegible]

The Middlesbrough, Stockton & Thornaby (England) Electric Tramways.

The Imperial Tramways Company, Limited, of Bristol, England, has issued an elaborate brochure of its newly equipped lines connecting the towns above mentioned, the electrical features of which lines are quite unusual in some respects. The system comprises at present a total track length of 15 miles, while other lines are proposed which will add about 20 miles more. The tracks are of a 3-foot 6-inch gauge, laid on a solid foundation 6 inches deep of Portland cement concrete, the whole roadbed, after the rails were laid, being floated in cement. The rails are 6-inch girders, 92½ pounds to the yard.



Plan of Power House.

The central power station, located on the water front at Stockton-on-Tees consists of two brick-wall steel-roof frame structures with monitors, as shown in the accompanying illustrations, one forming the boiler room and the other the engine room. The coal is discharged from the vessels by an electric crane on a wharf, into a hopper, where it is weighed in 3-ton lots, after which it is automatically hoisted and discharged by an elevator or conveyor, with a capacity of 20 tons per hour, into the storage bunkers of 300 tons capacity, from which it is fed by gravity into the hoppers of the mechanical stokers, and so into the furnaces.

The engine room has a basement below the ground floor, and this floor is supported upon iron girders, with boiler plates between them, concreted to floor level, and finished with artistic marble mosaic tiles, with borders in keeping. The condensing and pumping plant is arranged on the basement floor, and all steam condenser, suction, and other pipes and connections being also carried below the floor line, a clear space is thus obtained around the engines and generators. The engine foundations, of which there are three, are built in solid concrete from the basement floor level. The engine room measures 110 feet by 52 feet, and has a clear space of 36 feet from the floor to the tie bars of the roof principals. The boiler room is 78 feet by 48½ feet, and is of the same height as the engine room. Here there are provided three Babcock & Wilcox water-tube boilers, each having a heating surface of 3580 square feet, and being capable of evaporating 12,000 pounds of water per hour.

The smoke stack, which is 132 feet in height and 7 feet diameter at the top, is octagonal in section, and is built of best pressed brick and lined with fire brick. In the flue leading to it is placed a Green economizer of 240 tubes. The boilers supply steam to three Reynolds-Corliss horizontal cross compound condensing engines of 400 horse-power each, made by the E. P. Allis Company, of Mil-[illegible] phase type, of 300-kw capacity, 32 poles, 2500 volts, giving a frequency of 25 cycles at 94 revolutions per minute. The fields are excited from the 500-volt bus bars. To supply light when the machinery is stopped and to start the dynamos in the morning a battery of accumulators has been provided. These were made by the Tudor Company, and consist of 260 cells, with a discharge rate of 48 to 70 amperes; the capacity, at the lower discharge rate, being 240 ampere hours. For charging these accumulators, a booster is connected in series with the 500-volt bus bars. This booster consists of a rotary converter fed from step-down transformers of special design. Each transformer has the primary and secondary separated, so as to give the effect of a considerable reactance, this arrangement giving a large range of voltage on the rotary converter to provide for the alteration in the charging volts required by the cells.

The system of distribution is designed to give the maximum of power at any point of the system on the most economical basis. A 500-volt, continuous-current direct from rotary converters in the main station feeds the trolley lines for 2 miles on either side of the station, while the Middlesbrough and Linthorpe sections of the lines are fed by three-phase power transmitted at 2500 volts from the main station to the substation at Newport, and there transformed down so that power is delivered from this subcentre direct into the line at 500 volts.

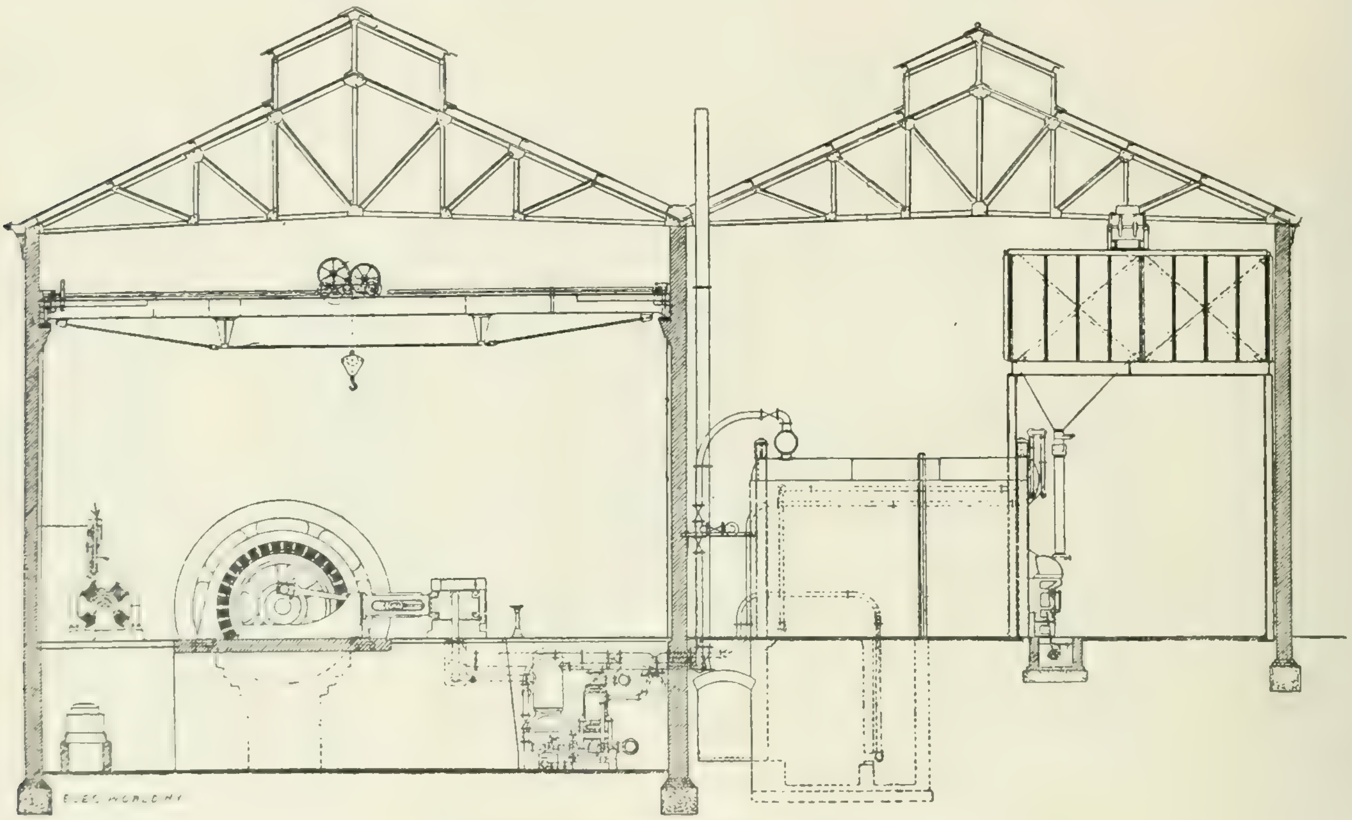
The Board of Trade regulation with respect to the return current is that the difference of potential between the generating station and extreme ends of the line shall not exceed 7 volts. The multiphase distribution was adopted partly for this reason. A further advantage lies in the comparatively small amount of copper required in the feeders conveying current to the trolley wires. The 7-volt limit in the earth return is fixed by the Board of Trade for the purpose of protecting gas and water pipes against the possible electrolytic effects of stray currents. With a single point of distribution only, the earth currents would always flow toward the generating station, but with more than one point of distribution the current along the line may be in opposite directions at different times, according to the distribution of the load; and thus the risk of [illegible] is greatly reduced.

The feeder which transmits this three-phase current at 2500 volts from the [illegible] power house to the substation consists of two concentric cables, in each of which are three conductors of copper suitably insulated, each conductor having an area of .0775 square inch. With this small section it is possible to transmit [illegible] per cent. At the sub- [illegible]

A novel feature of the main station equipment is a combination of stationary and rotary transformers for charging the batteries.

The charging current is passed through the rotary, and the pressure is raised from the line voltage of 500 to a maximum of 650 volts for charging. There being no direct-current primary generators in the station, it became a problem how to charge the batteries for supplying the excitation to the high-tension, three-phase generators.

This was solved in the following manner: A rotary converter was designed to supply the difference between the line voltage and the variable voltage required for charging; combined with this was a stationary transformer, having a ratio of transformation of 330 to 80 volts on a non-inductive load; the transformer was designed with a large amount of leakage between the primary and secondary, the leakage being adjusted so that, by changing the phase of the armature current by variation of the field current of the booster, the transformer ratio is varied, and consequently the voltage on the collector rings. In this way it is possible to vary the voltage on the continuous side of the rotary from 40 volts to 150 volts. The charging current is 60 amperes. The armature of the rotary is designed to carry 60 amperes continuously. All of the electrical apparatus was installed by the British Thomson-Houston Company, representing the General Electric Company of America.



Sectional Elevation of Power House

Wanted—A Time-Limit Damper Controller.

A request has been sent to the editors of The Electrical World for directions as to where to obtain a damper controller so constructed as to close a damper which is opened at the time the fire door is opened at any pre-determined period (from one to eight minutes) after the fire door is closed. Any one constructing such an instrument will confer a favor on the editors by advising them of it.

Another Possible Use for Acetylene.

When acetylene gas is burned with an insufficient supply of air it gives a very dense smoke, owing to the large amount of carbon in the gas. The soot derived therefrom is said to be distinguished by a deep blackness, showing not the slightest touch of color, and it is suggested that this is excellently adapted for the production of high grade printers' ink.

DIGEST OF CURRENT ELECTRICAL LITERATURE AMERICAN AND FOREIGN

By Carl Hering

Dynamos, Motors and Transformers.

ALTERNATOR DESIGN. Marshall. Lond. "Elec.," July 15. --A short note in which he shows that the diameter of an alternator rotor varies approximately with the output and voltage of the machine; the diameter in inches is given to a considerable degree of accuracy by the following formula: 30 plus one-fifth the output in kilowatts, plus the fraction 1000 divided by the terminal voltage; he suggests that this might be of considerable value as a rough guide to students. A table gives the actual and calculated value for eight different machines; the agreement is quite good.

TRANSFORMER FOR A THREE-WIRE SYSTEM.—"Zeit. f. Beleucht.," July 10.—An illustrated description of a transformer patented by the Union Company for supplying a three-wire secondary system from a two-wire primary. There are two primary coils placed symmetrically on the two sides of the same transformer; below each of these are two secondaries, the upper one on one side being connected in series with the lower on the other, and thence to the neutral wire connection, while the other upper one is connected to the other lower one, and thence to the neutral wire; by this sub-division of the secondary into four coils connected diagonally, the induction will be the same in both, even if the three-wire system is not exactly balanced.

STARTING NON-SYNCHRONOUS SINGLE-PHASE MOTORS. Arno. "L'Elettricita," 6, p. 265, and 7, p. 97; abstracted briefly in "Science Abstracts," June.—He shows that with a suitable resistance in the armature circuit a single-phase motor can be started by giving it a pull with the hand. In the second paper he describes a method to produce a dissymmetry in the armature at the moment of starting by opening the circuit of one of its windings; if the armature is not at a dead point it will rotate through a portion of a turn, and if the circuit is then closed there will be sufficient impulse to get the motor up to speed.

MAGNETIC LEAKAGE. Rothert. "Elek. Zeit.," July 14.—A brief reply to the recent criticism of Osnos (see "Digest," July 23).

ALTERNATOR FOR SEVERAL DIFFERENT VOLTAGES. Dahl. "Engineer's Year Book," Univ. of Minn., Vol. 6. —A short, illustrated article showing some modifications proposed by Shepherdson, in a 10-kw, 10-pole, single-phase alternator, so as to enable it to give different voltages. The coils, which are radial, have their terminals connected to blocks on the revolving armature frame in which screw plugs may be inserted so as to connect them in different groups, by means of which different voltages can be obtained.

MOUNTING ELECTRIC MOTORS.—"Amer. Mach.," July 14.—A short, illustrated article showing a typical method of mounting used in the Baldwin Locomotive Works, where many of the tools are driven by electric motors; the method is sufficiently flexible to apply to many cases. The motor is placed on a light angle iron frame bolted to the floor next to the machine, the driving being by means of very short belts and a short countershaft containing the cone pulleys; these short belts seem to be satisfactory.

PARALLELING CONTINUOUS CURRENT DYNAMOS. Springer. "Engineers' Year Book," Univ. of Minn., Vol. 6.—He shows the importance of the characteristics of the generators which are to be connected in parallel; he describes how these characteristics may be obtained and how they affect the paralleling; the internal and the external characteristics are discussed; he shows how compound generators are connected in parallel.

Lights and Lighting.

NERNST LAMP.—"Zeit. f. Beleucht.," July 10.—A short, illustrated description taken from a patent specification of his method of heating the material used for lighting, which becomes a conductor only after being heated, as has already been explained. One method is to surround the body with a coil of platinum wire, which is heated by means of a current. In the second method the rays are condensed on it from a reflector above the body, which is heated by means of a coil. In the third method the body is suspended from the movable coil of a solenoid through which the main current passes; before the body becomes a conductor its position is inside of the platinum spiral which heats it, but as soon as current passes it is automatically withdrawn from this spiral by means of the solenoid, so that the spiral is no longer in the way of the light.

TRAIN LIGHTING.—"Zeit. fuer Elek.," July 3.—A long, illustrated description of the Dick system of train lighting, which is used in Austria; other but briefer descriptions have already been referred to.

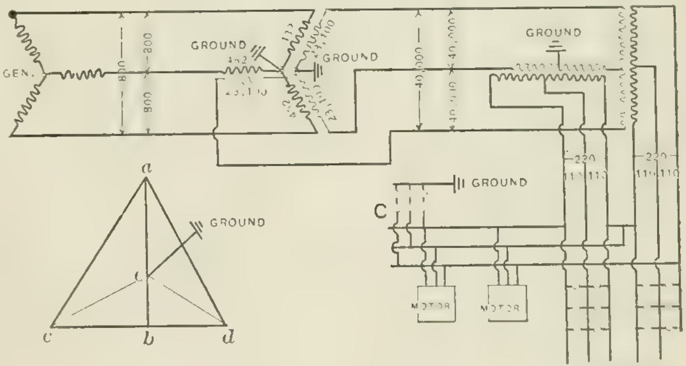
Power.

TRANSMISSION PLANT AT LES CLEES-YVERDON.—"Elek. Zeit.," July 14.—A long, well-illustrated description of this water-power plant, which is said to be one of the most interesting in Switzerland; it has been run for eighteen months and supplies twenty cities and villages with light and power. The three-phase system is used, with the primary in common and the secondaries partly in common for both light and power; the plant is designed for 1800 horse-power at the turbin shafts; the current is generated at 5200 volts, and a frequency of 50, the triangular system of connections being used; the total length of the primary circuit is 30 miles, and there are twenty sub-stations on one line and fifteen on another; the lights are distributed equally over the three-phases, and it has been found that unequal loading has practically no effect on the voltage; eighty motors are connected from 0.1 to 120 horse-power, representing a total of 750 horse-power; up to 2 horse-power they have short-circuited armatures and require no special starting arrangements.

PLANT AT CREUSOT.—Lond. "Engineering," July 15.—In this installment of a very long series on Schneider & Co.'s large iron works at Creusot, the central lighting station, railways and electrical products of that company are described.

STEAM POWER AND ELECTRICALLY TRANSMITTED WATER POWER. Saldini. "Elettricita," 17, p. 53; abstracted, with a number of the tables, in "Science Abstracts," June.—He compares the costs. He also shows that electric power has the advantage in economy only for the smaller motors up to 60 horse-power; but if the working day of nine hours can be increased the comparison is more favorable to electricity.

PROVOST-MERCUR 40,000-VOLT TRANSMISSION PLANT. Bly. "Jour. of El'ty," June.—An illustrated description of this plant, which is said to use the highest voltage of any plants where power is transmitted commercially over long distances. Experiments have been made with potentials ranging as high as 120,000 volts, and for which the line was a special one, having a length of 11,720 feet over a rugged country; it consisted of three circuits of galvanized iron wire; all the different varieties of cross-arms, pins and insulators found in the market were tested; up to the present time the results of these experiments have not been published. In the Provost-Mercur plant 2000 horse-power will be transmitted a distance of 32 miles to one place and 46 to another, the two places being 20 miles apart, and will be connected by another line so as to guard against accident to either of the others. At present there is only one 750-kw three-phase generator, driven by a turbine and giving 800 volts, which is raised to 40,000 by means of transformers; the copper loss in the 250-kw transformers averages about 2150 watts, and the iron loss about 3030 watts, the normal temperature at full load being 118° above the surrounding air. Three-phase generation, three-phase transmission, and two-phase distribution is the system used, and all the three-phase portions are star connected, the common centre or neutral point being grounded as shown in the adjoining diagram; the two-phase distribution is also grounded as shown. The line consists of No. 5 B. and S. medium hard-drawn copper supported in the form of an equilaterial triangle with 6-foot sides; these wires are not transposed, and a metallic telephone circuit 42 inches below the cross-arms is used; the insulators are of a special type of triple petticoat glass, and are supported by long locust pins boiled in paraffin; should a wire ground on a pin or cross-arm it would promptly burn them off, leaving the wire free. About twenty-five lightning arresters are used, with six choke coils. The fuses in the high-tension circuits each consist of a single No. 30 B. & S. bare copper wire 36 inches long, over which is an asbestos tube; the high-tension switches, which are illustrated, give a 6-foot break. The connections of the step-down transformers are shown in the adjoining diagram, which also shows how the two-phase circuit is grounded, this point being located in the three-phase-two-phase transformers at one-third the turns of the 86 per cent. transformer from the side connected to the centre



Elec. World

of the 100 per cent. transformer. The 220-volt secondary is also grounded through lamps through incandescent lamps, as shown at C. A tap is brought out from the centre of each of the single phases of the two-phase system, and this forms the neutral wire of the three-wire system used for the incandescent lighting; this grounding is believed to free the system from danger to shocks.

BARTON.—"Elec. Eng.," July 21.—A short, illustrated description of the monocyclic transmission plant at that village in Vermont. The water power is transmitted 15 miles, which is said to be the greatest distance over which the monocyclic system has been used; there are two alternators of 100 kw, each delivering current at 1040 volts.

NIAGARA FALLS. Dunlap. "Elec. Eng.," July 28.—A brief, illustrated description of the extension in the plant at the Gorge; the first turbine of the extension has just been started; there will be five of these of 2500 horse-power each.

ELECTRICITY IN MINING.—"Jour. of El'ty," June.—The beginning of an article of a general character, the present portion referring chiefly to electric hoists and tramways, giving general hints; also a table of the performance and limiting dimensions of mining locomotives.

Traction.

AUTOMOBILES.—"L'Ind. Elec.," July 10.—The greater part of this extra large edition of that journal is devoted to this subject. In a brief introduction it is thought that this industry will become one of the most important in the closing century, and that its development is largely due to the Automobile Club, of France. It is thought that steam, oil and electricity each have their limited fields; steam is, and will be, the agency for heavy vehicles; oil is adapted for much higher speeds and long tours, and in special cases to the service in cities; electricity will, in the next century, be the agency for cabs and carriages for city traffic. The advantages and disadvantages of electric vehicles are compared, and it is thought that the latter are more than balanced. The next portion is a long article by Hospitalier, referring to the recent trials in Paris; the various carriages are described and illustrated, and in some cases with diagrams of the wiring; all except one were provided with pneumatic tires; all the electric vehicles used the Fulmen accumulators. The results of tests of these accumulators are given, the authority being Hospitalier; those used had thirteen plates to the cell, the complete weight being 7.5 kg; a continuous discharge of 5 hours is considered normal, and at this rate the capacity was 105 ampere hours; the rate is 40 watts at the terminals; this corresponds to 3 amperes per kg, and is equivalent to 26 watt hours per kg. From a number of the wiring diagrams it appears that the battery is separated into two groups, which are used in series, or parallel on some of the vehicles. This is followed by the results of the trials, which are given quite completely in numerous tables, including also the amount and cost of the energy used. In conclusion he states that these trials have proved that the electric carriage is possible, and that it is the only possible one; we may be satisfied if the experiences of the next year show that it is practical; after two years it will be established that it is economical. This is followed by an article on the international exhibition of automobiles which was held last month in Paris; this includes illustrated description of a large number of vehicles.

"L'Eclairage Elec.," July 9, also contains a long article by Blondin, giving the results of these trials and including a large number of tables.

"L'Elec.," July 9, also contains a short article on these trials; the results were perfectly satisfactory, showing that such vehicles are very well suited for cities. Most of them were electrical, and a few were run with petroleum; a list of the prizes awarded is also given; the Jeantaud electric vehicle received the first prize of $200 for two-seated carriages, and the Jenatzy electric carriage of this class received the second prize of $120; the Krieger electric car- [illegible] ed the first prize of $200 among the carriages seating [illegible]

[illegible] LOO AND CITY RAILWAY.—Lond. "Elec." and [illegible] een opened in the city of London. It is [illegible] ate stations, thus obtaining the full [illegible] at the start and the up-grade at the [illegible] lon and Southwestern Railway station with the [illegible]

fifty cars, but only eight are run on week days and forty on Sundays and holidays; the weight of a car is 15 tons, and they, therefore, cannot start and stop as quickly as trolley cars weighing 8 or 9 tons; this did not, however, increase the accident account, which was only two-thirds of 1 per cent. of the gross receipts; an entirely different training of the motor men is necessary; they are instructed to coast as much as possible; a record of the condition of every battery is kept as it leaves the barn and returns to it, so that the amount of energy that each motorman has used is recorded. The snow plow weighs 22 tons and the sweeper 26 tons; they are satisfactory, a drift several hundred feet long and 7 feet high having been successfully cut through. The longest round trip is 22 miles, which is easily accomplished with one charge; as much as 40 miles has been run with one charge; the batteries, however, are ordinarily charged every half trip—that is, every 11 miles—the power plant being located at the centre of the system; the time for making a charge averages 1.25 minutes; the roadbed is nearly level the entire length, excepting a grade of 9.5 per cent. 300 feet long, which the cars will climb without assistance when the rail is dry; on a slippery rail a counterweight system is used. The cars average over 200 miles per day at a speed of 12 miles per hour; the cars ride very smoothly, owing to their great weight. Branch lines cannot be operated economically, as the cars must come back to the barn for a fresh battery so frequently; the wear and tear of the car and tracks is very much greater than with the trolley system; an 80-pound girder rail is used; the acid fumes have a most damaging effect on nearly all of the materials, including the insulation. The depreciation of the batteries is 2 cents per car mile and takes the place of that of the overhead work and bonding on a trolley road; the total operating expenses average 8.67 cents per car mile, ranging from 7 cents in the summer to 10 cents in the winter; this will be cut down, but even now compares favorably with that of the trolley system; he sees no reason why storage batteries should not be operated fully as cheaply as a trolley line; the first cost is greater, being, in this case, about $25,000 in favor of the trolley system, assuming a service of twenty cars.

NEW FORM OF CONTROLLER. Henry. "Elec. Eng.," July 21.—He mentions the many advantages claimed for his new "regenerative" controller, the description of which, however, is very brief. Among these claims are the following: 25 per cent. increase of capacity of motors; 40 per cent. increased efficiency; quicker acceleration; braking by returning current to the line; same speed for lower voltage at ends of long lines; electric coupling of the motors; greatly increased starting torque. It appears that separately excited shunt motors are used, and that therefore the waste in the series windings and the objections to them no longer exist; no resistance is used in the armature circuits, the regulation being accomplished with resistances in the field magnet circuit; rapid acceleration is produced much more economically than with series motors; the back kick due to the frequent breaking of the field circuit, which is so apt to pierce the insulation, is avoided by placing a non-inductive resistance of small carrying capacity in parallel with the fields whenever the armature circuit is open independently of the fields; in changing the armatures from series to parallel he short-circuits one of them with a resistance, leaving the fields excited; the E. M. F. generated is counteracted by the line current, thus allowing the circuit to be broken without flashing; the reversing is done by the fields instead of the armatures; the armatures for doing the same work carry 25 per cent. less current; arc extinguishing devices in the controllers are no longer necessary.

CAR MOTOR REGULATION.—"Elec. Eng.," July 28.—A short description of a system suggested by Hunter. It requires no resistance and controls the speed of the motors with the aid of a constant potential current which is varied in strength, and by interposing a varying counter E. M. F. independent of that of the motors; it is claimed to be of importance in the operation of large cars or trains; the forward part of the train is provided with a pilot car, which contains the necessary controlling devices.

ALTERNATING CURRENT TRACTION. Davis and Forbes. "Eng. Mag.," August.—An article which appears to be the first of a series, discussing the application of alternating currents to electric traction, and in which they point out the apparent limitations of the possible developments. The article is somewhat elementary in character; they show that the alternating cur- [illegible] over a long distance and then transformed into direct current. The [illegible]

EUROPEAN ELECTRIC RAILWAYS.—"St. Ry. Rev.," July 15.—A short table taken from the article noticed in the "Digest" [illegible] in Europe.

[illegible] RAILWAY. [illegible] Ry. Rev.," July [illegible] A short, illustrated article describing this three phase mountain rail- [illegible] already been given.

PITTSBURG STREET RAILWAYS. Fairchild. "Elec. Eng.," July 21 and 28.—An article giving brief descriptions.

PARIS.—"Elec. Eng.," July 28.—A short, illustrated description from "La Nature" of the combined trolley and battery system used in that city.

UNDERGROUND FEEDERS FOR ELECTRIC TRACTION. Morris. "El'ty," July 27; reprinted from the Lond. "Railway World."—A short article discussing the two systems briefly and giving some hints.

ELECTRIC TRACTION. Quin. "St. Ry. Rev.," July 15.—A reprint of a paper noticed in the "Digest" July 16.

MOTOR CARRIAGES.—"Elec. Eng.," July 28.—A brief, illustrated description of the Columbia carriages.

MINING LOCOMOTIVE.—"Elec. Eng.," July 28.—A brief, illustrated description of a low mining locomotive made by the Baldwin and the Westinghouse companies.

Installations, Systems and Appliances.

BERLIN.—"Zeit. f. Beleucht.," July 10.—The first part of tabular extracts from the report of the city electrician, Kallmann, on the financial features of the central stations at Berlin.

MORLEY.—Lond. "Elec. Rev.," July 15.—An illustrated description of this alternating current station.

CENTRAL STATION ACCOUNTS.—Lond. "Elec.," July 15.—An analysis of the accounts of the Wolverhampton station.

220-VOLT SYSTEM. Gray. "Engineers' Year Book," Univ. of Minn., Vol. 6.—A short article giving a few general hints in connection with such plants. There are now about fifteen plants of this kind in operation in this country.

SWITCHBOARD APPARATUS. Blaikie. "El'ty," July 27.—A reprint of the paper noticed in the "Digest" July 2.

OMAHA EXHIBITION.—"West. Elec.," July 23.—A short, illustrated description of the electric service plant at this exhibition.

Wires, Wiring and Conduits.

MAGNETIC CUT-OUT.—"L'Eclairage Elec.," July 2.—A brief description of the Guillaume magnetic cut-out, which is based on the properties of nickel or steel discovered by him. It consists of a plate of mica on which a wire of steel or nickel is secured in the form of a spiral; above this is a permanent magnet, which attracts this spiral while it is magnetic; the diameter of the wire is so calculated that when the current in it is normal the heat generated is such that it will remain magnetic, but if the current increases the wire gets so hot that it loses its magnetic properties and is no longer attracted by the magnet.

Electro-Physics and Magnetism.

SOURCE OF ROENTGEN RAYS. Swinton. Lond. "Elec. Rev.," July 15; abstracted briefly in Lond. "Elec.," July 15.—A Royal Society paper describing his experiments with a pin-hole camera (illustrated in the former journal) in which the image is seen on a screen through a tube. On directing it toward the anti-cathode he noticed that when the latter intersects the cathode stream at its focus, the dimensions of the active area are independent of the exhaustion, while they increase with the exhaustion in any other case. With an anti-cathode inclined to 45° to the axis of the conical cathode stream, it is found that those portions of the stream which are most normal to the anti-cathode surface are considerably the most efficient in producing X-rays. The fluorescent portions of the tube walls also produce these rays; this fluorescence is not produced by the cathode rays, but by the anode rays from the anti-cathode; there is only a difference of degree in the two kinds of rays.

VELOCITY OF IONS CAUSED BY ROENTGEN RAYS. Zeleny. (Univ. of Minn.), "Phil. Mag.," July.—A long article on the ratio of the velocities of the two ions produced in gases by Röntgen radiation, and on some related phenomena. The object is to show that the positive and negative ions which take part in the conduction of gases exposed to X-rays move with different velocities when exposed in the same electric field; also to determine the relation of these gases in several cases and to consider several phenomena which are consequences of and are affected by the difference in the two values.

CATHODE RAYS. Jaumann. "Wien. Akad. Sitzber.," 106, p. a number of articles. One on cathode rays by Wiedemann and Schmidt, from the "Wied. Ann.," 62, p. 603; another on the relation between the positive light and the obscure cathode region by Wiedemann, from the "Wied. Ann.," 63, p. 242; another on the mutual influence of the different regions of the same cathode, by Wiedemann, from the "Wied. Ann.," 63, p. 246; another on the deflection of cathode rays by Kaufmann and Aschkinass, from the "Wied. Ann.," 62, p. 588; and another on the magnetic deflection of cathode rays by Kaufmann from the "Wied. Ann.," 62, p. 596.

CATHODE RAYS. Jaumann. "Wien. Akad. Sitzber," 106, p. 533; abstracted briefly in "Science Abstracts," June.—He describes more fully the details of his experiments with the interference of electrostatic deflection of these rays.

DEFLECTION OF CATHODE RAYS. Kaufmann. "Wied. Ann.," No. 6; abstracted briefly in the Lond. "Elec.," July 15.—He superposes a magnetic upon an electrostatic deflection and from the resulting deflection he draws important conclusions. The deflection is inversely proportional to the square root of the difference of potential between the anode and the cathode. If along any given length of path a certain potential is maintained, the anode ceases to exert any influence and the deflection is inversely proportional to the square root of the difference of potential between the length in question and the cathode. The deflection obeys the law indicated by the emission theory.

STRUCTURE OF CATHODE LIGHT. Goldstein. "Berlin Akad. Sitzber," 40, p. 905; abstracted briefly in "Science Abstracts," June.—He describes the three distinct kinds of radiation.

BI-POLAR DISCHARGE. Wien. "Wied. Ann.," No. 6; abstracted briefly in the Lond. "Elec.," July 15.—He abolishes the distinction between anode and cathode rays, substituting the expressions "streams of positive and negative particles"; that is, it is claimed, shows a victory of the English view. Both kinds of light contain admixture of particles of the opposite sign, which he shows by an arrangement in which the cathode is put into an out-of-the-way side tube. The anode emits positive particles from its front surface, and the cathode, negative particles; both, if perforated, also emit particles of an opposite sign, though to a lesser extent.

FREE ELECTRICITY IN GEISSLER TUBES. Riecke. "Ann. Phys. Chem.," 63, p. 220; noticed briefly in "Science Abstracts," June.—He calculates the volume and surface density of the charges at various points in the tube.

RECTIFYING ALTERNATING CURRENTS. Janet. "L'Eclairage Elec.," July 2.—A reprint of an Academy paper in which he discusses the following problem: Given a Gramme ring with a commutator and two brushes, and either without magnets or without excitation of the magnets; by means of two slide-ring contacts connected to diametrically opposite points of the winding an alternating current is led through it, the effective value being maintained the same; the ring is revolved synchronously by means of a motor; what will then be the nature of the potential at the two brushes? It is discussed analytically, and the results of some tests are given. He arrives at the conclusion that in the development of the Fourier series of the voltage of one of the Paris stations the coefficient of the principal term will be numerically equal to the effective value of the voltage.

MECHANICAL FORCE ON IRON CARRYING A CURRENT. J. J. Thomson. "Phil. Mag.," July.—A short article on the mechanical forces acting on a piece of iron carrying an electric current; he shows how this force can be calculated, it being the sum of the force due to the currents alone plus the magnetic forces.

ROTATIONS IN UNIFORM ELECTRIC FIELDS. Schweidler. "Wien. Akad. Sitzber.," 100, p. 526; abstracted in "Science Abstracts," June.—A mathematical discussion of the general case. the conductivity of both sphere and surrounding medium being at the outset treated as finite.

PARADOXICAL CONDENSER DISCHARGE. Swyngedauw. "L'Eclairage Elec.," July 9.—A reprint of an Academy note in which he discusses an apparent paradox in the derived discharge from a condenser. Under certain conditions it has been shown that the quantity of electricity which passes through a certain shunt coil is much greater than the discharge from the condenser itself; numerous explanations have been proposed for this apparent paradox; he offers another and simple explanation. Under certain conditions this discharge may be ten times as great as the whole charge in the condenser.

COHERERS. Rovelli. "Elettricita," 17, p. 36; noticed briefly in "Science Abstracts," June.—He uses a coherer made up of iron filings. with two thin wire contacts; a mere touch, or even only blowing on it, will restore the needle to its position.

CONTACT ELECTRICITY. Pellat and Sacerdote. "Jour. de. Physique," 7, p. 24; abstracted at some length in "Science Abstracts," June.—A mathematical article.

CONTACT ELECTRICITY OF METALS. Kelvin. "Phil. Mag.," July.—A very long paper which was read at the Royal Institution May 21, 1897.

CONDUCTIVITY OF ELECTROLYTES. Kohlrausch. Holborn and Diesselhorst. "Wied. Ann.," 64, p. 417; abstracted, with some tables of the values, in the "Zeit. f. Elektrochemie," July 14.—An abstract of the paper recently noticed in the "Digest" in which they reduce the conductivities to a common unit.

CONDUCTIVITY OF NITRIC ACID. Veley and Manley. "Chem. News," 76; abstracted briefly in the "Zeit. f. Elektrochemie," July 14.—They give the results of measurements at different concentrations.

DIELECTRIC CONSTANTS OF LIQUID MIXTURES. Philip. "Zeit. Phys. Chem.," 24, p. 18; abstracted briefly in "Science Abstracts," June.—He measured them with a modified Nernst method.

CONDUCTIVITY OF HOT GASES. McClelland. "Phil. Mag.," July.—A paper describing investigations of the nature of the conductivity, not of the flame itself, but of the gases taken from the flame

RECENT RESEARCHES WITH THE ELECTRIC ARC.—"Elektrochem. Zeit.," July.—A summary of recent researches with references to the counter-electromotive force, polarization, etc.

ATMOSPHERIC ELECTRICITY.—"Zeit. fuer Elek.," July 3. An abstract of a paper by [illegible] mospheric electricity. He comes to the conclusion that atmospheric electricity is produced by the action of ultra violent radiation from the sun on the ice crystals in cirrus clouds.

ELECTRO-PHYSICS. "Science Abstracts," June.—Abstracts of a large number of articles which are of interest to physicists rather than electrical engineers; a number of them will, therefore, not be mentioned here specifically; a number of them are abstracts of articles in foreign languages already noticed in the "Digest."

MAGNETIC SUSCEPTIBILITY OF LIQUID OXYGEN. Fleming and Dewar. Lond. "Elec.," July 15.—The conclusion of the reprint of their Royal Society paper (see "Digest" July 23); it contains detailed tables of the results of their experiments. The susceptibility of balls of silver, bismuth, copper and of glass filled with mercury were measured, as was also that of water; with the aid of these they then measured the susceptibility of liquid oxygen. The mean value of the six sets comprising thirty-six determinations was 324 multiplied by 10 to the minus sixth power; this gives for the permeability 1.0041, which agrees within one part in a thousand with their former determination by a totally different method. He also determined the change in paramagnetic susceptibility of crystallized manganous sulphate, and found that it was increased by cooling, so that its value varies inversely with the absolute temperature and is increased threefold by cooling to the temperature of liquid oxygen; their tests show that this law may be valid over very wide limits and to very low temperatures. They think it possible that for paramagnetic bodies, over very wide limits of density and temperature, the law holds good that the magnetic susceptibility varies directly as the density and inversely as the absolute temperature. In an editorial reference it is said that if this is found to apply generally to paramagnetic bodies it will constitute one of the most important physical laws discovered during the last half century; it is suggested to call it the Fleming and Dewar law; it appears to be true, for certain substances at least, over a temperature sufficiently wide to cover more than one physical state of the substance—that is, for the gaseous and liquid states, for instance.

MAGNETIC SUSCEPTIBILITY OF LIQUIDS. Jaeger and Meyer. "Wien. Akad. Sitzber.," 106, p. 594; abstracted in "Science Abstracts," June.—A description of the apparatus and experiments.

ELECTRIC AND MAGNETIC OSCILLATIONS IN HERTZ WAVES. Waitz. "Ann. Phys. Chem.," 63, p. 234; abstracted briefly in "Science Abstracts," June.—His object was to show that the electric and magnetic waves possess different damping coefficients when passing through the same conductor.

EQUILIBRIUM FIGURES FORMED BY FLOATING MAGNETS. Wood. (Univ. of Wis.) "Phil. Mag.," July; abstracted briefly in the Lond. "Elec.," July 15.—A short article describing his method of showing Mayer's well-known experiment with floating magnets, showing how he overcame some of the difficulties involved. He uses a shallow glass dish partly filled with mercury, above a large, vertical electromagnet, and drops small, clean bicycle balls onto the mercury; these will arrange themselves in the forms shown by Mayer; illustrations of these forms are reproduced.

POWERFUL ELECTROMAGNET.—Lond. "Elec. Rev.," July 15.—An illustrated description, with dimensions, of the one designed by Weiss and referred to in the "Digest" June 11, July 9.

VACUUM TUBES. Ferry. "Phys. Rev.," July.—A description of an investigation to study photometrically the changes produced in the spectra of pure gases when subjected to various conditions of current and pressure in vacuum tubes. He found that the luminosity of the lines at a given pressure is directly proportional to the current strength; with a constant current it increases as the pressure decreases, at first slowly, then more rapidly.

EFFECT OF CATHODE RAYS ON GEMS.—"Sc. Am.," July 30.—A note stating that according to Crookes various gems and minerals glow with a beautiful phosphorescence in the cathode rays of vacuum tubes. It seems that the gems have characteristic colors when subjected to these rays, and in this way they may be tested without injury. (The note is headed X-rays, but it appears [illegible]

HIGH FREQUENCY INDUCTION COIL. Boynton. "Phys. [illegible]

[illegible] ANALYZER. Le Conte. "Phys. Rev.," July.—[illegible]

[illegible]

[illegible]

Electro-Chemistry and Batteries.

ELECTROLYSIS OF ZINC CHLORIDE. Foerster and Guenther. "Zeit. f. Elektrochemie," July 7.—They describe researches with neutral, acid and basic solutions of chloride of zinc, but the conditions are not given in condensed form. The second part refers to the nature of zinc sponge; it appears that zinc sponge is formed when the nature of the liquid in the immediate neighborhood of the cathode is altered by the decomposition; its formation is prevented if a little free acid is added continually; it is important that this acid electrolyte circulates rapidly over the cathode at not too small a velocity. The conditions for the formation of zinc sponge are very complicated, but are all due to the same original causes. They also found that by the addition of a neutral solution of persulphate of ammonium to a neutral solution of 250 gr. sulphate of zinc to the liter, a good deposit will be obtained with a current density of 1 ampere per sq. dm., and there will be no spongy deposit. When proper care is taken the formation of zinc sponge may be prevented entirely.

ELECTRODEPOSITION OF ZINC. Cowper-Coles. Lond. "Elec.," July 15.—A brief description of some recent investigations concerning the formation of zinc sponge. An analysis of the zinc sponge is given, showing numerous ingredients, and some experiments are described which are intended to throw some light on the subject of the formation of this sponge. The cathode was made of a thin aluminum plate, rotated in a horizontal position, and the solution was circulated; gas was projected beneath the anode; the current density was 15 amperes per sq. ft., and the voltage was 2; the deposit, when no gas was passed, was very spongy; the same was true when oxygen and air were used, but coal gas and carbon di-oxide gave good results, and there was practically no sponge formed; the deposits are illustrated.

ZINC EXTRACTION. Threlfall. "Science Abstracts," June.—An abstract of the article noticed in the "Digest" last year, describing the Ashcroft process used in a plant in New South Wales.

REFINING AND RECOVERY OF TIN. Cowper-Coles. Lond. "Elec. Eng.," July 15.—Brief descriptions of several of the methods which have been proposed.

REFINING LEAD ELECTROLYTICALLY. Cowper-Coles. "Elektrochem. Zeit.," July.—A short article describing briefly several processes which have been proposed.

PELETAN-CLERICI PROCESS. Witter. "Zeit. f. Elektrochemie," July 7.—A brief description of the tests of this apparatus made in Hamburg, where it was tried with thirty-five different ores.

SEPARATION OF METALS.—"Science Abstracts," June.—Brief abstracts of the recent articles by Waller and by Stortenbeker, recently noticed in the "Digest," on the separation of cadmium, zinc, cobalt, antimony, tin and iron.

ELECTROLYTIC PREPARATION OF OXYGEN AND HYDROGEN.—"L'Eclairage Elec.," July 9.—A brief reference to a commercial plant in Brussels. The electrolyte is a solution of soda maintained at a temperature of 40° C.; the voltage is 2.5 and the current 350 amperes; this corresponds to 22,000 watt hours, 1680 cb. m. of oxygen and 3360 cb. m. of hydrogen, per twenty-four hours; the energy required for producing 1 cb. m. of oxygen and 2 cb. m. of hydrogen is therefore 12.2 kw-hours; at a cost of 0.2 cents per kw-hour produced by water power or 1.2 cents when produced by steam, the cost of 1 cb. m. of oxygen and 2 cb. m. of hydrogen will be 2.44, or 15 cents, respectively. The oxygen is 90 per cent. pure and the hydrogen 99 per cent.; as the impurity in the oxygen is almost only hydrogen and vice versa, it is very easy to purify these gases, as they are merely passed through a red-hot tube, after which the water formed by their combination is absorbed.

PRODUCTION OF CHLORATES, BROMATES, ETC. Vaubel. "Chem. Zeit.," 22, p. 331; abstracted briefly in the "Zeit. f. Elektrochemie," July 14.—He describes a new process for the electrolytic production of chlorates, bromates, iodates, and hypochlorites. A cell is divided by means of a diaphragm; the anode chamber contains a saturated solution of potassium or sodium bicarbonate, and the cathode space a saturated solution of alkaline chloride, all heated to 60 or 70° C., and a current passed, the chlorine carried to the anode will be completely transformed into the chlorate. In the same way bromates, etc., of great purity may be produced.

ELECTROLYSIS OF ALKALINE CHLORIDES. Winteler. "Zeit. f. Elektrochemie," July [illegible].—The first part of an article giving the results of investigations in the decomposition of chloride of potassium, with special reference to the practical application. The question of carbon electrodes is discussed and he claims that by following certain precautions this material is well adapted. The [illegible] described, but no general conclusions are given.

[illegible] SOLUTIONS. Glaser. [illegible]

ALUMINUM ELECTRODES. Wilson. Lond. "Elec. Eng.," July [illegible] Royal Society paper which [illegible] to the passage [illegible] containing alum [illegible] to papers which deal [illegible]. The first part refers to direct currents, and describes the experiments which he performed. There were two cells with aluminum and carbon electrodes, each having 30 square inches area; an exploring electrode consisting of a platinum wire was inserted midway between the two plates, and the two cells were connected in series, the only difference being that the distance between the plates was twice as great in one than in the other; he used 44 volts. When the negative battery pole was connected to the aluminum and the current was 3.6 amperes the voltage was 4.4 and gas was freely evolved; on reversing the connections the current became zero and the voltage 22. A table shows the potential between the exploring electrode and the plates; it appears that the current on reversal first crossed the zero and finally became zero. In the next test pure water was used, and to one cell was added sulphuric acid, while the other contained potash alum; they were left for forty-seven hours with one-twenty-fourth of an ampere; on breaking the circuit the voltage in the first was 0.38, gradually rising to 2.4, while in the latter cell the potential fell to zero; for a reverse current of the same value the former gave 0.24 and the latter 1.29 volts. The aluminum plate which has been formed in the acid was then washed and placed in an alum solution, and it allowed 0.2 ampere to pass, while the one formed in the alum allowed only 0.083 ampere to pass. No general conclusions are drawn in this first portion.

METALLIC SULPHIDE ELECTRODES. Bernfeld. "Zeit. f. Phys. Chem.," 25, p. 46; abstracted briefly in the Lond. "Elec. Rev.," July 15.—He describes the changes which occur in electrolysis with electrodes of metallic sulphides.

POLARIZATION IN ALCOHOLIC SOLUTIONS. Haschek. "Wien. Akad. Sitzber.," 106, p. 580; abstracted briefly in "Science Abstracts," June.—Results of tests.

ELECTROCHEMICAL BEHAVIOR OF CHROMIUM. Hittorf. Lond. "Elec.," July 15.—An abstract of the paper noticed in the "Digest" July 30.

ACCUMULATOR.—"Elektrochem. Zeit.," July.—A short description of an accumulator made by a Berlin company and called the G. m. b. H. The object was to find a binding material which will make the mass more solid and less destructible; it was found that organic hydrocarbons used as a binding material for the lead oxide and answer all requirements (no further reference to any particular hydrocarbons is given). The accumulators thus constructed are said to be exceedingly strong, of light weight and to have a very great capacity; according to the tests made by the Reichsanstalt the capacity is 74.7 ampere hours per kg of positive electrode; according to the company's own measurements it was 20 ampere hours per 1 kg of weight of complete cell, under conditions of the most favorable efficiency (meaning, probably, at a very slow discharge). The electrodes consist of a frame like that for a slate, and made of hard metal. (No figures are given concerning the life of such plates nor the rate of discharge which they will stand.)

STRENGTH OF ACID IN ACCUMULATORS. Dolezalek. "Science Abstracts," June.—A brief abstract of the articles noticed in the "Digest" on the variation of the E. M. F. and efficiency of lead accumulators with the strength of acid. He considers that Liebenow's theory is the only one which can be consistently maintained; the differences in the E. M. F. with different concentrations are shown to be in excellent accordance with the calculated values; the low watt efficiency is believed to be due to the fact that the action is only partially reversible; it is calculated that the accumulator should work with maximum efficiency with acid of maximum conductivity—that is, with 30.4 per cent. of sulphuric acid; experimental results agree with this.

ACCUMULATOR CONSTRUCTION. FitzGerald. Lond. "Elec. Eng.," July 15.—In this continuation of his long serial he continues the discussion of the weight of the plates.

PERIODIC TESTS OF ACCUMULATORS.—Lond. "Elec. Eng.," July 15.—Replies to a request to state what periodic test should be made, what records should be kept, and how the cells should be treated.

RELATION OF CHEMISTRY TO ELECTRICAL ENGINEERING.—Lond. "Elec. Rev.," July 15.—A short editorial article showing the close relationship between these two sciences. It is thought that the principal problem for the chemist is not to find a cheap source or energy, but to develop and perfect the electrolytic apparatus in which the energy is utilized. A paper by Burgess in the "Wisconsin Engineer," Vol. 2, No. 2, is highly recommended.

CONGRESS OF APPLIED CHEMISTRY.—"Zeit. fuer Elek.," July 10.—The programme of the third International Congress for Applied Chemistry, which is to meet in Vienna from July 28 to August 2.

Units, Measurements and Instruments.

MEASURING QUANTITY OF ELECTRICITY DIRECTLY; A NEW METER. Blondlot. "L'Eclairage Elec.," July 2, and "L'Elec.," July 16.—A reprint of a short Academy paper describing an interesting method of measuring quantity of electricity directly in electro-magnetic units and an application of this to a meter. A long, hollow, coil is placed horizontally; at its centre there is a second coil of several turns of wire, having the form of a ring; this is suspended in a vertical plane, so that it can turn freely around its vertical diameter; the same current flows through both of them. The earth's magnetism having first been compensated, the inner coil, by the action of the current, takes a position of equilibrium in which its windings are parallel to those of the fixed coil. If the movable coil is deflected slightly it will make isochronous oscillations; he proves that, whatever be the intensity of the current and the frequency of the oscillations, the quantity of electricity which passes through a section of the circuit during one oscillation is always the same. He then shows how this quantity may be calculated so as to give the reading directly in electromagnetic units. To apply this principle to a meter it is only necessary to produce and count the oscillations; during each oscillation the quantity of electricity is the same, whatever be the current strength, and to obtain the total quantity during a certain time it is only necessary to multiply this quantity by the number of oscillations during that time; this is theoretically exact, but only if the variations in the intensity of the current take place only at the moments when the movable coil passes through its position of equilibrium, but this error is in general absolutely negligible in practice. In the suggested application the movable coil has a lever which projects beyond the fixed coil, and in its middle position it makes contact with a spring, closing the circuit of a magnet, which attracts that spring, so as to push the pointer in the opposite direction; thus at the end of every half oscillation the lever and its coil receive a fresh impulse; by means of a ratchet the electromagnet moves a recording wheel one tooth for each oscillation, thus recording the number of oscillations; the force imparted to the coil by the magnet has no influence on the duration of the oscillation, provided the oscillation is small. A number of models have been constructed, as well as a commercial form of meter, but the latter is not described. Instead of calculating the constant, the meter is calibrated empirically; a number of trials have shown that the ratio of the current intensity to the number of oscillations in a given time is independent of the current (that is, the current is proportional to the number of oscillations); for a meter registering up to 11 amperes it was only below 0.5 amperes that this proportion began to vary appreciably. Such a meter is applicable to alternating current as well as continuous; it will start even with a current of less than 0.1 amperes, owing to a device not described.

CALIBRATION OF LOW RESISTANCES. Fisher. Lond. "Elec.," July 15.—A discussion of the Mueller and Wallau method and of Callendar's comments (see "Digest," last week). He claims that when great accuracy is required the difficulty is due to the calibration of the slide wire proposed by Callendar; he claims that an accuracy such as is claimed by the latter in the calibration of this wire is very rare. He makes frequent references to the Crompton potentiometer, which he praises very highly; very low resistances cannot be measured with the potentiometer by means of the Clark cell, except with an abnormally large current, but with the Crompton instrument this cell is not used in such comparisons, the standard being the difference of potential at the terminals of a known or standard resistance in series with the one to be measured and a source of constant current. For high-class work no bridge method is comparable with that of the potentiometer.

MEASURING THE RESISTANCES OF ELECTROLYTES. McIlhiney. "Industries and Iron," 24, p. 245; noticed briefly in "Science Abstracts," June.—He describes a new method, which is a slight improvement of the ordinary potentiometer method. The electrolyte is connected in series with a known resistance and the potential difference at the terminals of the latter is observed; the electrolyte is then replaced by a second known resistance, the first being still in circuit; the potential difference is again observed at the same point as before; at the terminals of the electrolyte the current is alternated by a rotary commutator, but the current through the known coil is always direct. The method is said to be probably of use for approximate rapid measurements.

MEASURING MAGNETIC INDUCTION. Orlich. "Zeit. Instrumentenkunde," 18, p. 39; noticed briefly in "Science Abstracts," June.—A description of the experiments of the Reichsanstalt with the Koepsel instrument (see ELECTRICAL WORLD, last week, p. 114); the results show that for soft iron this instrument gives exceedingly accurate values, but somewhat less so for steel, although sufficient for practical purposes.

PERMANENCE OF MANGANIN RESISTANCES. Jaeger and Lindeck. "Zeit. f. Instrumentenkunde," 18, p. 97; abstracted in "Science Abstracts," June.—A description of the tests at the Reichsanstalt. They found that manganin copies of the standard ohm may even have greater constancy than the mercury standards; "patent nickel" alloy appears to have the same order of constancy as manganin (for this alloy see Lond. "Elec. Rev.," 42. p. 536, et seq.); mercury resistances diminish with time, and in the course of five or six years the diminution may amount to about a ten-thousandth of the nominal value; with manganin the tendency is for the resistance to increase; the greatest change in a 1-ohm coil is 55 millionths of the total resistance in five years. The second part of their investigations relates to tests of the constancy of manganin resistances of fractional parts of an ohm; the change was a little more than 0.01 per cent. in 2.5 years. In other tests of manganin coils of high resistances they found a very decided variation with time.

METALLIC RESISTANCES. Scott. Lond. "Elec. Rev.," July 15.—The first part of an article including several large tables which, if reliable, appear to be of value; they are for designing starting and regulating resistances. The first table, which has been compiled from many sources, and thus gives the average values, is for German silver, platinoid, iron and manganin. It gives the yards per pound and the pounds per yard, as common to all the materials, which is approximately correct; the watts per yard for a rise of

50° C. is also given as common for all four; the normal current in an iron frame represents approximately the safe current which it will carry continuously when wound as a vertical spiral with good ventilation; the diameters of the mandrils are given; the wire is usually wound as a closed coil, and then pulled out to about double its length, or somewhat more for the smaller wires, which lack stiffness; another column gives the current which these wire coils will carry for one minute, and these appear to be exactly double the other currents; the resistances and their reciprocals, as also those per 100 turns, are given. No 24 and No. 8 B. W. G. are generally the smallest and largest wires used. Another table gives the particulars for Hadfield's "resista," which is a manganese steel alloy having a resistance of 75.5 microhms per cb. cm.

ELECTROCHEMICAL ACTINOMETER. Rigollot. "Jour. de Physique," 6, page 520; abstracted briefly in the "Zeit. f. Elektrochemie," July 14.—This apparatus is said to be well suited for photometric measurements, and depends on the fact that a difference of potential will arise between two metallic plates in the same solution, on one of which the light falls, while the other is in darkness; heretofore only silver and silver salts were used; in the present article he describes investigations with other metals; a short table of the results is given in the abstract.

PYROMETRY. Stansfield. "Phil. Mag.," July.—A reprint in full of the Physical Society paper noticed in the "Digest" April 23, in which he describes some improvements of the Roberts-Austin recording pyrometer and includes some notes on thermo-electric pyrometry; the modifications were made in order to obtain large scale temperature records with a high degree of accuracy.

THERMOPILES. Rubens. "Zeit. Instrumentenkunde," 18, p. 65; abstracted briefly in "Science Abstracts," June.—The objections to the Melloni thermopile are sluggishness and the doubtful zero; by reducing the thermal capacity of the parts he succeeded in making an instrument of extreme sensitiveness; he uses iron and constantan in the form of fine wires, and is able to measure with certainty of one-millionth of 1° C.

DIRECT-READING PHASE METER. Bruger. "Elek. Zeit.," July 14.—The complete paper, of which an abstract was noticed in the "Digest" July 16; illustrations of the apparatus are given.

REGISTRATION OF ATMOSPHERIC DISCHARGES. Ducretet. "L'Elec.," July 16.—A short Academy note in which he mentions the registering of atmospheric discharges by means of the receiver for a wireless telegraphy apparatus. In about one hour during which there was a storm this receiver recorded automatically 311 intermittent atmospheric discharges; these were registered before the appearance of the lightning or the noise of the thunder.

STANDARDS OF LIGHT. Laporte. "Bul. Soc. Int. des Elec.," May.—The complete, long paper, an abstract of which was noticed in the "Digest" June 4.

CLARK CELLS ON CLOSED CIRCUIT. Wulf. "Wien. Akad. Sitzber.," 106, p. 526; noticed, with the results, in "Science Abstracts," June.—He made measurements on small cells of the standard pattern.

BALLISTIC GALVANOMETRY. Barus. "Phys. Rev.," July.—A description of a proposed new method of reading ballistic galvanometer deflections which he thinks offers some advantages. The needle is provided with stops, so that it can be deflected in only one direction, and it is held against these stops by the torque of a twisted fibre; when the current passes, the deflection will be less in proportion as the counter torsion is greater; the charge may then be expressed in terms of the observed twist, provided the deflection is a fixed value in all the experiments; the needle practically does not leave the plans of the coils. The theory of the arrangement is discussed at considerable length.

TEN-CANDLE PENTANE STANDARD.—"Prog. Age," July 15.—A short description, without any illustration, of Harcourt's standard.

SPEED INDICATOR. Browne. "El'ty," July 27.—A brief, illustrated description of an instrument consisting of a small, permanent magnet dynamo, the armature of which is made to revolve by being connected with a flexible shaft to the shaft whose speed is to be indicated. The voltage of this dynamo will be directly pro-[illegible]

PREPAYMENT METERS.—"Sc. Am. Sup.," July 23.—A reprint of the illustrated article noticed in the "Digest" July 2.

Telegraphy, Telephony and Signals.

[illegible]

[illegible]

TELEPHONES. Preece. Lond. "Elec. Eng.," July 15.—An abstract of his recent evidence before a committee. While in certain German cities the telephone is developed to a phenomenal extent, and far more so than in England, yet, taking the country as a whole, England is not in as bad a position as has been represented; the telephone is in the hands of the post office in Germany, and is unincumbered by any restrictions. He condemned the automatic exchange, but not for mechanical reasons.

ELECTRIC CLOCK.—"Elek. Zeit.," July 14.—A brief, illustrated description of the Kessel clock. The pivoted armature consists of two permanent magnets shaped something like a star with alternate N. and S. poles; these are opposite four radial electromagnets, through which a reverse current is passed once every minute; the armature will thus be turned each time through one-quarter of a revolution and held there; this armature operates the hands of the clock.

HAWAIIAN CABLE.—"Eng. News," July 21.—A note stating that the contract for this cable was signed July 2 on the part of the Hawaiian Government. It gives the Pacific Cable Company, of New York, an exclusive right for cables between those islands, United States, Japan and China, including also the Ladrones and the Philippine islands, subject to authorization by Congress. It is to go from San Francisco, the distance being 2097 miles; the total distance from San Francisco to Japan will be 6500 miles, or including 16 per cent. slack, about 7500 miles; the estimated cost of the cable and repair ship is $7,500,000. Official messages of the United States are to be transmitted free of cost forever.

SHIP TELEPHONE.—"Sc. Am. Sup.," July 16.—In an illustrated description of the Spanish battleship Pelayo there is included a description of the telephone system, with illustrations of the apparatus and the diagram of connections.

SWITCHBOARD FOR TOLL LINES. Clausen. "West. Elec.," July 23.—A short, illustrated description of a uniform method of interconnecting toll line circuits.

TRANSMITTING PICTURES.—"Sc. Am. Sup.," July 30.—A few further illustrations, accompanied by a brief description, of the Szczepanik invention, which was noticed in the "Digest" July 23.

Miscellaneous.

VACUUM DRYING CHAMBERS. Lond. "Elec." and "Elec. Eng.," July 15.—A short, illustrated description, the illustrations being better in the former journal, of some chambers for drying cables and other electrical apparatus; by using a vacuum in addition to heat the drying is effected in the smallest possible time and with the greatest thoroughness; the temperature need not be nearly as high as with the old method.

CARBONS. Jehl. Lond. "Elec.," July 15.—In this continuation of his long, illustrated serial he describes various presses and press pumps used in carbon factories in Germany.

MECHANICAL APPLICATIONS OF ELECTRICITY. Richard. "L'Eclairage Elec.," July 9.—Brief, well-illustrated descriptions of various applications taken from patent specifications.

ELECTRICITY AND THE LAW. Haas. "Elek. Zeit.," July 7.—A reprint of a paper read at the recent meeting of the Union of German Electrical Engineers. He shows that the electrical industry does not enjoy the protection of the law which is extended to other industries, as the stealing of electrical energy is not punishable and only on technical grounds. He recommends that the society take action for obtaining proper legal rights.

RESISTANCE OF THE HUMAN BODY. Dubois. "L'Eclairage Elec.," July 9.—A reprint of an Academy note in which he describes the determination of the relative value of the period during which the resistance is variable, under the different conditions of resistance, self-induction and capacity and circuit.

EXHIBITION.—"L'Eclairage Elec.," July 2.—Brief descriptions of some of the electrical exhibits at the Conservatoire des Arts et Metiers, including Guillaume's magnetic short circuit, described elsewhere, Richard's energy meter, which reads directly and at the same time registers, and some measuring instruments by Demichel, one of which is a double rate meter.

PRIZES.—"Elek. Zeit.," July 14.—A list of the prizes, as far as they concern electrical subjects, offered by the Industrial Society of Muelhausen.

CANADIAN ELECTRICAL ASSOCIATION.—"Can. Elec. News," July.—A very full record of the proceedings of this meeting [illegible] Some of these have already been noticed in the "Electrical World."

[illegible] "Jour. [illegible]," June.—A short article on the [illegible]

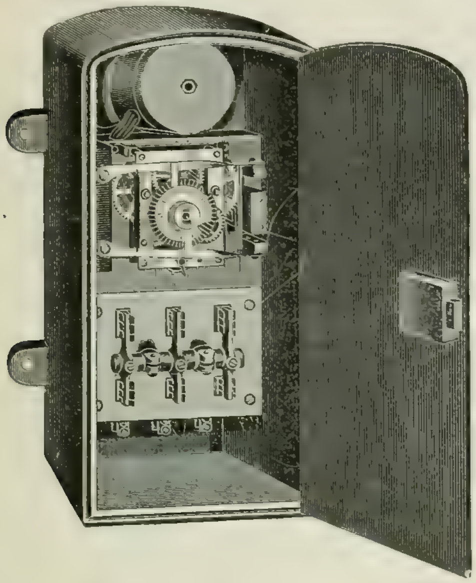
Automatic Cut-In and Cut-Out Electric Time Switch.

[illegible]

[illegible]

switch, operated by an electro magnet in conjunction with a lever and spring, whereby an instantaneous break or opening and closing of the circuit is obtained, the operating current being controlled by an eight-day clock movement.

Two discs or dials are mounted on the hour stem of the clock movement, and are held in position by means of an adjustable thumb nut. These discs or dials are divided into twenty-four sections, representing the hours of a solar day. Each dial has a zero point notched in the periphery, which allows a lever or contact arm to drop at the zero point. When time of switching on arrives (small dial) this contact arm closes a circuit through one of the magnet coils, which, acting on the lever and spring referred to, closes the knife switch, thereby completing circuit. This action of the magnet in turn opens the knife switch when the time arrives (large dial) for the cutting out of the lights or supply of current to the circuit. The current that is utilized in operating the magnets is controlled by circuit breakers, which prevent a constant flow of current passing through the magnet coils, therefore no current is consumed in throwing the switch except when the time arrives for switching on and off, and then only for a period of a second of time. This makes the action of the switch positive and prevents any injury to the magnets from an excessive flow of current.



AUTOMATIC TIME SWITCH.

This switch will automatically switch on or off a given number of lights or quantity of current at a predetermined time, and will perform its work in a satisfactory manner, owing to the reliability of the switch in its electrical and mechanical construction and the accuracy of time when both of the above actions take place. It will effect an immense saving that will accrue to the consumer of current on the meter basis, and likewise to the producer of illuminating companies in reduction of labor necessary for switching, aside from the saving made in the consumption of current gained in having all street arc light switched on at the same time. The switch operates and performs its work successfully on direct current two or three wire systems.

Improved Electric Heaters.

In constructing an electric heater the object sought is to transfer the heat generated in the device to the surrounding air. It is evident, therefore, that the greater the surface of the heating device exposed to the air the more readily will the heat be dissipated.

Some improved forms of heaters have been brought out by the Gold Street Car Heating Company, of New York. The resistance coils are supported in such a way that the support itself, while holding the wire firmly in place and not permitting vibration, offers the least possible amount of friction of the flow of air through the heater. The support consists of a one-fourth inch steel rod, which is thoroughly covered with an insulating enamel burned on the rod at a temperature of over 2000 degrees. This enamel is said to be an excellent non-conductor, and is not affected by any heat to which it will have to be subjected in practice. The rod is in wave form, as shown in Fig. 1, and the resistance coil when slipped onto it is supported in the manner indicated in the illustration.

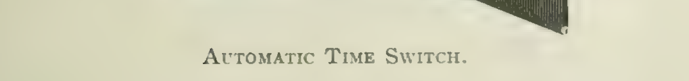


FIG. 1

The composition of the resistance wire itself has been the subject of special attention, and is said to combine high resistance with non-corrosive qualities. The wire has been tried under all conditions, and has never failed. The resistance coil is wound on an open pitch, so that when it is placed on the rod it is in its natural condition and not subjected to any strain whatever. By this form of construction a large amount of wire can be placed in a small compass without resorting to the use of a bulky and solid core, at the same time an even temperature on the wire itself is secured and free circulation of air through the coil obtained. It is stated that tests of these improved coils show that they have at least 30 per cent. greater efficiency than other heaters of this class. The company is using this form of construction in all electric heaters which it now manufactures.

An improved form of electric car heater sets into the panel under the seat, the front of the heater being flush with the panel. It is lined with asbestos, and is provided with an air space at the top. The coils are so arranged that the upper sets are in multiple and the lower set in single series. Usually six of these heaters are applied to a 24-foot car, and the heat graduated to three different degrees by turning the handle of a switch to any one of the three different points. Fig. 2 shows an interior view of a small-size panel heater. The coil used in this heater and the support are the same as those used in the three-degree heater.

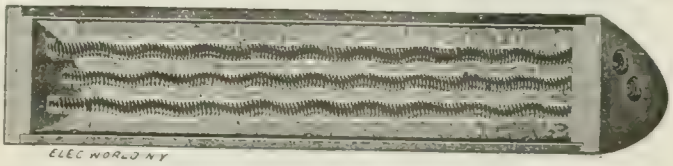


FIG. 2.

The Gold standard electric heater is shown in Fig. 3. It consists of three improved resistance coils and supports placed in series. These rest on porcelain plugs or caps at either end, and are incased in a cylindrical perforated sheet-iron casing. The heater is 3 inches in diameter and 20 inches long, and is commended for its simple construction and efficiency. It is particularly adapted for cross-seat cars. It is claimed that perfect uniformity of distribution of the heat can always be secured by the use of these heaters, for the reason that they can be placed about the car in such a way that this condition can always be maintained. The heaters are light in weight, and their durability is guaranteed.

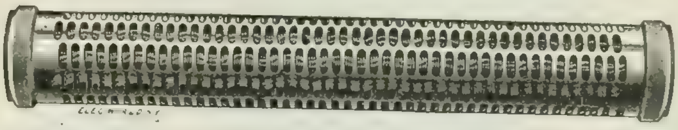


FIG. 3.

The company manufactures besides those above enumerated electric heaters of different styles and sizes for dwellings, office buildings, etc. The portable heaters are fitted with a three-point switch, making it possible to give three different degrees of temperature. They are provided with a flexible cord with plug attached so that it may be connected to an ordinary lamp socket. It is compact, efficient and ornamental, and is of small weight, so that it can be easily moved about from one room to another.

Narrow-Gauge Railway Motor.

The operation of a narrow gauge road demands a railway motor occupying a more restricted space than the motor built for standard gauge roads, while giving the same power. The General Electric Company has manufactured narrow gauge motors for some time past, and many are in actual service giving, it is stated, a high degree of satisfaction. One type of narrow gauge motor now built is the GE-58, which resembles in outer appearance the standard gauge motor, and has an output of 37 horse-power, based on the standard General Electric rating, i. e., a maximum rise of 75° centigrade in the temperature of the windings after a run of one hour at rated load, the temperature of the surrounding air not exceeding 25° C. This motor is built for comparatively heavy service in which the GE-52 motor would be too light, and is especially desirable in cases of combined city and interurban service, with moderately high speeds and heavy traffic. While designed for a minimum gauge of one metre (39¼ inches), the GE-58 may be used with wider gauge roads.

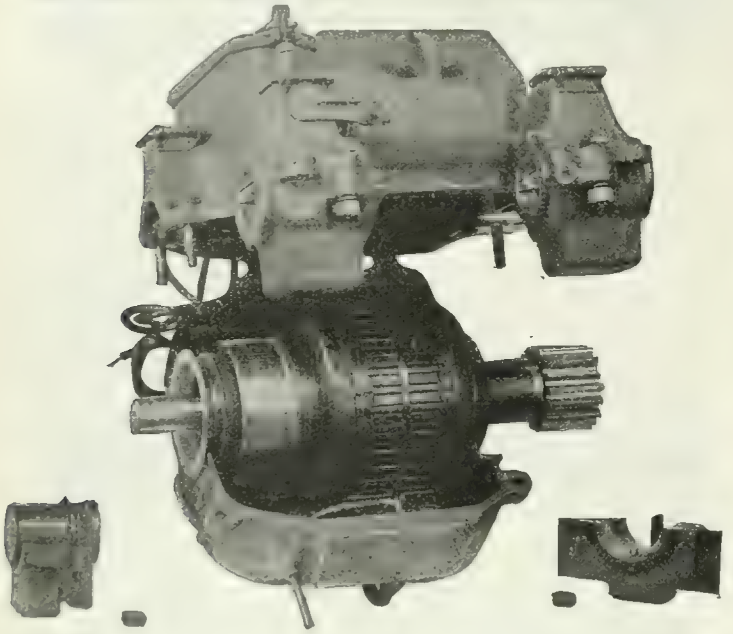
The magnet frame is made of soft steel of high magnetic permeability, cast in two bowl-shaped halves. The frame is divided in a horizontal plane, and the two parts when bolted together completely inclose and protect the armature, commutator brush holders and field coils. Extension pieces are cast on the top at each end, and extend over and partly inclose the car axle. To the under side of these extension pieces are bolted the axle bearing caps bored out to support and inclose the axle linings. The armature supports are made by bolting the bearing caps to the under side of the top frame at each end and boring them to receive the linings. The bottom frame is secured to the top frame by bolts so hinged that when the rear bolts are removed the lower frame will swing down, exposing the armature and field coils for inspection and cleaning. In this position the bottom field coils may be easily taken out, while by removing the armature caps and the bottom half of the gear case the armature and top field coils may be easily removed.

A large opening is provided in the top frame just over the commutator, through which the commutator, brush holders and brushes can be inspected and worn-out brushes replaced. Through the same opening it is possible to remove the brush-holder yoke and brush-holder bodies.

The armature bearing linings are made of machined cast iron, with three-sixteenth-inch Babbitt metal swaged hard and bored to the proper size to fit the shaft. The bearing of the commutator end is 2⅝x6 5-16 inches, and on the pinion end 3x7⅞ inches. The axle bearing linings are similar to the armature bearing linings, and are 8 inches in length and of the required diameter to fit the car axle. The upper supports for these linings are cast with the upper frame; the lower supports are caps bolted to the upper support. All bearings on the motor are provided with grease boxes and oil cellars of sufficient capacity for thorough lubrication.

The motor has four field coils, two in each frame, placed at an angle of 45° from the split, and held in place by pressed steel flanges, or spool holders, clamped by projections on the laminated pole pieces. The pole pieces are held in place by through bolts, with nuts on the outside of the frame, the coils being placed in position when the pole pieces are bolted to the frame. The field coils are wound with round wire insulated with asbestos, and are substantially insulated over all with wrappings of varnished cloth and tape. The insulation between field coils and motor frame is tested by 5000 volts alternating sufficient to thoroughly prove the quality of the insulation.

The armature is of the well-known iron-clad type, and is 14½ inches in diameter, with a spread of 6½ inches. There are thirty-three slots, and each slot contains three coils, collected together and insulated so as to form one triple coil. Hence there are thirty-three triple coils connected with ninety-nine commutator bars. A small number of coils is of special advantage when an armature has to be repaired, and the method of forming the coils into groups of three admits of substantial insulation of high quality. The insulation of the coils consists of specially prepared tape and cloth, which has high insulating qualities, and is impervious to moisture. When the coils are in place on the armature core they will withstand without injury a high potential test of 2500 volts between the windings and the core.


GE-58 Motor.

The commutator is 10 inches in diameter. Its segments are 4⅜ inches long with a wearing depth of 1 inch, and are insulated from the shell by cone clamping insulations of the best quality of pressed mica.. The completed commutator is tested by 5000 volts between segments and shell, and 500 volts between adjacent segments.

The brush holders of cast brass are constructed to receive two carbon brushes per holder. The brushes are 1⅜x2¼x½ inches.

GE-58 motors are adapted to nose, yoke or side-bar suspension. When the motor is mounted on 33-inch wheels the clearance between the bottom of the motor frame and the top of the rails is 4¼ inches; the clearance between the bottom of the gear case and the top of the track is 4¼ inches. The motor without gear or gear case weighs 1865 pounds, and complete, with both gear and gear case, weighs 2150 pounds.

Magneto Bell of New Design.

The accompanying illustrations show a magneto bell of new design, manufactured by the Williams Electric Company, Cleveland, Ohio. The generator

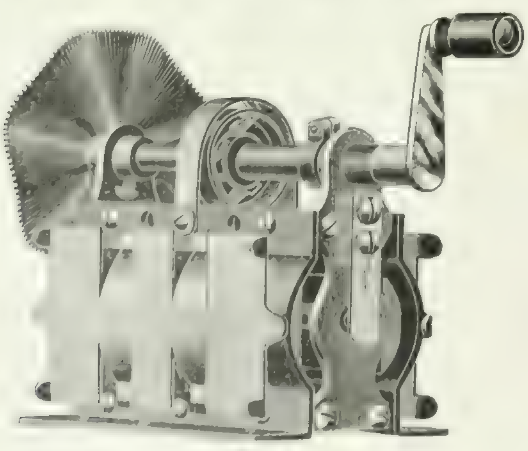


Fig. 2.

[illegible] of an inch in thickness [illegible] held close together onto [illegible] space between the [illegible] magnets around the [illegible] by means of contact [illegible] inwardly to hold [illegible] outwardly to hold [illegible] of the contact plate are left flat or straight, so as to make a good contact surface on the permanent magnets, and two portions are formed so as to make curves coincident with the outside curvature of the pole pieces. By this arrangement a better contact is obtained than in the old way, and at the same time a greater effective length of permanent magnetism. The end plates, which hold the shaft bearings, are punched from heavy brass, and have riveted into them long brass bearings, which insure a quietly running machine for a long period of time. These plates are practically self-centring. This feature is a very important one in making repairs on the generator. The machine can be taken apart and reassembled without the use of any special tools or appliances and with but little trouble. It is equipped with a reliable clutch form of automatic shunt or cut-out which, by reason of its simplicity of construction, is not liable to get out of order.

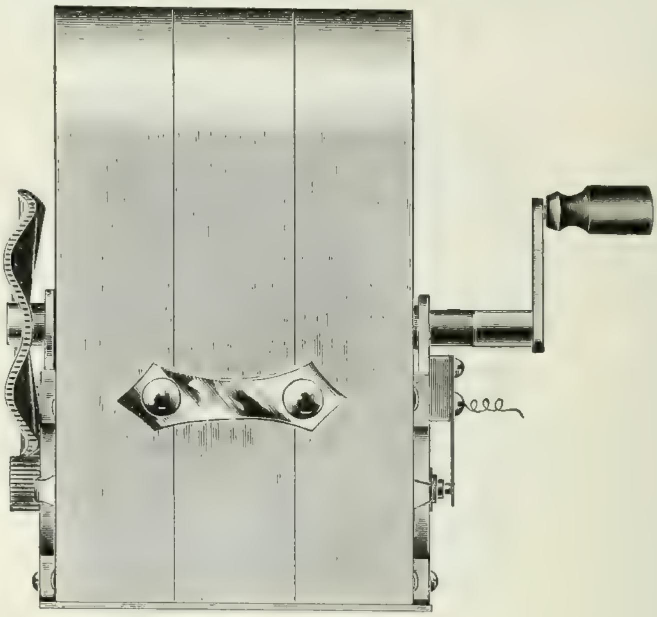


Fig. 1.

The driving gear, it is claimed, embodies an entirely new principle in gearing. It is placed on the left-hand side of the generator, so as to avoid unequal wear on the gear bearings. With this construction the proper centre distances between the gear shafts is maintained indefinitely.

The gear is made from a brass punching, radially corrugated for the purpose of distributing its tooth surface over the surface of the pinion in a uniform manner. This gear, it is stated, will not only last longer, but will run quieter during its life than will a wide-face cast-cut gear.

The pinion is attached to the armature shaft by means of a key and machine screw, and can be taken off and replaced with great ease. This little feature is of great convenience when repairs are necessary.

The ringer, Fig. 3, is a new departure in this line. It has but a single core, which is parallel with the vibrating armature. The core heads or end pieces are formed up of Swedish iron, and are swaged onto the core under an enormous pressure, which practically welds them to the core, thus forming a very perfect magnetic joint. The hammer strikes a very hard and stiff blow to the gongs, and acts in unison with the generator pulsations, whatever their frequency. This is a valuable feature in toll-line signaling, where sharp, clear and distinct tones are almost an absolute necessity.

The magneto complete is provided with a long lever gravity switch hook, with Craig silver contact pieces firmly attached to a hard-rubber block, the block and hook being mounted in such a way as to make the switch hook entirely self-contained.

The receiver-cord binding posts are unique in design. They form a lock for the cord tips, and hold like a vise, preventing the tips from working loose and dropping out.

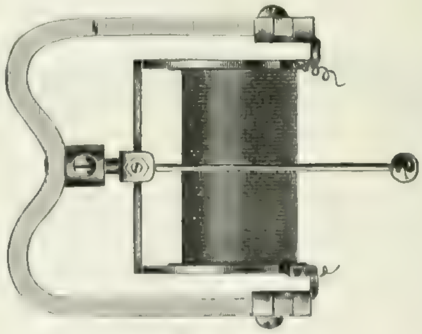
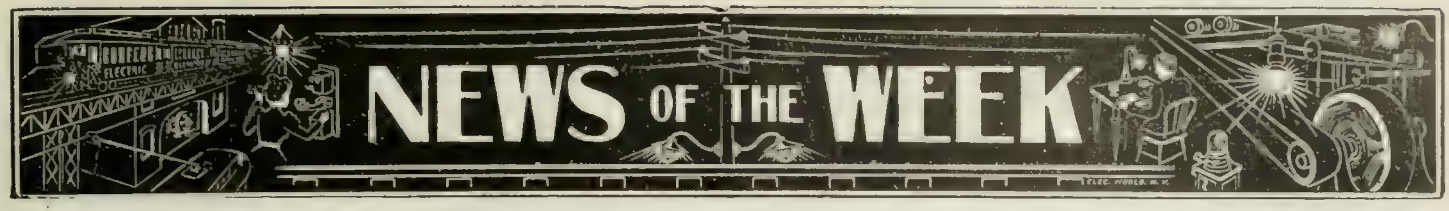


Fig. 3.

These machines are wound to ring through any resistance, from the standard of 10,000 ohms up to [illegible] ohms.

The Williams Electric Company states that its object in designing this machine was to construct a magneto bell that would last indefinitely and require the fewest repairs at the least possible cost in time and money, and great care was bestowed in producing the finished machine. The company is designing an efficient bridging bell, which it claims will not infringe any existing patent. It will soon be ready for the market.



Financial Intelligence.

THE ERIE TELEGRAPH & TELEPHONE COMPANY has declared dividend No. 59 of 1 per cent., payable August 15.

Special Correspondence.

NEW YORK NOTE.

Office of THE ELECTRICAL WORLD,
9 Murray St., NEW YORK, August 1, 1898.

THE WESTERN UNION TELEGRAPH COMPANY'S central cable office has been ordered by the West India & Panama Telegraph Company, which operates the submarine cables between Jamaica and Porto Rico, to decline messages for all stations in Porto Rico except San Juan.

BUFFALO AND NIAGARA FALLS NOTES.

BUFFALO, N. Y., July 30, 1898.

THE BUFFALO RAILWAY COMPANY is burying its feed wires on the Niagara street line in order to be in advance of the new pavement. This appears to be done voluntarily, and is a curious commentary on the attitude of electrical companies a few years ago, when it was maintained that the high potential currents could never be put under ground.

IT IS ANNOUNCED that the Lockport line of trolley road that is to include the Erie Railroad line between Tonawanda and Lockport. will be opened within ten days, though the exact date is not yet set. It is probable that part of the Buffalo City Company's line will have to be used to get across the steam lines in the north part of the city.

THE BUFFALO VALLEY trolley line has obtained its franchise from the Railroad Commission, and will now proceed to secure the right of way, most of which can be had for the asking. The undertaking involves considerable engineering work, as the road will have to cross Buffalo Creek twelve times, and there will need to be two other bridges in the 27 miles of track. This is a rich valley, through which the stream wanders from side to side in a way that makes numerous bridges necessary.

PITTSBURG NOTE.

PITTSBURG, Pa., July 30, 1898.

INSPECTING THE WESTINGHOUSE WORKS.—On July 30 on the invitation of the Westinghouse Electric Manufacturing Company and the Westinghouse Machine Company, 500 prominent business men and engineers of Pittsburg inspected the works of these companies at East Pittsburg. These two concerns will ship some large engines and generators to London. Three of the engines are of 2000 horse-power, and will be direct-coupled to Westinghouse generators, each of 2000 horse-power. These engines and generators are for the Metropolitan Electric Supply Corporation, London.

ST. LOUIS NOTES.

ST. LOUIS, Mo., July 29. 1898.

THE STATE SUPREME COURT by mandamus has ordered the Board of Public Improvements to grant the National Subway Company the right to connect its conduits on Olive Street with the buildings along the route.

THE COLLINSVILLE ELECTRIC LINE.—The promoters of the new electric line between East St. Louis and Collinsville have decided to push the work. It will probably be named the Monks Mound route, as it will run within a few yards of the historic Monks' or Cahokea Mound.

THE CITY COUNSELOR has submitted to the Board of Public Improvements his opinion on the application of the Bell Telephone Company for permission to erect poles in certain alleys in the subway district. He says the board is the legal judge of the necessity for the erection of poles, and that unless the board is convinced there is no necessity it has no right to refuse the applications for permits as made by the company.

THE FRANCHISE measure allowing the Lindell Railway to merge into one grant all the franchises it holds at present has been favorably reported to the City Council. It provides for connecting loops and lines between the various divisions of the road. It also provides that transfers shall be given over all the different divisions at eighteen different points; that the road shall pay to the city, two years after the ordinance is approved, $28,000 for six years, $32,000 for the next eight years, 3 per cent. of gross earnings for the next ten years, 3½ per cent. for the next nine years and 4 per cent. for the last nine years. In exchange for this the city extends the franchise for all the roads till 1942, and allows the construction of numerous loops and connecting lines.

MEXICO NOTES.

MONTEREY, Mexico, July 25, 1898.

IT IS REPORTED here that an American syndicate is arranging to build an electric street railway system in Tampico.

THE BUILDING occupied by the Federal Telegraph Company's general offices in the city of Mexico has just been equipped with a technical department in which the most modern electrical appliances have been installed.

A SYNDICATE of Mexican capitalists of the city of Mexico has petitioned the Mexican Government for a concession to establish a large street car manufactory in that city. Recently mechanics in that city constructed two cars for the Federal District Street Railway Company of the city of Mexico and their work was so well done as to call forth much favorable comment from high government officials.

ADVICES have reached here of the opening of a tramway, which runs for a distance of about 45 miles through the heavy mountainous section between San Antonio, a station on the Mexican Southern Railroad, to the town of Chilchotla, in the district of Tiotitlan, State of Oaxaca. It is reported that the road is to be equipped with electric traction in the near future. The road passes through a rich coffee section.

PACIFIC COAST NOTES.

SAN FRANCISCO, Cal., July 17, 1898.

THE EAGLE & SHAWMUT MINING COMPANY, of Jacksonville, Tuolumne County, Cal., is seriously considering a proposition to install an electric generating and transmission plant, to be operated by water power.

THE OLYMPIA LIGHT & POWER COMPANY, of Olympia, Wash., recently lost its car barn and rolling stock by a night fire. The loss amounted to about $18,000, and the cause of the fire is nnknown. The cars will be replaced as soon as possible.

THE LOS ANGELES LIGHTING COMPANY'S bid was finally accepted by the city of Los Angeles. Each street lamp will cost $6.50 per month. The masts will be retained and 180 lamps will be added. The reduced rate will save the city about $20,000 a year.

THE FORT WAYNE ELECTRIC CORPORATION has just shipped from its San Francisco agency a 250-light generator, to operate focusing lamps in hydraulic mining in Bolivia. The mines are owned by the Yani Development Syndicate. The plant will be operated by a Tuthill water wheel, manufactured at the Oakland Iron Works. The method of working is similar to that of the great North Bloomfield mine.

THE TRANSPORTS of the four fleets which have left San Francisco for the Philippine Islands have been more or less thoroughly equipped with electric fans. The local market was completely cleared of direct-current fans. General Electric fans adapted to an 80-volt current were in great demand for use on the war ships. Many fans were ordered and shipped from the East for use on the transport steamers to alleviate the suffering of the men from overcrowding in the tropics.

CANADIAN NOTES.

OTTAWA, Ont., July 30, 1898.

MR. P. E. MARCHAND, formerly superintendent for R. Anderson, has started in business on his own account, as electrical contractor and mechanical expert, at 128½ Sparks Street, Ottawa.

THE AGREEMENT between the city of Brantford, Ont., and the Brantford Electric & Operating Company for street lighting has been signed, the franchise being for ten years. The company will expend immediately about $10,000 on additional plant.

THE PROJECT to produce power by the construction of a channel from the Welland to the Jordan Rivers, Ont., has again been revived. Mr. William Pearson, of Oswego, is said to have pronounced the scheme feasible from an engineering standpoint.

A PROPOSAL is to be made to the City Council of St. John, N. B., to secure legislation to take over the property, privileges and franchises of the St. John Electric Street Railway Company, to be conducted by the city in the interests of the ratepayers.

THE OTTAWA ELECTRICAL ASSOCIATION has been formed, and officers elected as follows: Honorary president, Thomas Ahearn; president, J. Murphy; vice-president, P. E. Marchand; secretary, E. Bailey; treasurer, B. Nolan. The objects of the association are the advancement of education and mutual help.

EX-MAYOR ELLIOTT, of Brantford, Ont., representing the syndicate which has undertaken the construction of the proposed new railway between Brantford and the city of Woodstock, has just been conferring with Toronto members of the syndicate respecting arrangements for an early start in building the road. Mr. D. A. Middleton, of Ottawa, has just completed a survey of the road, which traverses as fine a stretch of agricultural country as is to be found in Canada, and is particularly adapted for railway construction, the average per mile of cost of construction being about 10 per cent. less than the ordinary estimate. The new line will be 26 miles in length. It is expected that active operations will commence on September 1 next.

FRENCH NOTES.

(From Our Own Correspondent.)

PARIS, [illegible] 1898.

PRIZE FOR A LOW CANDLE-POWER LAMP.—The Society for the Encouragement of National Industry has offered a prize of [illegible] francs for an electric incandescent lamp having a candle-power not to exceed two decimal candles, and to consume [illegible] of an ampere at a pressure of 100 volts. The prize will be awarded in 1899, if the requirements have been successfully met. If the problem is not entirely solved, however, the society reserves the right to record the results obtained. Models, descriptions, specimens, etc., should be addressed to the office of the secretary of the society, 44 rue de Rennes, before December 31, 1898.

ELECTRICAL APPARATUS.—The utilization of electric energy for various purposes in domestic life and in the smaller industries is realized more and more, and special applications have already been made in a very great number of cases in France, as well as abroad. A prize of 2000 francs will be given in the year 1900 to the inventor of a collection of apparatus and tools electrically operated, for the above named purposes, and applying to a special trade or small industry which shall be determined upon, either manufacturing, agriculture or otherwise. The models, memoirs, descriptions, samples, etc., should be sent, postpaid, to the secretary of the Society of Encouragement of the National Industry, 44 rue de Rennes. They must be sent before December 31, 1899.

SILVERING, GILDING, COPPERING AND NICKELING ALUMINUM.—According to a recent process patented by Messieurs Lenseigne and Leblanc, aluminum objects, in order to be covered electrolytically with other metals, are freed from verdigris by a diluted solution of soda or of caustic potash, or in a solution of hydrochloric acid diluted one-tenth. They are then submitted to a vigorous brushing in pure water. Thus prepared, the objects can be covered with a layer of gold, silver, copper or nickel by means of the following baths: Gold—Chloride of gold, 40 grams; cyanide of potassium, 40 grams; phosphate of sodium, 40 grams; distilled water, 2 litres. Silver—Nitrate of silver, 20 grams; cyanide of potassium, 40 grams; phosphate of sodium, 40 grams; distilled water, 1 litre. Copper—Cyanide of copper, 300 grams; cyanide of potassium, 450 grams; phosphate of sodium, 450 grams; distilled water, 5 litres. Nickel—Chloride of nickel, 70 grams; phosphate of sodium, 70 grams; distilled water, 1 litre. These baths must be heated between 60 and 70 degrees C., and the temperature must be maintained constant during the entire operation. The anodes must be of the same metal as that which is in solution in the bath.

SUBMARINE TELEGRAPHY.—At the Academy of Sciences, M. A. Cornu presented the memoir of M. E. Hardy "On Some Experiments of Submarine Acoustic Telegraphy, with the Aid of a Microphone with Pivots." We know that the sonorous vibrations are conveyed through the water at great distances, but as the amplitude of the vibrations is weak, in order to perceive from afar the submarine noises it is necessary to employ apparatus very sensitive to the sonorous vibrations, but entirely resisting to the exterior perturbations. The experiments made at Cherbourg, by order of the Minister of Marine, have shown the great superiority of microphones with pivots for this kind of observation, and make their application to submarine telegraphy so beneficial that the Minister of Marine has authorized their use. The microphone with pivots is made of a small disc of carbon, fixed at the centre of the vibrating plate. The elements of the pivots are set around this disc. Each pivotal element is composed of a movable portion, with counterweights, in order to regulate the pressure on the carbon. A small quantity of mercury surrounds each pivot, and facilitates the passage of the electric current through the movable piece without in any manner interfering with its mobility.

THE ELECTRIC AUTOMOBILE IN FRANCE.—The Professional Syndicate of Electrical Industries, the Syndicate of Electrical Machines and the Automobile Club of France have organized, through the initiative and under the presidency of M. E. Sartiaux, president of the Professional Syndicate of Electrical Industries, a "commission for the studies relative to furnishing electric current to automobiles." This commission is composed of M. E. Sartiaux, president; M. E. Hospitalier, vice-president; M. Geoffroy, secretary; MM. Bean, Eschwege, E. Fontaine, Geoffroy, Hérard, Mildé de la Valette, members. This mixed commission has for its object to organize, at first in the departments of the Seine and the Seine-et-Oise, then in the whole of France, a collection of ways and means to facilitate the charging of electric vehicles, and eventually the replacing of exhausted accumulators with charged accumulators. It will draw up a map and a list, in order to make known the points where the recharges could be effected and the conditions under which they will be done (prices, hours, etc.). It will endeavor to obtain the best conditions possible, or to promote the multiplication of these points in such a manner that in a few years an electromobile will be capable of traversing France with as [illegible] petroleum does to-day.

THE PRIZE COMPETITION OF AUTOMOBILE CABS.—The prize competition of automobile cabs, which has just been concluded, was organized by the Automobile Club of France, and had for its object the determination of the kind of vehicle best suited for city service. Let us say right here, that the results have been absolutely conclusive. They have demonstrated that the automobile cab complies admirably with the many exigencies of city traffic, the rigorous tests to which they have been submitted, both on the level road, as [illegible] proven this. M. Forestier, Inspector-General of Bridges and Roads, presided over the commission [illegible] commenced on June 1, and [illegible] consisted of nine trips about Paris. Each carriage was accompanied by a commissioner, who was to [illegible] On the [illegible] the carriages [illegible] competition, of which eleven were electric and one petroleum. On the first day of the competition the weight of every vehicle was ascertained. The carriages, with their entire complement of [illegible] The first step [illegible] and returning, at different speeds. With regard to the petroleum carriages, [illegible] of consumption on the level. The first day of the competition was concluded with tests of braking and of starting on an ascent averaging 120 millimetres per metre. Before the braking tests, the carriage, running down a descent at a minimum pace of 10 kilometres an hour, had to stop quickly on a given signal. The distance traversed from the moment the signal was given until the complete stopping of the carriage, was measured. The same operation was gone through during the ascent, but in this case the recoil, or fall-back, after stoppage, was measured. As to the tests for starting on the ascent, they were carried on in the same manner as for starting on the level. The remaining days of the competition, from June 2 to June 10, were employed in making trips in Paris. These trips, to the number of three, were laid out by the Count de Chasseloup-Laubat; their distance was about 60 kilometres, and they were chosen so that they would present all the difficulties of traffic which could be encountered in Paris. Each carriage was to make these three trips three times, in the nine consecutive days, at the rate of one trip per day. On June 11 were repeated the tests of traction of the first day, and on the 12th, to close the competition, the carriages made the journey from Paris to Versailles, going and returning. The consumption of petroleum of carriage No. 12, the only one which was not electric, was 14 litres per day. While awaiting the report of this competition, which is now being published, and which will inform us of all the details of these interesting trials, we will give the list of prizes awarded by the commission: First-class Carriages with Two Seats—First Prize: 1000 francs. Carriage No. 25. Cab, with electric motor, system Jeantaud. Second Prize: 600 francs. Carriage No. 13. Coupé, with electric motor, system Jenatzy, of the General Transportation Automobile Company. Second Class, Carriages with Four Seats—First Prize: 1000 francs. Carriage No. 16 Coupé à galerie, with electric motor; system, Krieger.

General News.

NEW INCORPORATIONS.

THE SILOAM SPRINGS TELEPHONE COMPANY, Clayton, Ill., has been organized, with a capital of $1500. The incorporators are G. L. Thompson, John Padgett and John W. Butz.

THE VIGO LIGHT & POWER COMPANY, Terre Haute, Ind., has been incorporated with a capital stock of $50,000. The incorporators are W. R. McKeen, H. Holman, James, A. J. and J. A. Crawford.

THE FAIRFIELD TRACTION COMANY, Lancaster, Ohio, has been formed by Henry B. Peters, William Davidson, George P. Rising, L. N. Ingram and Frank C. Neeb, with a capital stock of $100,000.

THE ADAMS-BAGNALL ELECTRIC COMPANY, Grand Rapids, Mich., has been incorporated for the purpose of manufacturing the Adams-Bagnall inclosed arc lamp. The company is capitalized at $235,000.

THE EAST ST. LOUIS & COLLINSVILLE ELECTRIC RAILROAD COMPANY, East St. Louis, Ill., has been formed with a capital stock of $2500. Among those interested are William Ortgrier, T. T. Ramey and W. E. Hadley.

THE CONSUMERS' ELECTRIC COMPANY, Cleveland, Ohio, has been incorporated with a capital stock of $30,000. The incorporators are A. W. Oppmann, Louis Perczel, Charles P. Salen, John Meckes and George B. Merrell.

THE UNION ELECTRIC COMPANY, Camden, N. J., has been incorporated with a capital stock of $6000. The incorporators are H. George Lewis, Charles J. Harr, H. G. Kepler, Charles H. Hagey, Joseph F. McCarthy and Samuel H. Richards.

THE TUXEDO & EMBLA PARKS WATER & ELECTRIC LIGHT COMPANY has been incorporated at Baltimore, Md., with a capital stock of $25,000. Among those interested in the company are G. O. Wilson, H. A. Leonard, J. H. Neudecker, F. E. Wilson and W. F. Smith.

THE RIVESVILLE & MONTANA TELEPHONE COMPANY, Rivesville, W. Va., has been incorporated with a capital stock of $50,000. Among those interested are C. E. Gaskill, F. B. Clayton, J. S. Koogle, J. D. Arnett, F. F. Prickett, A. S. Prichard, J. S. Cox and J. G. Floyd.

THE KINDERHOOK POWER & LIGHT COMPANY, Troy, N. Y., has been incorporated with a capital stock of $50,000. The following are the directors of the new company: James Purcell, Valatie, N. Y.; James R. Hughes, James Hogan and John Ritz, of Stuyvesant Falls; William D. Barnes, of Brainard.

THE TELEGRAPH AND TELEPHONE.

ZANESVILLE, OHIO.—A new telephone line is being built between Zanesville and McConnellsville.

PEORIA, ILL.—The Citizens' Telephone Exchange Company will petition the City Council for a franchise.

EVANSVILLE, IND.—The Evansville Telephone Company has been granted a franchise to conduct business in the city.

BELLEFONTAINE, OHIO.—The city will issue $10,000 in bonds for a new fire-alarm system and headquarters for the fire department.

SAVANNAH, GA.—The [illegible] Telephone Company has obtained permission from the Council of the city to build its lines within the city limits to its exchange.

DALLAS, TEX.—A franchise to erect and operate a district messenger service, fire and police telegraph has been granted to O. J. Gorman and associates, of that city.

WABASH, IND.—The Central Union Telephone Company is preparing to build a new long-distance line from Goshen to Elkhart, and another from Goshen to Ligonier.

MAMARONECK, N. Y.—The New York Telephone Company opened an exchange in this village on August 1. The office is in the bank building, on the Boston Post Road.

DENISON, TEX.—A company of Chickasaw capitalists will build a telephone line from Tishomingo to Denison, covering the greater portion of the eastern half of the Chickasaw nation.

NILES, MICH. Dowagiac capitalists will establish a new telephone system here to compete with the Bell interests. It is stated that the new system will be connected with the independent long distance line.

WARREN, OHIO.—A small telephone war is imminent in Warren and Niles. The Central Union Telephone Company has been charging $18, $24 and $30 a year, and the new company has made its rates $12 and $18.

BELVIDERE, ILL.—The Belvidere Telephone Company will soon begin the construction of a line to Kingston. The erection of this line will give this place 300 more miles of telephone connections in Northern Illinois and Iowa.

MANSFIELD, OHIO.—At a meeting of the stockholders of the Mansfield Telephone Company, recently held, most of the stock was subscribed for. Application from Mt. Vernon and another place for some of the stock were received.

PEKIN, ILL.—A new telephone line is to be built between this city and Havana. It will pass through Hainesville, Spring Lake, Manito, Forest City and other places which have heretofore lacked telephone facilities. A copper metallic line will be built.

LOWELL, MASS.—The New England Telephone Company will build during the present season a new trunk line from Machiasport to Calais, Me., about 40 miles, with a spur line about 12 miles long to Lubec. Also a trunk line from Manchester, Vt., about 30 miles.

SPARTANBURG, S. C.—The Home Telephone Company has applied for a charter, and expects to organize soon and begin work. It proposes to connect its lines to about twenty neighboring towns in three or four counties. The construction work will be of the best.

ATCHISON, KAN.—Mayor Donald vetoed the ordinance granting a franchise to a new telephone company to establish an exchange in this city, but the Council passed the ordinance over the veto. The new company will fix its rates at $2 per month for business 'phones and $1 for residences.

BEL AIR, MD.—The Baltimore & Bel Air Telephone Company has asked permission of the County Commissioners of Baltimore County to string telephone wires from Upper Falls to Franklinville, and thence to Jerusalem. The Baltimore & Harford Telephone Company has asked for permission to string wires from Bradshaw to Reckord.

SUMMIT, N. J.—There is a small war between the Township Committee and the New York & New Jersey Telephone Company, which has taken the form of the destruction of property. On July 17 the wires and cables of the telephone company were cut from the poles. The Township Committee declares that the wires were strung without a franchise, and has been demanding that the poles and wires be taken down. After the work of destruction was finished the telephone company set a gang of men to work to repair the damage. The men were not interfered with, contrary to general expectation.

TRENTON, N. J.—The State Board of Taxation has disposed of two appeals made by the New York & New Jersey Telephone Company. The company appealed from an assessed valuation of $100,000 placed on its property in Orange in 1897, and from an assessment of $43,000 on its Elizabeth property for the same year, but the board fixed it at $47,752.28. The company asked to have the Orange valuation reduced to $35,000. In the Elizabeth case, the board suggested that the City Solicitor of Elizabeth and Treasurer Snow, of the telephone company, have a conference and seek to reach an agreement. They did so, and the result that a valuation of $40,000 agreed upon by them was confirmed by the board.

WASHINGTON, D. C.—Proceedings have been commenced in the District Supreme Court against the Chesapeake & Potomac Telephone Company for the purpose of testing the recent act of Congress, reducing the rate for telephone service in the District. An application for a mandamus was filed by Mr. O. G. Staples, asking that the telephone company be compelled to furnish him with a telephone service, and an injunction was asked by J. F. Manning & Co., enjoining the telephone company from removing its instrument from the complainant's office. Both of these suits are in the nature of test cases, and will, it is stated, be vigorously supported by the Telephone Subscribers' Association. It is understood that the company will make a hard fight in the hope of securing an adverse decision upon the new law, and thus be enabled to maintain the old standard of rates.

ELECTRIC LIGHT AND POWER.

FLUSHING, L. I.—The Citizens' Lighting Company of Far Rockaway has been sold to the Queens Borough Electric Light & Power Company of the same place, which has executed a mortgage with the Colonial Trust Company for $250,000 at 5 per cent.

LIVINGSTON, MONT.—The electric light plant of this city was almost entirely destroyed by fire, entailing a loss of $32,000. There was an insurance of $24,000. The plant was the property of the Livingston Water Power Company, and will be rebuilt at once.

DULUTH, MINN.—A special election will be held on August 30 to vote on the proposition to issue bonds to the amount of $100,000 for a municipal electric light plant. The Council committee has submitted a report, estimating the cost of the necessary plant at $89,000.

CHICAGO, ILL.—Sealed proposals will be received until August 30 for contracts for the erection of an electrically operated traveling crane for the new pumping station at Springfield Avenue and Central Park Avenue, in this city. The proposals must be made out on the blanks furnished at the office of the Department of Public Works. Mr. L. E. McCann is the Commissioner of Public Works.

DETROIT, MICH.—At the recent meeting of the public lighting commission, Secretary Starring submitted a report showing that the average cost of operating the city arc lamps during the year was $51.85, against $64.19 for the preceding year. The total expenditures for 1744 arc lights was $90,439.85. During the year the aggregate current generated was 3,281,615-kw hours, of which 2,975,019 were used for arc lighting and 306,596 for incandescent lighting.

KALAMAZOO, MICH.—The Kalamazoo Electric Company has passed into new hands, Mr. W. A. Foote, of Jackson, having purchased a three-fourths interest in it. The new organization, which has a capitalization of $100,000, is officered by the following named gentlemen: President, W. A. Foote, of Jackson; secretary, S. S. Hulburt, of Battle Creek; treasurer, B. Foote, of Jackson. Mr. W. A. Foote is interested in the Jackson, Albion and Battle Creek electric companies.

DES MOINES, IA.—The General Electric Company is preparing to make some extensive improvements in its plants in this city. The Fort Wayne water-power plant will be extensively developed. The improvements will give the company duplicate plants in the city. Five water wheels will be installed at the Fort Wayne plant, and the steam-power machinery will be abandoned. It is the intention of the company to use the water-power plant in future when there is a sufficient head of water, and the Edison plant when steam is necessary.

WASHINGTON, D. C.—A new division has been created in the District government by the commissioners, to be known as the Electrical Department of the District of Columbia. All matters pertaining to street lighting, the electrical equipment of underground and overhead trolley roads, underground conduits for electric lighting and power, telephone, telegraph and other purposes, all overhead wires and poles and exterior work relative to the District of Columbia, fire-alarm systems, police telegraph service, etc., will be supervised by the new department.

THE ELECTRIC RAILWAY.

FITCHBURG, MASS.—The Fitchburg & Suburban Street Railway has been opened for business between Fitchburg and Leominster.

MILWAUKEE, WIS.—It is stated that it is the intention of the Milwaukee Electric Railway & Light Company to expend $1,000,000 in improvements on its property before the end of the present year.

NEW BRITAIN, CONN.—The third rail line between New Britain and Bristol, which is a continuation of the third rail line from Hartford, was tested a few days ago. The trial trip was made by officials of the road, and everything worked well.

BUFFALO, N. Y.—It is stated that representatives of Buffalo capitalists have started for Honolulu, Hawaii, to secure street railway privileges in that city. It is understood that they have the backing of capitalists who control the Buffalo Street Railway Company.

PITTSBURG, PA.—The large car barn of the Penn Avenue branch of the Consolidated Traction Company was destroyed by fire on July 24. The loss, in addition to the building, includes forty cars, the total value of the property destroyed being about $150,000. It is said that there is an insurance of $110,000.

OCONOMOWOC, WIS.—Upon the completion of the present extension of the Milwaukee Street Railway & Light Company's line to Waukesha, and other improvements, the company will take up the proposition to extend its line to Oconomowoc. This work will involve an expenditure of at least $200,000.

TOLEDO, OHIO.—The new electric railway to be built from Toledo to Lyons, Ohio, has received the indorsement of the Chamber of Commerce, and the work of construction will now go on with all speed. It is stated that the road will bring into close communication with Toledo nearly 75,000 people in the country districts.

NEW YORK, N. Y.—Daniel Cortelyou has begun a suit against the Midland Electric Railroad Company of Staten Island to recover 5 cents. This sum was paid by him under protest as an extra fare. The suit is in reality a test one to determine the right of the Midland Company to charge two fares instead of issuing transfers.

MARION, IND.—George Sweetser, vice-president of the Marion Bank, has been appointed receiver of the Indiana Traction Company, on a petition from Charles Lohman, former secretary of the company, who claims that $1000 is due him. The Indiana Traction Company is a corporation formed to build an electric railway from Marion to Indianapolis.

BUFFALO, N. Y.—The Aldermanic committee on streets has reported to the Board of Aldermen in favor of granting the petition of the Buffalo Traction Company to charge a 5-cent fare on its lines, provided it makes an arrangement with the Buffalo Railway Company, whereby passengers may get transfers from one company's lines to the other on the payment of a single fare.

VINCENNES, IND.—The street railway company recently advertised for women to act as conductors on its cars. More than fifty applications were received, from which five young women were selected for the positions. They will receive a salary of about $5 per week. The uniform which they will wear will resemble a bicycle costume, and they will wear caps on which the word "Conductor" is inscribed.

SANDUSKY, OHIO.—The Sandusky Street Railway has been sold to Judge C. S. Bentley, of Cleveland, for $60,024, which is said to be two-thirds of the appraised value. Judge Bentley represented a syndicate of Cleveland and Norwalk capitalists and 95 per cent. of the first mortgage bondholders. The line will be improved and probably consolidated with the People's line, which will be purchased later by the same syndicate.

NEW YORK, N. Y.—The State Railroad Commissioners have granted permission to the Kingsbridge Railway Company, the North End Street Railroad Company and the Fort George & Eleventh Avenue Railroad Company to construct their respective railroads in the upper part of the city. All these lines will be operated by electric power. The plans of these companies were outlined in THE ELECTRICAL WORLD of June [illegible], 1898.

GREENSBURG, PA.—The Greensburg, Jeannette & Pittsburg Street Railway has been sold to a syndicate of Harrisburg capitalists, at the head of which are Benjamin F. Myers and Patrick Russ. It is the intention of the new company to improve the road and rolling stock and extend the line to Irwin this summer. The company also proposes to purchase the Greensburg

& Hempfield line, change it to the standard gauge and extend it to Mount Pleasant in the early future.

KANSAS CITY, MO.—The contract for the construction of the Broadway electric line has been awarded by the Metropolitan Street Railway Company to L. E. Myers, of Chicago. It provides that the track shall be laid for the operation of the cars in ninety days. The roadbed will be of the most approved style of construction, the rails being 70 feet long. The joints will be welded and the rails will be laid in cement. When this line is completed it will be one of the best in the State.

SOMERVILLE, N. J.—The New York & Philadelphia Traction Company on July 17 started its first car on the line between this place and Bound Brook. This opens the first link of five miles on the proposed electric road between New York and Philadelphia. The Traction Company is now building its line in Bound Brook to a point one mile east of the town, where it will connect with the line of the Brunswick Traction Company. Work is also in progress which will connect the New York & Philadelphia Traction Company's lines with Dunnellen, Princeton and Trenton.

WORCESTER, MASS.—A movement is on foot for the consolidation of the Worcester & Marlboro and the Marlboro, Framingham & Southboro electric street railway companies. If the plan is consummated, it will be possible to ride on electric cars from West Warren to Boston, through Worcester, Framingham, Natick, Wellesley and the Newtons, a distance of about 80 miles. The Marlboro, Framingham & Southboro line is in process of construction. The deal will be made in accordance with the general law governing such transactions, the Worcester & Marlboro Company leasing the other line.

NEW YORK, N. Y.—The employees of the Metropolitan Street Railway Company have formed an organization with protective and benevolent features, known as the Metropolitan Street Railway Association. Each member before he is elected must certify that he is temperate and of good habits. The association has the approval of the Metropolitan Company. The initiation fee is $1, and the dues are 50 cents a month. Members in good standing will receive an allowance when incapacitated by sickness or accident. It is stated that the association will practically take the place of a labor organization.

CHICAGO, ILL.—It is stated that there is a possibility of consolidating the three street railway properties in Chicago within the next sixty days. No details as to the proposed plans in negotiating the consolidation can be obtained. It is likely, however, that a new corporation will be formed, and the stock of the different companies placed in the hands of a trustee at a certain price, payable in cash, or in cash and stock of the new company. The present capitalization of the three companies is as follows: West Chicago Street Railway Company, $13,089,000; North Chicago Street Railroad Company, $10,000,000; Chicago City Railway Company, $12,000,000, making a total of $35,000,000.

BUFFALO, N. Y.—The Buffalo, Tonawanda & Niagara Falls Electric Railroad Company on July 16 opened for traffic a new extension of its line. This new line begins at the corner of Tonawanda and O'Neil Streets on the northerly limits of the city of Buffalo, and follows O'Neil Street to Niagara Street, and thence along Niagara Street about one mile to the ferry on Niagara River, which runs between the terminal of this new extension and various resorts of Grand Island. This line will be further extended along Niagara street to the village of Tonawanda, and will prove to be the most popular electric line between Buffalo and Niagara Falls, as it follows the bank of the Niagara River the entire distance. Mr. Henry B. Smith, of Bay City, Mich., is principal stockholder of this company.

LEGAL NOTE.

TELEPHONE SWITCHBOARD DECISION.—A patent decision of great importance to the independent telephone movement was rendered by Judge Showalter, of the United States Circuit Court at Chicago, on July 29, in the case of the Western Electric Company v. Kellogg Switchboard & Supply Company, in which the complainant sought to restrain the defendant company from installing a switchboard for the Kinloch Telephone Company of St. Louis. Judge Showalter denied the preliminary injunction asked for. The complainant applied for an injunction on the Firman patent, which expires on January 19, 1899, and the validity of which has been recently sustained by Judge De Haven, of the United States Circuit Court, Northern District of California, upon very narrow lines. The decision in California has been appealed to the United States Circuit Court of Appeals; and relying upon that decision, the complainant here sought to obtain an injunction and thus prevent the Kinloch Company from beginning operations as had been planned. It was shown by the affidavits of Prof. Elisha Gray, Professor Carhart of Michigan University Milo G. Kellogg and F. W. Dunbar, that there was no infringement. Professor [illegible], T. D. Lockwood, C. E. Scribner and others gave affidavits to the contrary effect. The court stated in substance that it was his impression that there was no invention in the Firman patent; [illegible] Judge De Haven had sustained the validity of the patent, in view of the prior state of the art, and especially [illegible] counsel for complainant that, in his opinion, if the case went to the Circuit Court of Appeals they would have great difficulty in sustaining that opinion. He also stated that [illegible] doubtful if defendant infringed. He said, however, that he preferred to place [illegible]

[illegible] conduit, expended over $1,000,000 and has about 5000 instruments already installed. The switchboard, which is being manufactured by the Kellogg Switchboard & Supply Company, of Chicago, will be completed and service for subscribers will commence within a few days. It is being made under the patents of Milo G. Kellogg, of Chicago. It has a present capacity for 6160 telephone lines, and provides for an ultimate capacity of over 20,000 lines in one exchange. The largest telephone switchboard heretofore constructed has had a capacity for switching only about 6000 telephone lines in one exchange. The Kellogg Company has been engaged on this board for about a year.

PERSONAL NOTE.

MR. A. CHURCHWARD, who was so long connected with the Excelsior Electric Company as its electrical engineer, has become associated with the Fort Wayne Electric Corporation, Fort Wayne, Ind. Mr. Churchward is well known in electrical circles through his work with single-phase alternating motors, rotary transformers, etc. The Fort Wayne Electric Corporation is to be congratulated on securing the services of Mr. Churchward. It is understood that as soon as its new factory is completed the company will enter extensively into transmission work.

Trade and Industrial Notes.

THE FOSTORIA INCANDESCENT LAMP COMPANY, Fostoria, Ohio, it is stated, proposes to increase its plant to twice the capacity of its present works.

THE VILLAGE OF RICHMOND, MICH., is to have an electric light plant with Westinghouse electrical apparatus. The steam plant will be furnished by the Ball Engine Company, Erie, Pa.

MICA.—For the convenience of the Pacific Coast trade, Mr. A. O. Schoonmaker, of New York, carries a stock of mica with his agents, Messrs. Reger & Atwater, of San Francisco, Cal., for prompt delivery.

THE WESTERN ELECTRIC COMPANY, it is stated, is about to open an establishment in Detroit, Mich., and has filed articles of incorporation for a company in that State, with a capital of $1,000,000.

MR. A. O. SCHOONMAKER, 158 William Street, New York City, has issued a folder, giving views of the mica mines in India, whence Mr. Schoonmaker obtains his supply of this important material. Mr. Schoonmaker handles mica uncut or block, cut to any size or pattern.

IN ADDITION to carrying a large and well-assorted stock of the celebrated Loricated conduit for interior wiring, the Central Electric Company, Chicago, announces that it has full and complete lines of all sizes of circular loom conduit and plain brass and iron armored interior conduit and all fittings.

MESSRS. J. W. HILL, president, and H. E. Teachout, secretary, of the Mutual Telephone Company, Des Moines, Ia., after a four days' inspection tour among telephone manufacturers, placed an order with the Sterling Electric Company, Chicago, for a 2000-drop metallic circuit board before leaving for home.

THE BALL ENGINE COMPANY, Erie, Pa., has furnished engines aggregating 550 horse-power for the isolated electric plant of the Peruna Drug Manufacturing Company, Columbus, Ohio. These engines are direct connected to Siemens & Halske generators, and the plant, it is stated, will be, when completed, one of the most complete in the city.

THE WALKER COMPANY has received a large order for electrical apparatus from its Paris agency, the Exploitation des Procedes Electriques Walker. The order calls for 500 complete street railway equipments, comprising 1000 25-hp motors, 1000 controllers and 500 trolleys. It is stated that this apparatus is destined to Italian, French and German cities. The order represents a money value of about half a million dollars, and it is to be filled in fifteen months.

MR. F. S. BLACKALL, of Blackall & Baldwin, 39-41 Cortlandt Street, acting for the Shanghai, China, Municipal Council, is inviting tenders for the supply of an electric light plant complete, including engines and boilers, which are to be used in increasing the existing plant in Shanghai. The apparatus needed is two 100-kw alternators, direct coupled to horizontal medium speed engines, switchboard and instruments, water-tube boilers, etc. Sealed proposals must not be sent later than August 10.

THE ELECTRIC APPLIANCE COMPANY, Chicago, has recently issued a little folder calling attention to its self-contained automatic telephone hook. This hook was designed by the manager of its telephone department, and is manufactured exclusively by the company. It is claimed that it can be installed in a smaller space than any other hook on the market. Its installation is very easy, as the hook is put together complete in one piece of apparatus and all that is necessary is to screw it in the telephone box.

MESSRS. JULIUS ANDRAE & SONS COMPANY, Milwaukee, Wis., who are the Milwaukee selling agents for Lundell fan motors, have succeeded in placing these goods in many of the largest local business houses, hotels and theatres, including the Alhambra Theatre, Palm Garden and Kroeger Brothers' large clothing establishment. Mr. [illegible], of the company, has just returned from a trip through Southern Wisconsin in the interest of Andrae telephones and electrical supplies. He reports trade exceptionally good in that section of the Northwest.

THE ELECTRIC STORAGE BATTERY COMPANY last week closed a contract, through its Chicago office, with the South Side Elevated Railroad Company in that city for two batteries, each of [illegible]-kw capacity. One of these batteries will be installed on the company's property at Twelfth Street and the other at [illegible] Street, and both will be used to regulate the fluctuations of the load and to maintain an even potential at extreme points on the line. Both batteries will be installed with tanks and [illegible] of sufficient size to permit of doubling of capacity if it should be found desirable to do so.

THE WALKER COMPANY has appointed Mr. J. S. Webster as sales agent for Minnesota and the Dakotas, with offices at [illegible], Lumber Exchange, Minne apolis. Mr. Webster has been identified with the sale of Walker apparatus for the last two years, but his time has mostly been taken up in connection with installations and the design of special apparatus. A 90-kw direct connected lighting plant, installed for Wyman, Partridge & Co., Minneapolis, is one of the neatest and most complete in the country, and a view of the engine room is given in the latest Walker pamphlet, which shows some interesting Walker lighting plants, including the Astoria Hotel in New York.

THE RASTER CARBON RHEOSTAT COMPANY, Chicago, reports that it is now in a position to furnish all kinds of motor starting boxes with automatic release, as well as controllers, field regulators and dimmers. Its trade has been exceptionally brisk for this time of the year, and is constantly growing. The W. R. Garton Company, of Chicago, is selling agent for the Raster Carbon Rheostat Company, and has closed some very valuable contracts. Mr. Garton, president of the W. R. Garton Company, and consulting engineer for the Raster Carbon Rheostat Company, has lately made some extensive trips in the interest of this business, and his labors have been crowned with success. The Raster Carbon Rheostat Company is getting out a new dimmer catalogue, as well as a circular illustrating its automatic motor starter. In this catalogue is illustrated complete equipments for theatres, also a very handsomely designed switchboard for theatres, whereby the dimmers may be located at some convenient but distant point, while the controllers are so arranged on the switchboard that they may be placed in such a position in the theatre to enable the operator to work in harmony with the performance. This company has lately manufactured many special forms of resistances, and in every instance they have proven highly successful and satisfactory, both mechanically and electrically. It has been obliged to increase its facilities and extend its factory.

Trade and Miscellaneous Publications.

THE CROUSE-HINDS ELECTRIC COMPANY, Syracuse, N. Y., has issued a pocket catalogue of its knife switches, switchboards, panel boards, etc., etc. The catalogue contains forty-six pages, and the illustrations of the various articles are very clear. This company is the sole owner and manufacturer of the Hinds patent tubular arm switch.

STORAGE BATTERIES IN LIGHTING AND POWER STATIONS.—The Electric Storage Battery Company, Philadelphia, Pa., devotes its circular No. 42, just issued, to an illustrated description of the installation of chloride accumulators in the plant of the Claremont Electric Light Company. Claremont, Vt. This plant exemplifies the advantage of the application of storage batteries to small lighting installations, and is said to be one of the most unique of its kind in this country.

THE PERU ELECTRIC MANUFACTURING COMPANY, Peru, Ind., manufactures a very complete line of carbon batteries, porcelain cutouts, insulators and tubes, and illustrates these apparatus very completely in a catalogue and price list just issued. This company is one of the pioneers in the manufacture of open circuit carbon batteries, and it has been its aim to produce a high-grade battery, using only the very best material, and at the same time to sell the product at as low a price as is consistent with best quality.

"ELECTRIC MINE HAULAGE" is the title of a very artistic catalogue just issued by the Baldwin Locomotive Works, Philadelphia, and the Westinghouse Electric & Manufacturing Company, Pittsburg, Pa. It describes and illustrates electric mining locomotives for underground haulage. In designing these locomotives the range of practical requirements has been considered. Their compactness makes them perfectly adaptable to low and narrow entrances, and by reason of the absence of moving parts exposed to external injury, mechanism of the simplest character possible, and running parts readily accessible of replacement, the cost of maintenance is brought to a minimum.

THE L. P. & D. TRANSMITTER COMPANY, Montpelier, Vt., is sending to every electric light station in the United States a copy of a catalogue just issued by it, describing and illustrating its system of power transmission. The peculiar properties of the L. P. & D. system of belting are as follows: The driver and driven may be close together or the belt centres may be any distance apart. The strain on the belt is reduced and the friction on the bearings is less than in straitway belting. All the advantages of a friction clutch are obtained, and none of the disadvantages. This catalogue will enable those who are not familiar with this system to obtain a better understanding of its availability in electric light stations. A free copy may be obtained by addressing the company.

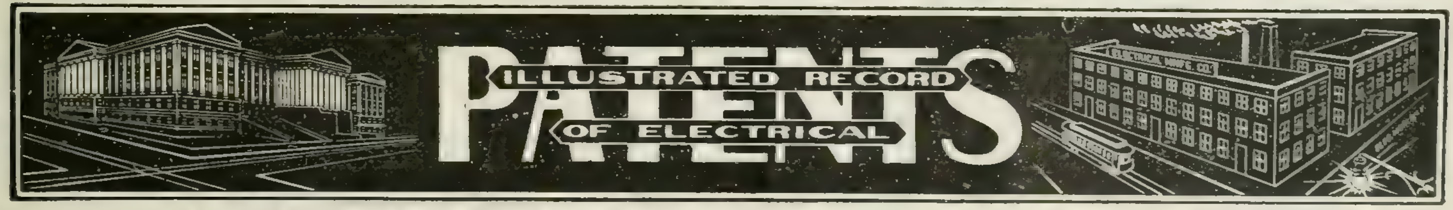
THE RELIABLE ELECTRIC MANUFACTURING COMPANY, Worcester, Mass., has recently issued a neat catalogue describing and illustrating the electrical goods manufactured and dealt in by it. This company furnishes the best and most up-to-date telephone instrument in the market, and has in its employ men from most of the prominent factories in Europe, with years of experience in the work. Its telephone instruments are neat, serviceable and reliable. The transmitter is so delicately adjusted that the slightest sound can be distinctly heard, at the same time giving perfect articulation, yet it does not easily get out of adjustment. It has been thoroughly tested on long distances and in general use, and has given excellent satisfaction. The company makes some very neat interior sets.

A HUGE CATALOGUE.—The Western Electrical Supply Company, St. Louis, Mo., may safely claim to have published the largest general electrical catalogue of the year. Its general catalogue No. 14 is just out, and contains no less than 753 pages, and to enumerate the articles illustrated and described would be far beyond the limits of available space in these columns. Everything needed in all branches of the electrical line is listed. The illustrations are clearly executed, and the book complete is very neatly gotten up. For the convenience of customers in ordering by letter or telegraph, a trade number and code word are given to each article, the trade number to be used in ordering by mail and the code word in ordering by telegraph. The general contents of the book cover light and power machinery, fan motors, arc lamps, arc lights and station supplies, electric heating supplies, testing instruments, construction materials, tools and appliances, electric railway supplies, house goods and telegraph supplies, telephones and accessories, electric and combination fixtures and leather belting.

THE FIFTIETH ANNIVERSARY OF THE ROEBLING WORKS.—Not many concerns related to the electrical industries can boast of an existence of fifty years, but the John A. Roebling's Sons Company, Trenton, N. J., enjoys this distinction. Fifty years ago Mr. John A. Roebling moved his little business from Saxonburg, Pa., to Trenton, N. J. The transfer was made in the spring of 1848. To commemorate this interesting event the company has issued a souvenir catalogue, which the company is sending to its customers and friends to whom it may be of interest and value. It should be explained that the concern has really been in business fifty-eight years, J. A. Roebling, the founder, having started at Saxonburg in 1840. Fifty years of this time have been spent at the present site of the works in Trenton. In the catalogue the company illustrates to a certain extent the growth of its business, and in addition to this it has added some interesting data in regard to large bridges, with which the name of Roebling has been identified. These include the Brooklyn Bridge, the Niagara Suspension Bridge and others of great note. The main body of the catalogue refers particularly to wire rope and electrical wires. The tables have been thoroughly revised and brought up to date. The catalogue includes specifications and other valuable and interesting information of weatherproof copper wire, weatherproof galvanized iron wire, fire and weatherproof copper wire, underwriters' copper wire, office wire, annunciator wire and cables, lamp cords, magnet wire, rubber insulated copper wire, lead encased cable for electric light and power, lead encased telegraph cables, lead encased telephone cables, armored submarine cables and aerial cables. The Columbia rail bond is well illustrated, and its features and advantages well brought out. Considerable data about bi-metallic wire are given, and copper trolley wire, both round and in special shapes, is listed and described. The catalogue completely covers everything manufactured by this well-known establishment, and is a worthy production on a worthy occasion.

Business Notice.

THE ILLUSTRATIONS in this issue were made by the Photo-Engraving Company, 9-15 Murray Street, New York City.



UNITED STATES PATENTS ISSUED JULY 26, 1898.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

607,830. DEVICE FOR OPERATING ELECTRIC SWITCHES; J. H. Cary, of Springfield, Mass. App. filed Jan. 8, 1896. The combination of a source of electrical energy; suitable conductors; means for switching in a predetermined amount of electrical energy; one or more rotary electromagnetic motors in the circuit; a switch ring or equivalent device operated by the electromagnetic motor and a supplementary or derived circuit made or broken at will by the operation of the switch ring.

607,877. METALLIC GATE SCREEN; A. P. Prichard, of Tacoma, Washington. App. filed Sept. 9, 1897. In combination with a safe or vault, a screen, doors in the screen provided with openings or cutaway portions whereby they are permitted to fit over the knobs or handles of the doors, pivoted slides lying across the openings, said slides being adapted to come in contact with the handles or knobs by a forward movement of the screen and sound an alarm.

607,918. CROSSOVER FOR TROLLEY SYSTEMS; C. E. Davis, of Chicago, Ill. App. filed Nov. 21, 1896. A crossover for trolley systems having overrunning trolleys, comprising a broken trolley wire, an electrical connection between the two parts of said wire, a normally open bridge piece pivotally connected in proximity to one end of said broken trolley wire, and projecting above the same in the path of the trolley wheel so as to be moved to bridge the break when engaged thereby, a weight below the trolley wire connected with said bridge piece, so as to normally hold it open.

607,919. ELECTRIC TRAMWAY; A. Diatto, of Turin, Italy. App. filed Dec, 1, 1896. In an electric railway system, the combination with a vehicle, of an electromagnet, a magnet bar carried thereby, cords having a connection with the magnet, and springs having connection at one end with the vehicle and the other end with cords.

607,921. ELECTRICAL MEASURING INSTRUMENT; George K. Elphinstone, of London, and A. C. Heap, of Penn, England. App. filed May 13, 1898. The combination of the electromagnet core, the primary windings disposed thereon, the secondary winding, a pivoted or swinging coil mounted between the poles of the core, and included in close circuit with said secondary winding, and an indicating device operated by the swinging coil.

607,984. MAGNETIC ORE SEPARATOR; G. J. Crean, of Montreal, Canada. App. filed Jan. 7, 1898. A magnetic ore separator, comprising a series of stationary magnets arranged in the form of an arc; a hopper located adjacent to said magnets; a rotatable carrier adapted to travel across the surface of and in close proximity to said magnets and intermediate of same and said hopper, and said carrier being adapted to receive movement from the ore particles running from said hopper and adhering to said carrier.

607,989. INTERIOR CONDUIT; E. E. Erickson and F. W. Erickson, of Boston, Mass. App. filed June 3, 1898. In interior conduit systems, an outlet insulator, consisting of an internally threaded metal member, composed of a disc, from one side of which extends two rings of different diameters; and an insulating member fitting over the ends of the rings and into the channel between them.

607,994. MICROPHONE; T. J. Howell, of London, England. App. filed Jan. 3, 1898. In combination in a microphone, a honey-comb disc having a series of cells, the front diaphragm, a screw-down cover to hold the diaphragm in place in front of the honey-comb disc, a rear plate extending across the series of cells in the disc and a conducting spring for forcing the rear plate with the honey-comb disc forward as a whole, the said cells being filled with carbon granules.

607,997. ELECTRICALLY SELF-PROPELLING VEHICLE; L. Krieger, of Paris, France. App. filed March 11, 1897. In an electrically self-propelled vehicle, the combination with steering wheels pivotally journaled upon opposite ends of a stationary axle, an electric motor connected to each wheel, and means for varying the speed of either motor to steer the vehicle.

608,013. REVERSING RHEOSTAT; I. E. Storey, of Philadelphia, Pa. App. filed Jan. 29, 1898. In a motor controller, the combination of a rotary shaft carrying a crank disc, an abutment on the disc, a toggle lever bearing at one extremity against the abutment and pivoted at a fixed point at the other, and a spring connected to the toggle joint.

608,015. SECONDARY BATTERY; G. Walter, of Strasburg, Germany. App. filed Aug. 19, 1897. An instrument for removing detached material from storage batteries, consisting of a box-shaped spatula, with a handle, and with ridges extending crosswise of the box, the rear side of the box being closed and the lower end thereof being in the form of a thin, flat wall.

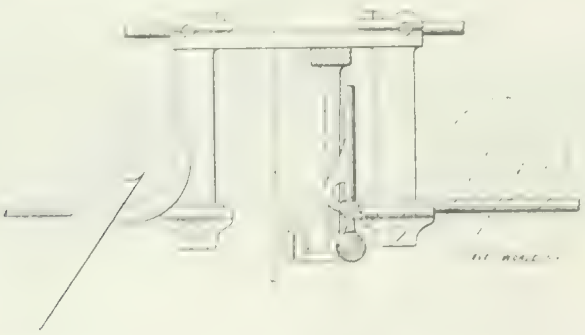
608,031. RAILWAY SIGNAL SYSTEM; G. T. Cunningham, of Boston, Mass. App. filed Nov. 13, 1897. The combination with the track rails divided into sections, of a conductor divided into twice as many sections as there are in each rail, and a connection from the respective conductor sections to the rail sections on opposite sides of the track alternately.

608,076. ELECTRIC TELEPHONE SYSTEM FOR HOUSES; L. Plaut, of New York, N. Y. App. filed Sept. 9, 1897. In an electric house telephone system, the combination with a call box provided with contact plates for the call bell system, and a cover for said call box provided with contact plates for the telephone system, of a spring actuated push spindle, guided in the cover of the box and provided with two contact arms adapted respectively to form contact with the contact plates of the call-bell system in the box and with the plates of the telephone system, on the cover.

608,088. INSULATED RAIL JOINT; G. A. Weber, of New York, N. Y. App. filed Nov. 5, 1897. An insulated rail joint, comprising a rail chair for supporting the contiguous ends of rail sections, having a bolt supporting plate at one edge thereof, insulating material between the ends and said plate, said insulation extending to or near the top of the bolt supporting plate and conforming to the angle of the rail chair, insulated blocks on each side of the rail sections, a bolt or bolts extending through the insulating blocks, rail, insulation and bolt supporting plate, and an insulation for the end of the bolt passing through the bolt supporting plate.

608,100. ANNUNCIATOR GAS FIXTURE; J. L. Bixby, of Arlington, Mass. App. filed Nov. 26, 1897. A cock having a passage connecting its inlet and outlet; a valve controlling that passage a spring plunger controlling that [illegible] the plunger and automatically hold the plunger when in its elevated position, against the force of the spring.

608,104. ELECTRIC SOUNDING DEVICE FOR SHIPS; J. P. Brockley,



No. [illegible] Trolley [illegible]

[illegible]

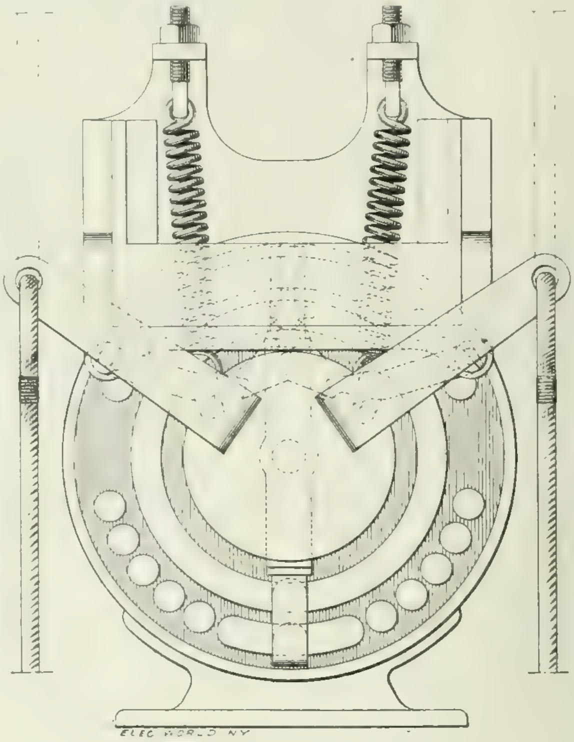
608,1[illegible]. ELECTRIC LIGHT [illegible]

[illegible]

608,1[illegible]. [illegible]

[illegible]

608,133. MEANS FOR PREVENTING STRAY MAGNETISM IN DYNAMO ELECTRIC MACHINES; J. F. Kelley, of Pittsfield, Mass. App. filed May 27, 1898. A dynamo electric machine, having an energizing coil and a magnetic part within the influence of said coil, in which said coil sets up a magnetomotive force, in combination with a coil surrounding said part and adapted to produce therein a magnetomotive force, which neutralizes and prevents the passage through said part of the magnetic flux produced by said first force.

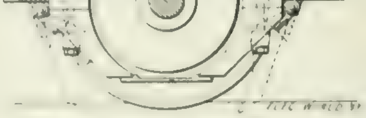


No. 608,013.—Reversing Rheostat.

608,134. ELECTRICAL CIRCUIT CONTROLLER; R. Lundell, of New York, N. Y. App. filed Feb. 1, 1898. A circuit breaker, consisting of electromagnetic means for interrupting an electric circuit, in combination with means controlled by the movable part of the circuit breaker, and adapted to force or eject a blast of air around the circuit breaking contacts thereof.

608,135. COMMUTATOR BRUSH HOLDER FOR DYNAMO ELECTRIC MACHINES; R. Lundell, of New York, N. Y. App. filed Feb. 4, 1898. A brush holder having adjacent brushes rigidly clamped against conducting pieces or blocks, which permit them to abut against each other, said conducting blocks in turn being securely fastened to an arm or stud by means of flexible springs.

608,137. ELECTROMOTOR FOR ELECTRICALLY PROPELLED VEHICLES; A. Siemens, of London, Eng. App. filed Nov. 18, 1897. In an electromotor for propelling a vehicle, the combination with the axle having



No. 608,137.—Electromotor for Electrically Propelled Vehicles.

an armature secured thereon, and rotating therewith, of field magnets located above said armature, pole pieces depending from said field magnets and partly surrounding the armature and extending in a plane at right angles thereto, said pole pieces being formed in two parts having a hinged connection, whereby the lower portions thereof may be swung back to permit the body of the vehicle, with the magnets, to be raised off of the armature, and means for securing the two parts of the pole pieces, in fixed relation to each other.

608,163. BICYCLE LOCK; F. V. Walstrom and John Erickson, of Chicago, Ill. App. filed May 13, 1897. In a bicycle lock, the combination of a locking [illegible] from said lock, but electrically connected [illegible] a contact device at the lock adapted to be operated by the [illegible] insertion or removal to open or close the alarm circuit, and a second contact device in said circuit.

The Electrical World.

Vol. XXXII. NEW YORK, AUGUST 13, 1898. No. 7.

PUBLISHED EVERY SATURDAY BY

THE W. J. JOHNSTON COMPANY,

9 Murray Street, New York.

Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York.

New England Office, 620 Atlantic Ave., Boston.
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THE ELECTRICAL WORLD,

9 Murray Street, New York.

Vol. XXXII. NEW YORK, AUGUST 13, 1898. No. 7

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THE CRITICAL LIMIT OF POWER.

There has always been quite a widely accepted idea that there is a limit of the power of generating stations above which—considerations of distribution entirely aside—it does not pay to increase the size, or in other words is as well to operate two stations of smaller size as the one of large size. Some four years ago this critical limit for generating stations was placed by one prominent writer at somewhere between 3000 and 5000 horse-power, and this was criticised by many as being too high a figure. Now that single generating units equal or exceed this power it is recognized as absurdly low for a station limit. With direct-current systems the limit of size is quickly determined by the power consumed in the district which can be covered at practical voltages. In traction work where the load is concentrated, as in some of the larger cities of this country, single stations of 8000, 10,000 or 12,000 horse-power are often built with feeder losses so great that multiple stations would undoubtedly be preferable, but the advantages of concentration are so much in evidence, and the power lost in the feeder system so little in evidence, that concentration is practiced where it should not be. By alternating systems, now that high voltages are becoming fashionable, distribution may be carried economically from a single center of generation over a district covering several hundred square miles, and in the more densely populated parts of this country stations might be loaded, having a capacity far beyond anything so far attempted. The question then arises at what point is it just as economical to operate two stations as one of the same aggregate capacity?

Taking up the various parts of the station one by one, there is as a rule no gain in the boilers after a station has reached a few thousand hp-capacity. The gain in large boilers over smaller ones is extremely slight, and as station size increases the boilers are not enlarged in size, but are increased in number. With the engines there is a continuing advantage, as the size increases, both in efficiency and weight per horse-power, and, as the largest sizes so far used for electrical generation purpose are greatly exceeded by sizes of a similar type used in marine practice, special experimental work is not as yet involved by increase in size, and the cost per horse-power continues to go down as the size increases. The design of electrical generators of the alternating type is now so well understood that untried sizes can be built with certainty of successful operation, but there is as a rule no economy in first cost per horse-power of unusual sizes, as the special designs and special construction machinery outweigh the saving in material and workmanship.

No matter how large the station, there is still some little gain per horse-power in the first cost, due to concentration, as it is cheaper to erect duplicate apparatus at one point than to construct the equivalent of the same at several points. But the greatest saving is undoubtedly in the operation of single large stations. Even if the size has become so great that the concentration allows no increase in the size of the generating units themselves, the duplication allows many little economies that would not pay with a smaller equipment. This is owing to the fact that the complexity of these little economies does not increase with their increased size, while the saving is directly proportional to the size. The single item of feed-water pumps serves as an example, for even in stations of a moderately large size the pumps are extremely wasteful of steam. But when the capacity of the plant becomes very great multiple expansion flywheel pumps can be introduced, their economy overbalancing on account of their size the disadvantage of increased complexity.

Many other details, such as oil circulating equipment, coal and ash-handling machinery, mechanical draft, economizers, etc., are similarly affected. An example of this may be cited in the case of alternating current stations in the use of storage batteries. While this may not be advisable in small or moderate sized stations, owing to the complexity, the cost and the inefficiency of the rotary transformers needed therewith, undoubtedly there is a size of plant above which these factors would be more than outweighed by the advantages gained, since these advantages are directly proportional to the size of the plant, while the added complexity is no greater and the inefficiency and the cost per kilowatt are less. One crane, for another example, serves an engine-room containing ten generating units as well as one containing five. When the station reaches a certain size it pays to install a crane operated by power; the saving in manual labor with stations larger than that size being greater than the cost of power equipment. The larger the station also the greater is the differentiation of labor and in consequence the greater is the effectiveness of that labor.

As a rule the greater the centralization of the power generation the better is the load factor. In a lighting system the peak of the load does not occur simultaneously in residence and business districts. In a railroad system, pleasure resort lines may have their peak at one time and the lines serving business districts at another. Combined lighting, power distribution and traction systems gain still more by the improvement in load factor due to the combination of different loads.

Thus it appears that increase in size causes a continued increase in economy, so far as the station itself is concerned, which increase undoubtedly grows smaller and smaller as the size continues to increase, but never reaches zero, approaching that value, as the mathematicians would say, asymptotically. At a certain point dependent on the concentration of the load this gain is met by the disadvantage of long feeders, but with high tension alternating currents this point is not reached until the district is a very large one, sufficiently large in the case of large cities for stations of a power hitherto unheard of. For example there is no engineering reason (considerations of ownership aside) why one central station should not generate all the electrical energy utilized in the Greater New York and some little of the adjacent suburban district by current distributed at a voltage now quite common in that territory, namely, 5000 volts. The power of such a station would run up into the hundreds of thousands of horse-power with an economy that would stimulate a demand for its output enormously. With the rapidly expanding use of electric power for all purposes, and the continual process of consolidation of allied and rival interests, this highly centralized central station may not be far in the future.

SWITCH PILLARS

[illegible] ardized a practice superior to anything in the same line in America. This practice is the use of what are known in England as switch pillars. They consist of cast-iron cases, generally placed above the ground, located near the sectional insulators of the trolley line [illegible] sary. As a rule each pillar contains four switches by which the four lengths of overhead trolley wire running in the two directions on the up and down tracks may be connected or disconnected from a bus bar, and one or more switches by which the feeders passing [illegible] about a half a mile apart, one section of the overhead trolley wire on one track may be opened in case of trouble without interfering with the current supplied to any other part of the system. If the feeders are looped into the pillars their sections may be similarly cut out.

In this country several practices in this detail are to be found. Some roads tie their whole overhead system together, depending on the ability of their generating stations to burn out grounds and thus prevent the latter from shutting down the whole system. Others insulate their various sections from each other absolutely at the sectional insulators, running separate feeders to each section, thus obtaining at the feeder panels of the power station switchboard absolute control of the current supplied to the separate sections of the line. While this is an advantage, it involves considerable disadvantages, as the feeders do not assist each other at times of unequally distributed loads as they do when the system is tied together. Some engineers favor the bridging of the sectional insulator by a connection brought through a box on the pole in which there may be a switch or fuse or both. In case there is a short circuit on any section, as soon as the circuit breaker supplying the feeder of that section from the switchboard opens, the current taken by the short circuit comes through the fuses and blows them, insulating the section and rendering its supply of power controllable by the station switchboard attendant. In case of fire or other trouble on account of which it may be desirable to take the power off from any section of the line this can be done by the switches at the sectional insulators and the feeder switches at the main switchboard. By this arrangement the feeders help each other out to a certain extent on unequally distributed loads, and in case of trouble current supplied to the sections may be controlled by the power station.

With large systems the drop of voltage in the feeders necessitates the use of the feeder and main principle whereby the line voltage even in the immediate neighborhod of the generating station is lower than the station voltage by an amount practically the same as at the distant terminals. This is accomplished by making no connection between the station bus bars and the trolley wires where they pass the station and by making the shorter feeders of smaller cross section than the longer ones so that the drop in the two on the average load shall be about the same. In smaller systems, however, this principle is departed from and all of the overhead copper, including the trolley wires and the so-called feeders, are simple mains, the trolley lines being connected direct to the bus bars at the station near which cars get full machine voltage which falls off due to the drop as they run from that point. In many such systems a group of feeders may be seen following the lines, each feeder being tapped into the trolley wires in its own district, with no cross connections between the feeders. In this case the economy of copper is very poor, owing to the fluctuating loads on the various sections and the fact that the feeders cannot to any considerable extent help each other, as they could if they were frequently cross connected. There may generally be seen in such systems a very marked difference between the cross section of the overhead copper leaving the station and that of the copper in the return circuits. This is not because of any assistance from ground returns or any difference between the calculated drop in the two sides, but because of the fact that the whole return circuit is cross connected and tied together, and the fluctuating loads at various points can mutually adjust themselves between many return lines, while they are limited by the overhead system to their own individual feeders. In this respect the English system is superior to the American one, as by means of the switch pillars all the feeders and the trolley lines are cross connected, utilizing all copper in the most advantageous way for the conduction of current

Some New Isolated Plants—II.

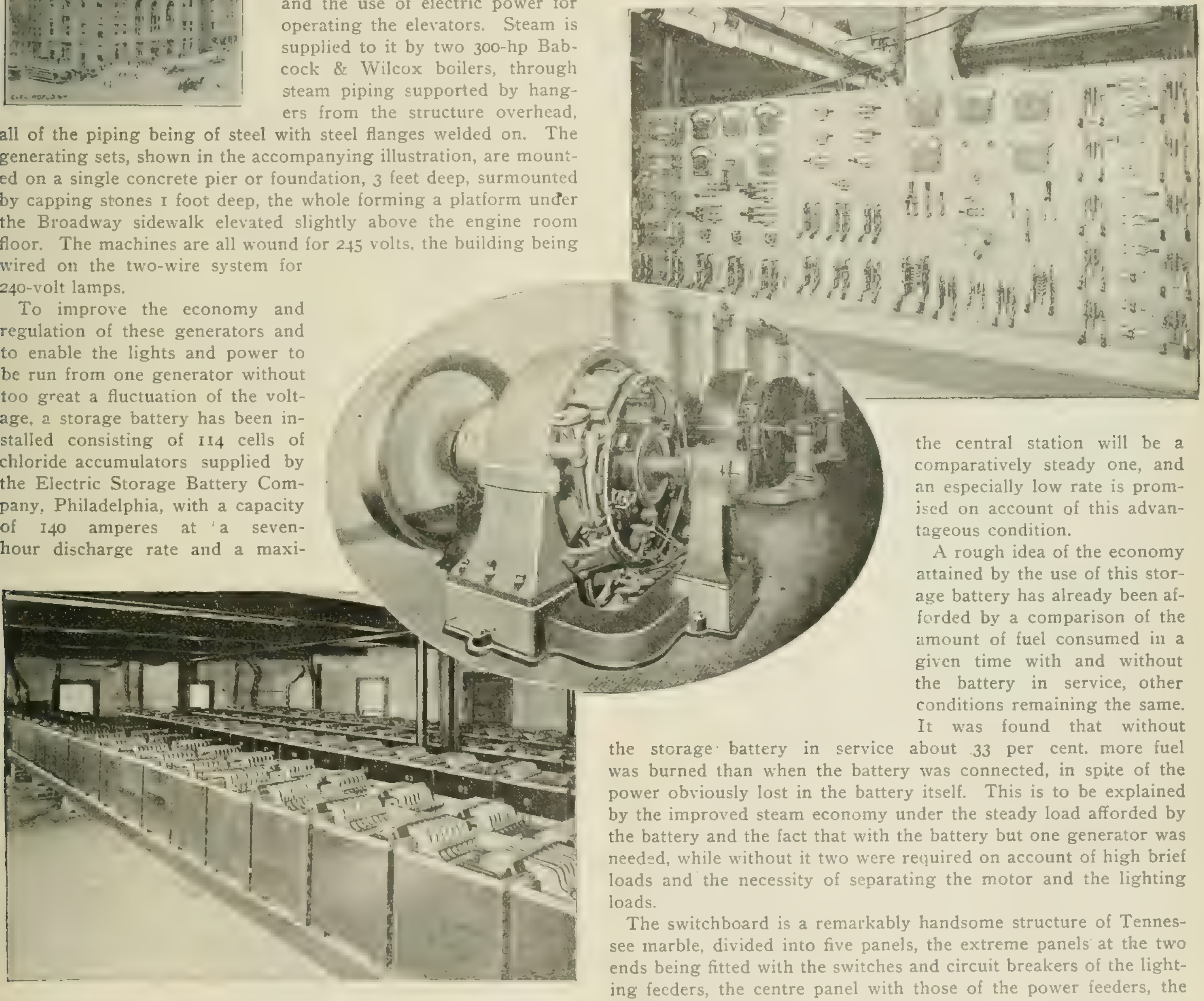
THE DUN BUILDING.

ONE of the most handsome office buildings recently constructed is that erected by R. G. Dun & Co. for general office purposes at the corner of Broadway and Reade Street, the whole building being planned on the principle that the best is none too good, regardless of expense.

The isolated plant of this building is of considerable size, owing to the expected lavish use of lights and the use of electric power for operating the elevators. Steam is supplied to it by two 300-hp Babcock & Wilcox boilers, through steam piping supported by hangers from the structure overhead, all of the piping being of steel with steel flanges welded on. The generating sets, shown in the accompanying illustration, are mounted on a single concrete pier or foundation, 3 feet deep, surmounted by capping stones 1 foot deep, the whole forming a platform under the Broadway sidewalk elevated slightly above the engine room floor. The machines are all wound for 245 volts, the building being wired on the two-wire system for 240-volt lamps.

To improve the economy and regulation of these generators and to enable the lights and power to be run from one generator without too great a fluctuation of the voltage, a storage battery has been installed consisting of 114 cells of chloride accumulators supplied by the Electric Storage Battery Company, Philadelphia, with a capacity of 140 amperes at a seven-hour discharge rate and a maximum emergency discharge rate of 600 amperes. This battery is connected with the generating system by a motor-driven differential booster, the motor and booster being mounted on a common bedplate, the whole constructed by the General Electric Company. The arrangement of the battery and booster circuits is such that the battery at night can be thrown straight across the bus bars to carry the whole load of lights and motors, while during the daytime, when the generators are running, the lighting system will be connected to them direct, and the motors, in parallel with the storage battery, will be connected to the generator or generators through the differential booster, the arrangement being such that the charging current or the current passing from the generator to the battery and its load will pass through the armature and series field of the boster, the series field tending to cut down the constant excitation of the shunt field. By this means the fluctuating demand which the elevators would exert on the generating system in spite of the steadying effect of the battery will be reduced, owing to the fact that the fluctuations will vary the booster e. m. f. in such a way as to cut themselves down, thus making the battery take up most of the variation of the load.

For further provision against any emergency a breakdown service from the Edison street mains is provided. This breakdown service will eventually be so connected that the whole plant can be run by it, although at present only the lighting feeders are arranged for supply from this source. The final arrangement is so planned that the Edison current will only reach the elevator load through the storage battery with the booster arranged to smooth out the fluctuations, as when charging from the generators, so that the demand on the central station will be a comparatively steady one, and an especially low rate is promised on account of this advantageous condition.



Battery Room, Row of Generators and Switchboard of the Dun Building.

A rough idea of the economy attained by the use of this storage battery has already been afforded by a comparison of the amount of fuel consumed in a given time with and without the battery in service, other conditions remaining the same. It was found that without the storage battery in service about 33 per cent. more fuel was burned than when the battery was connected, in spite of the power obviously lost in the battery itself. This is to be explained by the improved steam economy under the steady load afforded by the battery and the fact that with the battery but one generator was needed, while without it two were required on account of high brief loads and the necessity of separating the motor and the lighting loads.

The switchboard is a remarkably handsome structure of Tennessee marble, divided into five panels, the extreme panels at the two ends being fitted with the switches and circuit breakers of the lighting feeders, the centre panel with those of the power feeders, the panel immediately to the left controlling the generators and to the right the storage battery and booster. Every circuit entering or leaving the board is equipped with an Ideal circuit breaker, and all lighting and power feeders are fused on separate panels behind the board. The board is fitted with two complete sets of triple-pole bus bars, on either of which the generators may be run separately or in multiple, but on one of which the storage battery will be customarily run alone. During the daytime the arrangement will be such as to carry the lighting feeders immediately from the generators, run singly or in multiple with each other, on one set of bus bars, and the motor system, consisting principally of screw type elevators, on the other set of bus bars, supplied by the storage battery, the booster being inserted between the two sets. By means of the switches on the board other combinations may be made, the generator being shut down at night and both lights and power being carried from the battery direct without a booster. The main generator switches are double-throw, one throw to each set of buses.

The power feeder switches supplying the elevators are also double-throw between the two sets of buses and the lighting feeder switches are double-throw, one side going to the generator buses and the other to the Edison breakdown service. All bus bars, studs and main connections, as well as the contacts between the same, are proportioned for a current density at full load of 750 amperes per square inch, the contacts being all sweated.

An admirable point of the system is the location of the storage battery, which is placed on the roof beneath a special light steel frame iron-sheathed superstructure. By this arrangement there is not the slightest danger of corrosion from the battery fumes reaching the apparatus in and about the engine room; there is not the slightest difficulty in obtaining ventilation, and there is no danger of the fumes becoming noticeable in the building. There is, of course, plenty of room on the roof and the battery can, therefore, be a single tier in height, as shown in the accompanying illustration. The regular arrangement allows the utmost simplicity in connection from cell to cell. The steel and iron work in the battery room is painted with an asphaltic paint and the walls are finished in rough mortar. The battery cells contain fifteen plates each in wooden boxes, in each of which there is room for four more plates if necessary. The battery is tied to the switchboard by two 375,000-cm cables on each pole, these cables running with all the other cables of the lighting and communication systems in a single vertical runway through the building. An interesting detail of this runway is the arrangement of the iron-armored conduits, the lengths of which are let into holes in steel plates mounted on the steel structure at each floor, the fastening being effected by nuts threaded on the conduits.

Besides the six Sprague screw type elevators there are one ash hoist, one sidewalk elevator and one 72-inch fan, all motor driven, as well as one Quimby screw pump, which is run at night from the storage battery to supply whatever water is used throughout the building, the water pressure being maintained by pressure drums in the basement with pneumatic cushion, a small air pump maintaining this by an occasional run. The building also contains a 10-ton refrigerating plant, an interesting detail of which is the disposal of the circulating water which carries off the heat of the condensed ammonia. This water, of about 100° temperature, is ordinarily piped to the sewer, the water, costing $1 per 1000 cubic feet, as well as the heat, being entirely lost. In this building, however, the water is piped to the kitchen of a large restaurant above, where it will be largely used in dish-washing machines, etc., the kitchen being, therefore, supplied with water at four temperatures, ice cold, ordinary, about 100° and about boiling point.

The consulting engineer of this plant was Mr. R. P. Bolton, the constructing engineers of the switchboard and wiring being P. M. Mowrey & Co. The engineer in charge of the plant is Mr. G. M. Dunscomb.

Convention of the Ohio Electric Light Association.

The fourth annual meeting of the Ohio Electric Light Association will be held at the West House, Sandusky, Ohio, on August 18 and 19. The following papers will be read: "Positive and Negative Economies in Small Central Stations," by E. P. Roberts; "Some Suggestions Relative to Determining the Cost of Electrical Supply," by M. E. Turner; "The Meter's Relation to the Dividend," by Caryl D. Haskins; "Comparative Commercial Qualities of Old and Modern Transformers as Applied to an Exchange," by J. H. [illegible]; "Long Distance Transmission of Power," by E. J. Berg.

The following queries from the question box will be brought up for discussion:

1. What are the advantages and disadvantages of inclosed arc lamps for [illegible] lighting?

2. Can the candle power of arc lamps be accurately determined by the use of a portable photometer?

3. [illegible] competition of the gasoline incandescent [illegible]?

4. Is it advisable for a plant to change from 15,000 cycle alternating single-phase to 7200 two-phase if no question of motor business is involved?

5. What are the types and makes of gas engines in use in the smaller plants of the association, the time of their installation and their condition at the present time?

The [illegible], with offices at the [illegible] Cleveland.

The Sayers Winding.

The American patent No. 607,593, issued to Mr. W. B. Sayers on July 19, 1898, for a modification of the Sayers winding, adds no little to the ingenious combinations already proposed by Mr. Sayers for the reduction of commutator sparking and for the automatic internal provision of an e. m. f. in the short-circuited sections proportional to the load for properly reversing the currents while the adjacent commutator segments are under the brushes. To make clear the working of this latest modification it may be well to describe the earlier plans proposed by Mr. Sayers, the following information and figures being taken from his earlier American patents, the first of which was No. 516,553, issued March 13, 1894.

The general plan of the Sayers winding contemplates the insertion between the commutator segments and the junctions of the armature coils, which are in ordinary windings connected directly together, of auxiliary coils or turns, so arranged as to cut the field at the instant of commutation, and of sufficient strength to reverse the currents within themselves, the field in which they lie being automatically proportioned by the armature reaction to the armature load. Each of these turns is, of course, active only at the instant when its segment is under the brush, being on open circuit the rest of the time. The first patent mentioned above describes these auxiliary turns or coils, *B*, Fig. 1, as wound upon a ring armature in a direction the reverse of that of the main windings, *A*, and with a backward lead in the case of a generator—that is, the commutator windings are set off to one side of the junctions, *D*, with which they connect in such a way as to follow the latter as the armature revolves. With this reverse winding the fringe of the field used for commutation should, of course, be in the reverse direction from that normally used, and to obtain this the brushes must be shifted in the opposite direction from that customary, or, in the case of generators, the lead should be backward. The auxiliary winding, if wound, as described, further back than the coils to which it is connected, will be, at the instant of commutation, under a stronger part of the field horn than they will, and if of the same number of turns as the latter it will thereby give an e. m. f. sufficiently greater than that in the main coils to reverse the current. It will be readily seen that on account of this backward lead the commutation will be brought under the horn into which the field is concentrated under heavy load by the armature reaction, and the action on the auxiliary coils will therefore be strengthened as the load increases, instead of weakened, as in ordinary windings, the reversing action in the short-circuited coils being thereby rendered more or less proportional to the load, instead of the reverse.

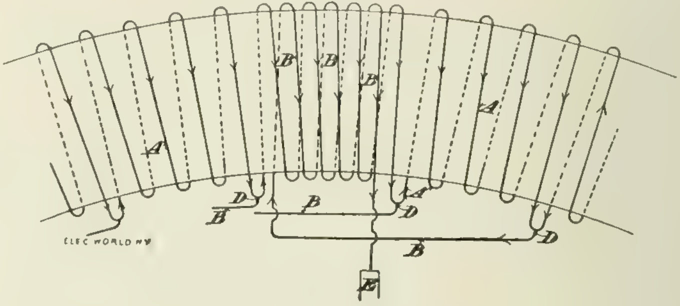


Fig. 1.

On account, also, of the reversed lead the armature reaction tends to assist instead of to oppose the field magnetization.

This arrangement is obviously fitted for running the armature in one direction only, since the auxiliary coils are wound to one side of the junctions of the main coils to which they are attached. To run the same machine as a motor, the armature distortion being reversed and the crowding of the lines of force therefore being thrown over to the other horns, the direction of rotation must be reversed. To provide an arrangement capable of running in either direction and either as a motor or a dynamo, a plan is outlined in patent No. 524,119, issued August 7, 1894. This patent describes a multipolar drum winding of either the lap or wave type, each commutator coil, B^1, B^1, Fig. 2, spanning only a small part, say one-sixth, of the pole angle, embracing and preferably adjacent to the slots carrying the two armature coils, A^1 and A^2, with whose junction, [illegible], it connects. Thus when the machine is running in either direction as a generator, one side of the commutator coil follows the armature coils, with which it connects and is under the crowded horn of the pole piece, after its other side and also its armature coils have left it. It, therefore, effects the reversal, its reversing tendency being more or less proportioned to the armature distortion, and hence to the load. When the machine is running as a motor, the other side of the commutating coil is active, as it is ahead of its armature coils and gets under the crowded leading horn before they do, its complementary side being inoperative and the leading side effecting the commutating reversal. Various modifications are described in this patent, consisting of peculiarly shaped pole pieces, metallic bridges, etc., the general principle remaining the same.

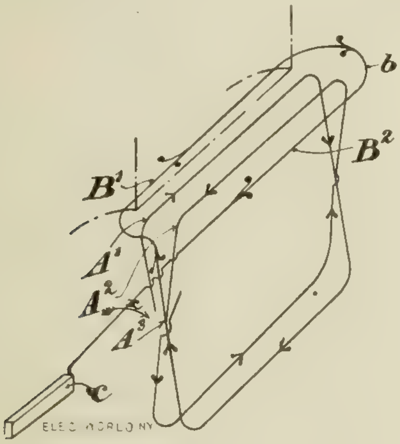


FIG. 2.

In the patent just issued by the American office, No. 607,593, a further modification is effected, consisting, as shown in Figs. 3 and 4, of iron frames, surrounding each field pole outside of its exciting winding, the sides of the frames running axially along the armature, being brought down and arranged as small pole pieces, *p p*, close to the face of the armature. The purpose of this device is to provide an auxiliary field through the armature core and completing itself through these frames, this auxiliary field being entirely independent of the main field excitation, its magnetomotive force being solely due to the armature cross magnetization and being, hence, proportional to the armature load up to saturation of the circuit. The brushes should be so set that the commutator coils, as B^1 B^2, which just span the distance between two of these auxiliary pole pieces, *p*, shall be immediately under them when the corresponding commutator segments are under the brushes. The lines of force, then, through this auxiliary field circuit, will exert an e. m. f. between the short-circuited segments of the commutator suitable for reversing the current in the windings between these segments, this e. m. f. being automatically proportioned to the load. It may be seen that there is required no shifting of the brushes in either direction with this arrangement, and it may be run either as a generator or a motor, there being, consequently, no demagnetizing reaction on the part of the armature. The slots in which the armature coils are wound are, at the instant of commutation, not magnetically closed by a pole shoe above them, but are midway between the poles; thus self-induction of the turns is reduced. It would seem at first sight as though these extra turns in the winding would double the armature copper without a corresponding gain, but, as the commutator coils carry current only intermittently for brief periods, they can be of smaller cross section than the armature winding and, since there is no lead, and, consequently no armature demagnetization, but simply a distortion, which distortion helps instead of hinders commutation, heavier armature currents may be generated with the same field iron and copper.

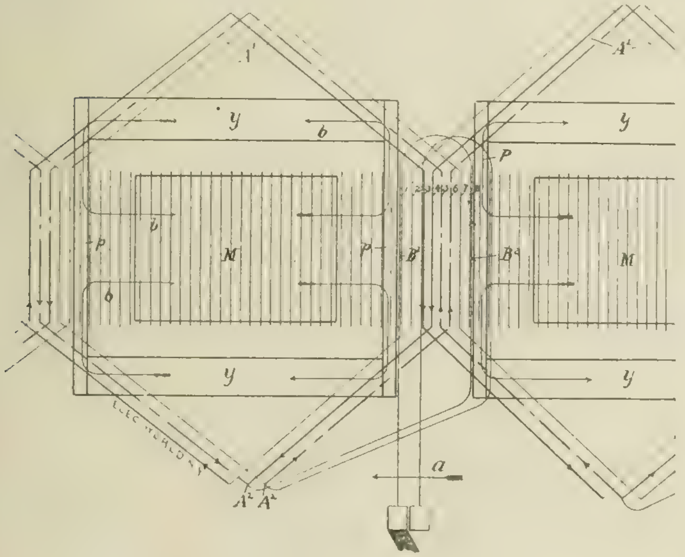


FIG. 3.

In the London "Electrician" of July 8 there is described the "Sayers Automatic Third-Brush Regulation of Dynamos," this being presumably developed by the same inventor. This arrangement, which is shown diagrammatically in Fig. 5, connects the shunt field exciting coils between one of the main brushes of the machine and a small auxiliary third brush bearing against the commutator midway between the main brushes, and therefore getting on no load about one-half the full voltage of the machine. As the load rises the lines of force passing from the field poles to the armature are crowded into the following horns (in the case of generators), and—the field coils spanning these horns—the fields get more than one-half the total machine voltage, the proportion rising as the load increases. The effect is obviously proportional to the load within limits prescribed by the permeability of the system, such a machine being practically compounded or over-compounded without any series winding. It is necessary, of course, that the shunt coils of the machine be wound to give the no-load excitation with half the machine voltage across the terminals. As most machines are wound with two or more field spools in series, they can easily be arranged for this modification by simply multipling the coils and adding the pilot brush. Curves are shown in the contemporary referred to, giving the results of tests made on such a machine with a capacity of 300 amperes and 120 volts. It is said that the pilot brush, which was of carbon about one-fourth of an inch in thickness, gave no trouble from sparking. The characteristic curves show, as might be expected, a very satisfactory compounding effect.

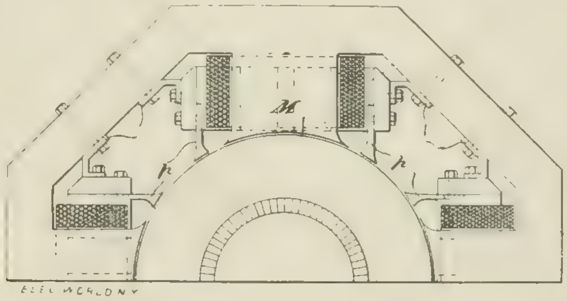


FIG. 4.

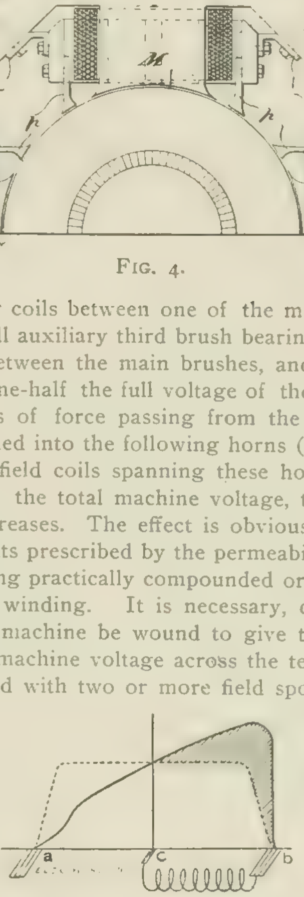


FIG. 5.

The Seashore Electric Railway at Brighton, England.

From the fact that the Society of Engineers recently paid a visit to this odd railroad, it appears that it has been rebuilt since its destruction by the force of the waves about two years ago. The line is about 3 miles long, the rail level at its deepest portion being 15 feet below high-water level. The car, 46 feet x 22 feet in size and weighing loaded about 50 tons, is supported on the trucks by steel tube columns, the deck being 25 feet above the rail level.

Electrical Power Distribution in an English Dock Yard.

All of the shop machinery at the Portsmouth dock yard is to be driven by electric power according to "Industries and Iron." The magnitude of this proposed installation is well shown by the estimated cost, which is one-half a million sterling.

The De Laval High-Pressure Steam Boiler and Turbine.

A clear description of the working mechanism of this remarkable turbine shown at the Stockholm exposition has been translated by the "Iron Age," from which the following is taken:

The boiler, *A*, consists of a single long pipe of small diameter, curled in a helix, A^1, over which the products of combustion pass. The fuel is fed at the top of the boiler, and is carried to the fireplace through the central chamber, A^2, the lower end of which ends above a cone of masonry, which spreads the fuel on the surrounding basket-shaped grate. The air of combustion is forced into the fireplace by means of a blower, partly through the flue, A^6, which enters below the grate, and partly through A^5, from which the air is forced through mouth pieces immediately above the top level of the fuel, where it serves to complete the combustion of the gases. Should the steam pressure rise too high, the air supply through A^5 and A^6 is cut off, and air is instead forced in through A^4, by means of the dampers in these three pipes, which are manipulated by the damper regulator shown, which consists of a piston, the steam pressure on which is counterbalanced by a spring. The water is fed to the boiler by the feed pump, *G*, which has several plungers (four in the 50-hp system, and six in the 100-hp system) in order to furnish as even a supply of water to the boiler as possible. The suction pipe of the pump is connected with the water cistern, *B*, in which is a float controlling the feed pump, so that all water condensed is returned to the boiler.

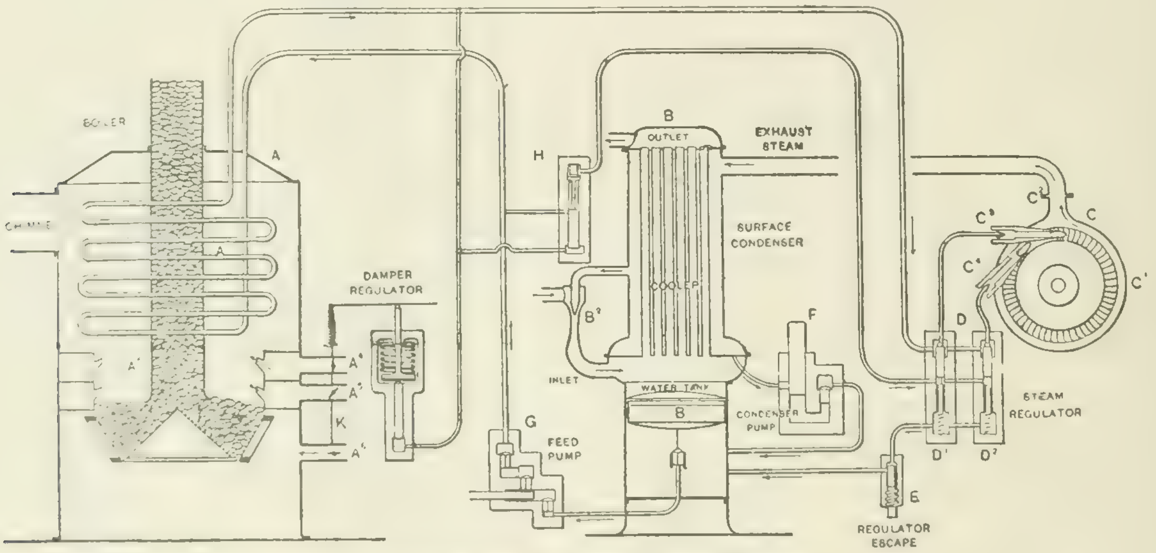


Diagram of the De Laval Steam Turbine.

The steam generated in the spiral pipe at the exhibition plant had a pressure of 1735 pounds, which at the steam turbine was reduced to 1420 pounds per square inch. The steam is first conducted to the throttles, *D*, which open one or more of the turbine nozzles, according to the load. The pressure of the water in the lower ends of the steam regulators is determined by the regulator escape, *E*, which is opened and closed by a centrifugal governor.

From the upper ends of the steam regulators the steam is conducted through four mouthpieces, or tuyeres, C^3 and C^4, with very small apertures. The turbine disc, C^1, is constructed as a double turbine with two rows of buckets and a division wall. From the [illegible] then through the division wall, and finally through the other series of buckets. The discs make 13,000 revolutions per minute in the [illegible]

[illegible]

Particularly noticeable at the power plant in question was the small floor space occupied by this combination of boiler, steam turbine [illegible]

The Mental and Moral Influence of an Engineering Training *

I have read somewhere that the chief obstacles to the progress of men are gravity, friction and natural depravity. The more you think about this statement the more complete it is. Voltaire said: "All general statements are untrue, and probably this one is also." At the bottom of this cynical witticism or witty cynicism is a certain truth, but we may take the general proposition with regard to the obstacles to human progress as fairly correct.

For some generations society has agreed to leave to the engineer the care of friction and gravity, but natural depravity has been left to ministers, lawyers, editors, teachers, the mothers of families, to anyone, in fact, but the engineer; and this is where society makes a mistake. The best corrector of human depravity is the engineer, because he must deal with conditions, while other may deal with symptoms. The engineer must always square himself with the laws of nature, which are perfect, unchanging and eternal. So far as he fails to do this he fails in his business and misses his daily bread. Other men can square themselves with human laws and human notions of morality, and so they can twist along without ever knowing the difference between right and wrong. And that is why the engineer is the best moral guide. He must have a passion for truth and the faculty of thinking straight or he cannot succeed in his business. This is no mere extravagance of words to amuse you for the moment. It is a solemn truth.

We can all remember crises involving moral issues when great numbers of the clergy—perhaps the majority—were on the wrong side because of confusion of thought and false proportion. They have mistaken a conventionality for a moral truth. Or they have been mistaken in the relative value of two moral offenses. Or they have been led away by expediency—that most dangerous guide. Every day we see the talents and the energies of able lawyers bent to defeat justice and to shield crime, and this is defended by sophistries that have lived for centuries. You remember what Macaulay said about this: "We will not at present inquire whether it be right that a man should, with a wig on his head and a band round his neck, do for a guinea what without these appendages he would consider it wicked and infamous to do for an empire."

But, on the other hand, it is the good fortune of the engineer (and into that good fortune you young men have now entered) that sophistry and ignorance will surely kill him professionally, and that his success will be in direct proportion to what he actually knows and to his determination and power to reason straight. If he does not know the stresses in his bridge or engine, if he does not know the endurance of his material, if he does not design his structure according to what he knows he cannot long pretend, even to himself, to be an engineer. Nature, calm and unrelenting, always stand looking at him. No other man in the world has such stern and unswerving discipline, and so it comes about that no other man is so safe a moral guide as the engineer, with his passion for

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[*] [illegible] address delivered by Mr. H. G. Prout to the graduating class of [illegible]

truth and his faculty of thinking straight. This is no mere statement of a theory, but of observed facts. It has happened to me, over and over again, to discover that I get a sounder opinion on any matter of human conduct from the engineers of my acquaintance than from men of any other calling; and this is chiefly because nature has taught them that their opinions are worthless unless they are severely reasoned from known facts. Other men, especially ministers and editors, get the dangerous trick of thinking that their opinions are valuable merely because they are their opinions.

Electrical Shop Work.

BY B. F. FELIS.

As brazing is now quite an important operation in the modern electrical shop, a brief description of the best methods of setting up and using a brazing outfit may be interesting. The object in brazing or silver-soldering pieces of metal together is, of course, to unite the several parts in practically a single piece with a joint not readily fused. If well done, the joints are hard to find. The crudest form of brazing apparatus is obtained with an ordinary forge, shown in section in Fig. 1. An ordinary portable forge, such as is used in all electrical working shops, can be made serviceable for brazing with but a few alterations. The old-fashioned brick forge with bellows requires that the space below the coal grate be enlarged, as shown in the drawing. The course of the air blast from the bellows is indicated by the arrows. This sample is given to show that effective brazing can be done even with the crudest of appliances. The process consists in placing the parts to be brazed in the fire after the coke or charcoal has been burned so that the flame is bright and clear. The methods of brazing will be described farther on.

Fig. 2 shows a more improved device for brazing. This requires two pipes which unite at *C*. One-inch pipes of iron are usually used with valves of the globe type. Any pipefitter can make it up. The top pipe receives an air blast from an air blower or compressed air chamber. The lower pipe receives ordinary illuminating gas or vaporized hydrocarbons, such as petroleum, gasoline, etc. Rubber or canvas hose-pipe connections are usually employed to connect the pipes with the gas and air supply. The air and gas mix and discharge at *D*. A perfect combustion is made and brazing can be done quickly and effectively.

Fig. 3 illustrates how a two-burner brazer may be constructed. One-inch iron or brass pipes may be utilized and provided with check valves for regulating the supply of air and gas as shown, gases combining at *D*.

The plan of the burners is such that the flames meet at a central point, increasing the intensity of the heat and hastening the brazing operation. The back and base work is firebrick.

The arrangement of the burners permits the workman to watch the work on all sides without removing it from the flame.

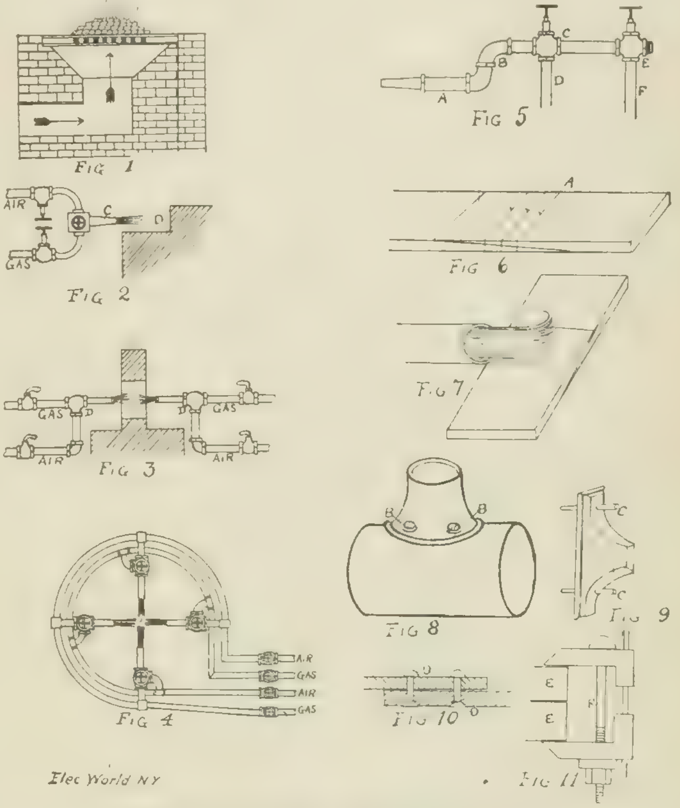
Fig. 4 shows a plan for erecting a four-flame outfit. The main air and gas pipes are bent into a circular shape and one fitted inside the other. Four pipes branch radially inward from the outer circle. Four more project from the inner circle and turn into the sides of the first pipes, as shown. The drawing shows the arrangement in plan. A fire-brick base is furnished. With this device, it is possible to entirely envelop the article in flames. The concentration of heat is intense and most effective.

Fig. 5 is a detail of one burner and will serve as a pattern. The pipes are one inch in diameter, of iron, and the joints are leaded. An air pipe, *F*, leads to the main, *E*, at which point a check valve is connected. Gas pipe *D* leads to the main at *C*, where a similar valve is put in. The combined gas and air pass to *B*, where the pipe is dropped a few inches to correspond with the height of the base of the furnace plate. The burner, *A*, is a plain piece of piping, the nozzle end of which is slightly reduced.

EXPERIMENTAL BRAZING.

Before attempting to braze important parts of electrical apparatus or other articles, experiment with some plain pieces of sheet steel. Take two pieces and lap the beveled edges, as in Fig. 6. Then wire the lap with fine wires, *A*. Next put the joint in the flames of the brazing apparatus and heat red. Both sides should be heated alike. Fig. 7 shows the flame from one of the burners directed against one side of the joint. There must be no dirt, filings or foreign stuff between the laps. Borax is the flux used. There are three kinds—calcined, broken and granulated. All three are sold at supply stores, ready to use. The borax protects the exposed surfaces of the metal from the heat, so that when the solder is applied the metal surfaces can be joined clean. Both borax and solder are alternately applied to the joint until the union is complete. As full descriptions for this work accompany the packages of borax and solder, we need not deal with the matter further.

Instead of wiring parts together for brazing, screws, pins, rivets, etc., may be required. A job like that in Fig. 8, in which a flanged piece is to be brazed to a tube, could not be wired. Screws *B*, *B*, are used. Holes are first drilled and tapped. The screws are inserted, the parts brazed and then the screw heads are chipped off and the stubs filed down and smoothed over. The pin method is shown in Fig. C, in which two pieces are held together by pins, *C*, *C*. After brazing, the pins are chipped off, smoothed down, and if neatly done no trace of them will be seen. The rivet method is presented in Fig. 10, in section. The rivets are indicated, *D*, *D*, and both ends may be countersunk or left with round heads. Or the ends can be filed down smooth, so as not to show. A clamp is serviceable in some cases. Suppose parts *E*, *E*, are to be joined. A clamp like that shown can be forged, the jaws drilled for a clamping bolt *F*, and the device used to hold parts together during the operation of brazing.



DETAILS OF BRAZING FURNACES AND TOOLS.

The final work is cleaning off of the slag, and general corrosive matter which has accumulated about the joint. This is done with the sand blast, chipping tools, filing or grinding. The first method requires so much apparatus that the other systems are used chiefly. Final polishing is done with emery cloth.

Tests of the Isolated Plant of the Chicago Public Library.

A complete set of tests of the mechanical equipment of the new Chicago Library gives some data of interest concerning the electrical plant. Each generating unit consists of two 60-kw General Electric dynamos, coupled to the shaft of an Erie Ball vertical cross-compound engine. There are four such sets beside one smaller one. The indicated friction load was 12 horse-power, which, with field coils excited, ran up to 16.9 horse-power. The steam per hp-hour was, at full load, 24.7 pounds, and at half load 31.1. Complete tests were also made of the elevators, which are of the drum type, over counterweighted, driven by electric motors and installed by the Crane Elevator Company. The larger elevators, loaded to an average weight of 5200 pounds, and counterweighted by an average of 4400 pounds, running at 300 feet per minute and stopping at every floor, consumed 6.25 kw per car mile, the number of stops being 332 per car mile.

The Calculation of Alternating Current Generators—I.

BY ALEXANDER ROTHERT.

During the period which has elapsed since the electrical exposition held at Frankfort-on-the-Main probably the most noticeable advances in electro-technics have been in the direction of the generation and utilization of very powerful alternating currents. Both monophase and polyphase apparatus have been greatly improved and, on account of its advantage for power transmission and the running of non-synchronous motors, the polyphase system has probably received the most attention and has therefore been more completely developed. On account of the simplicity of the apparatus necessary for the generation and transformation of the alternating current a wide and constantly increasing field is open to it.

With the change from the comparatively small generators used for illuminating purposes of several years past to the immense machines used at present for purposes of power transmission many problems of design and construction have arisen, and the effect of certain reactions which are negligible in the older machines has assumed extreme importance in the modern power generators. In the older machines a change in the inductance of the load carried made a very great change in the e. m. f. at the terminals of the machine, and when working with loads of large inductance it was found impossible with the excitation provided to keep up the potential at the terminals. As is well known the armature reaction of alternators working on non-inductive loads is not of very great importance, but this is no longer the case when the load is highly inductive and in consequence the currents lag behind the e. m. f.

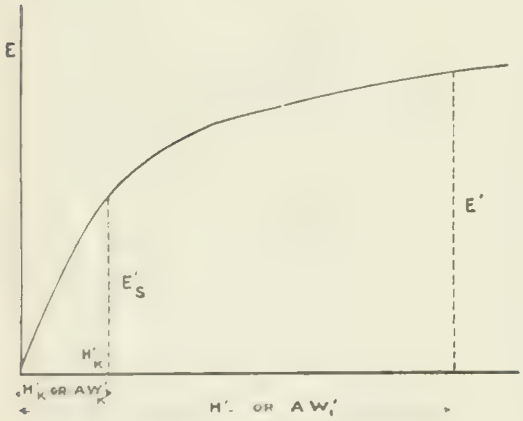


FIG. I.

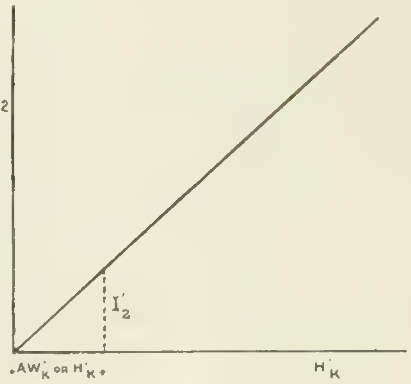


FIG. 2

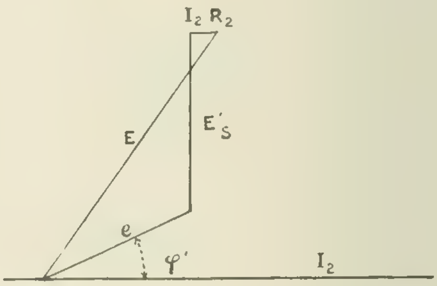


FIG. 3

Owing to the reaction of the lagging current it is necessary to provide greater exciting power in order to prevent the terminal e. m. f. from dropping when the load is increased. For this reason power generators were provided with more powerful fields and in consequence relatively fewer turns on the armature.

In this manner it has become possible to construct generators capable of carrying heavy inductive loads with comparatively little drop at the terminals from light to full load.

On account of the lack of a proper theory, designers and constructors were reduced to the necessity of using empirical or "cut and try" methods for designing such machines. There was an urgent demand for a theory which would allow the predetermination of the characteristic curve of the machine when working on loads of different inductances. Gisbert Kapp was perhaps one of the first who investigated the effect of inductive loads upon the performance of alternators. He [illegible] out on non-inductive load the effect of the inductance of the armature. He showed that if there is an inductive load the armature currents react upon the field excitation and this reaction is proportional to the angle of lag. The essential feature of Kapp's method is that he makes a distinction between the self-induction and the reaction of the armature.

The consideration of the effect of the angle of lag in Kapp's method is only approximately correct and only holds good when the lag is small.

On the other hand the theory of Behn-Eschenburg was welcomed as being a decided advance, especially since in it there is no distinction made between self-induction and reaction and the theory [illegible] simple and comprehensible.

In order to make a careful investigation of the errors of the theory and to make a fair comparison between it and a theory to be given further on, which is free from these errors, I will give a brief description of Behn-Eschenburg's method.*

The theory of Behn-Eschenburg has for its object the determination of the p. d. between the terminals of the machine with any given excitation, when the machine is working on more or less heavy loads with various angles of lag. In other words, it is for the purpose of determining a series of characteristic curves which will show the performance of the machine as the load and also the angle of lag are varied. The abscissæ of these curves are the excitations and the ordinates are the volts between the terminals of the machine.

It is evident the p. d. between the terminals is the resultant of the impressed e. m. f. and of the ohmic and inductive drops. Since these quantities are not in the same phase it is necessary to combine them by the usual method of vector addition.

The impressed e. m. f. for various excitations is obtained by running the machine at its normal speed and measuring for each excitation the volts at the terminals, the machine, of course, carrying no load. This curve may also be derived by calculation from the number of conductors on the armature, the flux passing through it, and the number of revolutions per second. This no-load characteristic is merely the magnetization curve of the machine and has the same form as the curve of induction in an iron magnet with an air gap. Such a curve is shown in Fig. 1.

The drop due to resistance and self-induction may be obtained from what is known as the short circuit curve. To obtain this the machine running at normal speed is short-circuited through an ammeter whose inductance and resistance may be neglected. To any excitation there will correspond a certain current which can be read upon the ammeter and by varying the excitation a series of such currents may be obtained. Since the ammeter is considered non-inductive and to have no resistance the whole of the e. m. f. impressed upon the armature is expended in forcing the current through the armature circuit. Since we have observed the excitation necessary to cause this current to flow we can by referring to the first or no-load characteristic curve find what the corresponding e. m. f. is. Consequently we know the drop through the armature for any given current. If the resistance of the armature is known this drop can be separated into that due to the ohmic resistance and that due to the inductance.

In order to avoid confusion in the following discussion and in the diagrams it may be well to state here that all quantities denoted by the letter H with or without subscripts, represent magnetizing forces expressed in ampere turns, while all quantities denoted by the letter B represent total induction or fluxes. The subscript 1 always refers to the field magnet; 2 to the armature, and r to a resultant.

The short circuit curve is shown in Fig. 2, with the field ampere turns as abscissæ and armature currents I_2 as ordinates.

The lower portion of this curve is usually a nearly straight line, passing through the origin.

In order to construct the diagram we select any excitation H_1 to which corresponds, according to Fig. 1, the e. m. f. E^1; further we select a load the current I_2 and the lag φ in the outside circuit. To the current I_2 corresponds in the short circuit curve Fig. 2 a certain excitation H [illegible]; we must now find the inductive drop which corresponds to this excitation, $H^1{}_k$. Behn-Eschenburg obtains it from the magnetization curve, Fig. 1, which gives the e. m. f. for each excitation. Corresponding to the excitation $H^1{}_k$ (in Fig. 1), the drop due to the self-induction is $E^1{}_s$.

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* See The Electrical World, Vol. XXX, p. [illegible]

The diagram when constructed will appear as shown in Fig. 3. The conditions which it must satisfy are the following:

$E^1{}_s$ s at right angles to I_2 and consequently also to $I_2 R_2$ because it represents the drop due to the self-induction. The angle between I and e is that of the lag of the current in the external circuit. As is seen, the values from which the diagram is constructed are taken from the curves shown in Figs. 1 and 2. From the diagram we are able to determine the p. d. between the terminals for each excitation if the current and the angle of lag are known. This p. d. is, of course, represented in both magnitude and direction by e, and by constructing the diagram for a series of different currents and angles of lag we can from the values thus obtained plot curves, using as co-ordinates loads and terminal e. m. fs. which will show the performance of the machine when run on any load.

It is, however, not quite so simple to determine the required excitation for each load if the p. d. at the terminals is to remain constant, and it is this case which is much the most important in practice.

This theory is apparently very correct and convenient; it, however, has in common with the theory of Kapp certain unfortunate deficiencies which sometimes may cause very erroneous results.

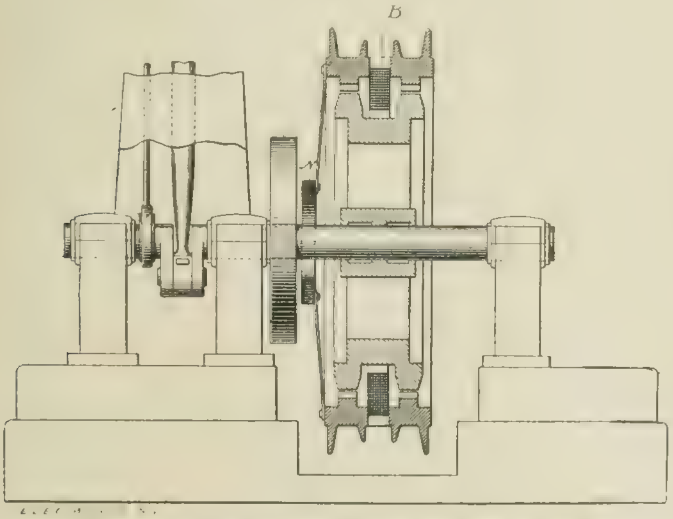
These deficiencies are as follows:

The effect of magnetic leakage is left entirely out of consideration and the effect of the diminishing permeability of the iron as it approaches saturation is completely ignored. It is tacitly assumed that the permeability of the iron is constant. E. m. fs. are combined as if to any given increase of the excitation there always corresponded the same increase of e. m. f. whether the iron is partially saturated or not. This assumption and consequently the composition of e. m. fs. is generally admissible in the theory of transformers and of polyphase motors in which the iron is only slightly saturated. With generators, however, this condition no longer holds good, for in most of them certain parts of the magnetic circuit approach or may actually attain saturation.

Under these conditions it is no longer permissible to assume that a given increase in the magnetizing force will produce a proportionate increase in the induction and consequently in the e. m. f. given by the machine. Hence the combination of e. m. fs. under these circumstances will lead to serious errors and to wrong conceptions concerning the action of the machine.

The Leakage of Magnetism into the Engines of Direct-Coupled Units.

Mr. J. F. Kelly, of the Stanley Electric Manufacturing Company, has patented an arrangement shown in the accompanying illustration for preventing the exciting coil of direct-coupled units, such as the Stanley inductor alternator, from setting up a stray field into the engine parts, the patent being No. 608,133, issued July 26, 1898.

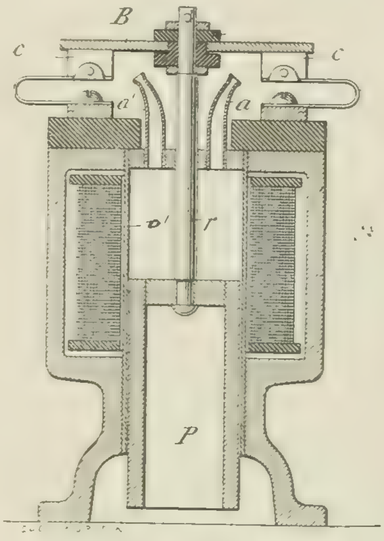


A Device for Preventing Injurious Stray Fields

As may be seen in the illustration, such an exciting coil, B, concentric with the shaft tends not only to set up a magnetic flux through the armature teeth and poles of the inductor where it is wanted, but also gives a m. m. f. along the shaft which, being of steel, throws quite a field into the engine. This field, crossing such gaps as those between the cranks and the lower end of the connecting rod, tends to draw these surfaces together, giving sometimes a most unaccountable binding and heating. The sensitiveness of shaft governors is also likely to be affected. To overcome this the patent claims the use of a coil, N, about the shaft between the generator and the engine, the exciting current being passed through said coil whose ampere turns are proportioned to overcome the magnetizing force set up by the main exciting coil, B.

An Arc Arrester for Motor Controllers.

Mr. Robert Lundell, of the Sprague Electric Company, has claimed in patent No. 608,134, issued July 26, 1898, a novel device for preventing arcing across the contacts of motor controllers. Instead of attempting to blow out the arcs in any way at the fingers of the controller itself, there is inserted in the main supply circuit of the controller a magnetically operated switch, shown in the accompanying illustration. The exciting coil of this switch is energized by the movement of the controller immediately before the opening of any contacts therein. The current in the coil, M, attracts the iron plunger, P, which forces up by means of a rod, r, the conducting plate, B, breaking the contacts between the latter and the spring-supported fingers, c c. The movement of the plunger, P, also forces the air out from the cylinder above it, through the nozzles, a a, giving a blast to blow out the arcs which might otherwise hold between the fingers, c c, and plate, B. The circuit of the exciting coil, M, is opened and closed by auxiliary contacts in the controller.



A Controller Blow-Out.

Carbide Works in Europe.

One single manufacturer of electrical machines—namely, Schuckert & Co., of Nurnberg, Germany—reports a sale of electrical machinery for carbide-producing apparatus, aggregating over 20,000 horse-power. The annual capacity of this machinery in carbide will be about 20,000 tons. The American Consul-General at Frankfort reports that the price in Germany to large consumers is the equivalent of about $8 per 100 kilograms (220 pounds); this price running up rapidly as the size of the orders runs down.

Electric Kitchens for Hospital Ships.

It is announced in the daily press that the Women's National War Relief Association was told, in answer to its request for information as to what it could do for the hospital ships, that electrical kitchens would be appreciated. The association proposes to supply such kitchens for the ship "Missouri," now being fitted out in Brooklyn.

A Direct Reading Electrolytic Thermometer.

Messrs. Hartmann & Braun, of Frankfort, Germany, have brought out a high-temperature thermometer or pyrometer, consisting of a temperature wire, the resistance of which is constantly indicated by a direct reading ohmmeter.

The Cost of Municipal Lighting in Detroit, Mich.

The following discussion of cost is quoted from the third annual report of the public lighting commission of Detroit:

The fiscal year just closed is the first in which a municipal lighting plant of any size has had as near a thorough test as possible, and the results are awaited by those interested for and against an institution of its kind. The physical results—that is, the conversion of fuel and water into electric current—for the year will bear comparison with the results of any plant, commercial or otherwise, generating electricity. The results from labor will not compare as favorably for the reason that slightly higher wages are paid and much shorter hours of work obligatory.

The commission considered that the plant, operated under its enforced conditions, should produce an arc light of 2000 candle power for the year at about $50, and the heads of departments were instructed accordingly. The first step was the reorganization of the force of employees. The heads of departments and clerks were put on the salary list, and made subject to call for work at any time, day or night, without extra compensation for work in excess of eight hours per day. The operating crews were assigned work in three divisions of the day; i. e., from 8 A. M. to 4 P. M., from 4 P. M. to 12 M., and from 12 M. to 8 A. M. The repair crews and clerks were assigned to duty from 8 A. M. to 5 P. M., with a noon hour for dinner. Employees in the operating crews having similar duties were allowed to exchange shifts between themselves. The arbitrary shifting of crews was abolished and the former relief crews done away with. This resulted in a marked saving of labor and in station maintenance supplies. The item of trimming was a very heavy one, and the routes for trimmers were rearranged, increasing the work from an average of 59 lamps to 74 lamps and 7⅜ miles average length of routes. The work of each trimmer, however, was calculated to be done in about seven hours, the trimmer walking his circuit, and no work to be required of the trimmer after completing his circuit.

By these economies the commission was able to reduce the cash outlay per lamp from $64.19 per annum for a monthly average of 1564 lamps for the preceding year, to $51.85 per annum for a monthly average of 1744 lamps. The reduction was largely in the item of labor, being reduced from $43.57 per lamp to $33.27 per lamp, while the reductions in the cost of supplies was from $20.62 to $18.58 per lamp.

To arrive at the cost of an arc lamp to the city of Detroit per annum, there should be added to the above cash cost of $51.85 a certain amount for interest on the investment, for loss of taxes through the plant not being owned by private parties and for depreciation. The first two items are easily computed, for the average investment for the year was, in round numbers, $750,000, with interest at 4 per cent., and the assessed value of the same was placed by the city assessors at $400,000, with the rate of taxation at $17.68 for the city and at $3.24 for the State and county, a total tax of $20.92 per $1000; but with the latter—that is, the figuring of the depreciation—there is a wide difference of opinions. As per the statistics published by the London "Electrician" it is customary for the municipal lighting plants of that country to set aside annually about 3 per cent. of the entire investment as part of the expenses for a sinking fund. The writers on the subject in scientific journals in the United States have ranged from 3 per cent. to 7½ per cent. as the amount to be charged off for depreciation or for a sinking fund. This commission held in its preceding report that a plant established and maintained similar to the Detroit city plant should [illegible]

Interest at 4 per cent. on $750,000 average investment... $30,000.00
Depreciation at 3 per cent. on $750,000 average investment [illegible]

A total [illegible]

Proportioning this on the basis of the electrical output and we have $55,207.27 chargeable to arc lighting, or $31.65 per annum per arc lamp. The total cost of an arc lamp to the city of Detroit per annum on these figures may, therefore, be placed at $83.50.

In February, 1893, the Detroit Electric Light & Power Company offered to light the city of Detroit for a period of ten years at the rate of $102.20 per arc lamp per year. While there are no recent bids available from which the exact cost to the city of an arc lamp by commercial companies may be obtained, it is entirely reasonable to presume that in common with all other industries the cost per lamp has been reduced at least 10 per cent. during the interval of five years which has elapsed. The cost, therefore, at present may be assumed to be not greater than $90 per arc lamp per year. For a number of reasons it is believed that the rate of $90 per year is a conservative figure, which may be justified.

Taking that assumption as correct, it will be seen that the amount per arc lamp which the city has saved during the past year, after allowing the 3 per cent. for depreciation, as compared with the cost of the same lamp by a commercial company, was something less than $7. This narrow margin, the commission believes, fully justifies its course in reducing the expenses during the past year to the lowest minimum possible consistent with the best service and the limiting conditions under which a municipal plant must always be operated.

While it is possible that improvements in some machinery may be made soon, which would cause a partial loss to the city of the value of part of its investment in machinery, on the other hand it is only fair to state that there is an equal probability of compensating improvements in other devices and which will enable the city to further reduce the cost per lamp per year. Reductions in cost, due to such improvements, of course would not accrue to the city if it already had a lighting contract extending over a period of years.

The ultimate success of the plan of municipal ownership of a public lighting plant, viewed from the standpoint of economy to the taxpayer, cannot as yet be claimed to be assured in the city of Detroit. Time is an essential element of consideration in arriving at a judgment at all valuable upon this question. The plant, the business of which we have the honor to administer, has been in existence since April, 1895, but it is only since November 1, 1897, that the construction feature of our business was completed and the plant placed upon a purely operating basis. This period is entirely too short to justify absolute conclusions as to the ultimate success of the municipal venture from an economical view.

The margin of profit per lamp at the present time, while it is not large, nevertheless is a showing to the advantage of the city, which it is to be hoped will be maintained or increased in the future. It is but just to observe in this connection that the quality of light furnished has been uniformly of the full standard of 2000 candle power, which is better than was found practicable to obtain of contractors; and also that collateral advantages not easily reducible to terms of pecuniary value have accrued to the city by reason of its operation of its own lighting plant. The results, such as they are, have been secured by the commission only by the practice of the strictest economy and the rigid exclusion of all of those elements so apt to intrude into the administration of public municipal affairs, and which operate only to confound business principles and political expediency in perplexing entanglement. It has not been at all times easy to persuade some that these two policies occasionally clash irreconcilably, and, in the determination of the one or the other to be followed, it was the duty of the commission to be guided solely by the interest of the taxpayer.

An Improvement Over Ash Hoists.

A novel form of sidewalk ash elevator has been installed in connection with the boiler plant of the United States Appraiser's Warehouse in New York City, the work having been done by the Link Belt Engineering Company. The elevator consists of an endless chain carrying buckets which scoop the ashes from below and deliver them above the sidewalk into a spout, which shoots them into wagons. The spout folds down into the main frame, which is telescopic and can be lowered below the sidewalk when not in use. The capacity of the machine is about fifteen tons per hour.

DIGEST OF CURRENT ELECTRICAL LITERATURE

AMERICAN AND FOREIGN

By Carl Hering

Lights and Lighting.

REMOVABLE LAMP BASES.—"Zeit. f. Beleucht.," July 20. —The beginning of an article from "Dinglers' Polytech. Jour.," giving brief, illustrated descriptions of the various forms of removable lamp bases which have been devised. They are divided into two classes, one in which only a part of the base is removable and the other in which all of it is removable. The base is an expensive portion of the lamp, and it is claimed that the price of lamps would be reduced by making these bases removable, so that those from old lamps can be used again; this would enable lamps to be kept in stock without bases. any desired base being afterward attached; in many of these the plaster of paris joint, which has proved to be so troublesome on account of the moisture, is avoided.

ELECTRIC PRINTING IN PHOTOGRAPHY.—"Elek. Anz.," July 3.—A brief, illustrated description of the Schwarz apparatus, in which arc lights are used to replace sunlight for photographic printing. The apparatus consists of several arc lamps behind each of which there are three plain reflectors at right angles to each other and covered with white enamel; the lamps are conveniently mounted on a stand. To illuminate a surface of 1 sq. m. uniformly requires four lamps arranged at the corners of a square. Prints are made with this in fifteen minutes to one hour, according to the current strength and sensitiveness of the paper.

Power.

POWER DISTRIBUTION IN FACTORIES. Mavor. Lond. "Elec. Rev.," July 22.—A brief abstract of a recent paper, the original of which contains tabulated replies received from a number of manufacturers, to inquiries which he made; he divides these into two groups, one for weaving and spinning, corn and flour mills, and engineering works, in which the power is derived from one or two large engines, and the other for paper mills, chemical, sugar refining and engineering works, in which the power is derived from a number of small engines. In the first group the average coal consumption per indicated hp-hour is 3.1 pounds, and the total cost of the power, including labor, is 0.26 cents; for the second group these figures are 5.3 pounds and 0.448 cents. He also gives the particulars for a foundry in Glasgow, where nineteen small engines were replaced by one gas engine of 120 horse-power, driving hydraulic pumps and a dynamo; the net result of the change was a saving of $300 per month in cost of fuel and from $400 to $500 per month in the saving of working expenses. He concludes with some advice as to the best way of making the change; it is a bad plan to use an old engine to drive a dynamo, or to use the old boilers, and he advises a separate, new installation of an efficient type, sufficient to replace the isolated engines, and leaving untouched any old engines that are working with fair economy, especially those working groups of machines through shafting; after the economy of this change has been found, the question of making the complete change can be safely answered.

PLANT AT CREUSOT. Lond. "Engineering," July 22.—The conclusion of the description noticed in the "Digest" last week; illustrated descriptions of various electrical machinery made by that company are given.

GAS ENGINE INSTALLATIONS. Koerting. "Elek. Anz.," July 3.—A reprint of a recent lecture on the cost of operation of gas engine plants, including data and conclusions favorable to gas engines.

TRANSMISSION AT VERY HIGH VOLTAGES. Bly. "Jour. of El'ty," July.—A reprint of a Pacific Coast Elec. Trans. Assn. paper, in which he makes certain recommendations which he considers good practice for transmission at extremely high voltages. Extremely high efficiency in the transformers is not desirable at all times, as its attainment is accomplished only at the expense of reliability; the transformer and line losses should be considered collectively, and not individually. Oil is indispensable for the insulation in such transformers; one-eighth of an inch of mineral seal oil will require, with an alternating current of 60 cycles, a little over 20,000 volts to be punctured, and this is about 6 or 8 times what is required to jump across a similar air gap; hard wood, such as maple or walnut, when properly treated with oil, is one of the best materials to be used for supports of the coils of such transformers. He acknowledges the comparative success of the Wurts lightning arresters. He prefers glass to porcelain for the insulation, and lays special stress on the construction of the supporting pin, which he claims is as important as the insulator itself; he objects to pins of or containing iron, and recommends those that are strictly non-conducting, like those made of prepared wood, which have been found very satisfactory. He points out the importance of the capacity of the line under these high voltages, especially on very long lines; it may be practically neutralized by a reactance, but such a system is very difficult to regulate, as the balance is easily disturbed.

ELECTRIC MOTORS IN PAPER MAKING. Bell. "Cassiers' Mag.," August.—A short article in which he makes an estimate of the cost for a typical case, including the first cost and operating expenses. He concludes that the best field for electric motors in paper making is in reducing the cost of power; by this means a mill can be located so as to obtain its material and ship it economically, at the same time having the advantages of a cheap water power; electric transmission enables the plant to be located with reference to shipping as well as to the water power. With coal at $3 per ton electric transmission of 500 horse-power or more, with an average water power within a radius of 15 miles, will pay nine times out of ten. He discourages the use of electric heating, recommending producer gas instead.

CENTRIFICAL PUMPS. Richards. "Jour. of El'ty," July. —A reprint of a short Pacific Coast Elec. Trans. Assn. paper. He shows that centrifical pumps are especially well adapted to be driven electrically; their disadvantages are the constant duty and the speed of rotation; the former is overcome by subdividing the plant into smaller units and the latter, by the adoption of what he calls the conoidal system.

BUFFALO TRANSFORMER STATION. Dunlap. "West. Elec.," July 30.—A brief, illustrated description of the first section of the permanent installation.

HIGH-SPEED ENGINES. Peache. "Cassiers' Mag.," August.—After a brief discussion of the conditions to be met by high-speed engines and their limitations, he gives brief, illustrated descriptions of a number of British high-speed engines for electric light and power stations.

PACIFIC COAST ELEC. TRANS. ASSN.—"Jour. of El'ty," July.—Verbatim reports of the proceedings of the second annual convention; the papers are also reprinted in that journal, which is the official organ of that association.

Traction.

BRAKES FOR STEEP GRADES.—"L'Eclairage Elec.," July 16.—A note stating that a system used on Swiss railways consists in the use of two shoes of steel, one on each side of the car, provided with points; they are mounted so as to be readily lowered to come in contact with wooden girders placed along the sides of the track. A car weighing 9.5 tons and running at a speed of 10 km per hour, was stopped within a space of 2 to 4 meters on a grade of 9.2 per cent.; some of the details of the test are given.

AUTOMOBILES.—"L'Energie Elec.," July 1 and 16.—This double number is devoted entirely to illustrated descriptions of the various vehicles in the recent Paris test, together with tabulated results of these tests.

BLACKPOOL.—Lond. "Elec. Rev.," July 22.—A brief, illustrated description of the electric trolley line from Blackpool to Fleetwood.

POWER CONSUMPTION IN RAPID TRANSIT SERVICE. Carus-Wilson. "St. R'y. Jour.," August.—A reference to an article on this subject by Armstrong in the June issue of that journal, in which it was stated that the greatest economy in railway service can be secured by driving the motors at a high rate of speed at first, and then allowing them to coast, rather than to drive them at a lower rate of speed and coast a shorter distance. Carus-Wilson analyzes the resistance loss in both methods, and finds that it is not negligible, as stated by Armstrong, but considerable, and is greater in the coasting than in the "uniform speed" method. He considers the total losses from all causes about the same in both methods of running, but points out that with the method recommended by Armstrong about 30 per cent. more heat is generated in the motors, and that the maximum current is about 20 per cent. greater, both of which are important objections to the "coasting" method.

RECENT TRACK CONSTRUCTION OF THE SIOUX CITY TRACTION COMPANY. Wilson. "St. Ry. Jour.," August.—An illustrated description of the method of laying track in asphalt and brick pavement employed in that city. A T rail 6 inches high in 60-foot lengths was used; it was mounted on steel ties, spaced 3 feet center to center, and held together by tie rods spaced 7 feet 6 inches; under each rail was a continuous concrete beam, keystone in shape, with an average width of 15 inches and depth of 9 inches. The rails with the ties, etc., were first placed in position and supported on wooden blocks, and was all surfaced, lined and gauged; the concrete was then placed under the rail; as the concrete had to set for eight days, the track was exposed to the sun during this time, and its expansion and contraction, owing to differences in temperature, amounted to from 3 to 4½ inches in 400 feet; to hold them in uniform temperature, the rails were covered with inverted V-shaped troughs during this time. The ends of the rails were butted close together, but no trouble from the track getting out of line has been experienced. In asphalt paving stone blocks, close to the rail, are used. The formulas for mixing the concrete, etc., are given in the article.

THE ELECTRIC RAILWAY SYSTEM OF SPRINGFIELD AND HOLYOKE.—"St. Ry. Jour.," August.—A well-illustrated article. The principal feature of the Springfield road is a new car house; there is only one entrance track. This allows the use of a small door, so that in winter there is no difficulty about keeping the car house warm and washing the cars when in the car house. The overhead contacts in the car house are made up of angle irons instead of wires, and are consequently rigid, so that the trolley pole does not slip off. The station is being reconstructed, and will contain four 1200-hp engines. In Holyoke, forced draught is used in the power station instead of natural draught, and the results are satisfactory; the system includes a mountain inclined railway, on which two mountain cars connected by a cable are operated; each car is equipped with motors and these furnish the only power, the use of the cable being simply to balance the dead weight of the two cars when one is ascending and the other descending; the grades are from 7 to 21 per cent., and average 14 per cent. Another novel feature of the incline is that it is a single track road with a turnout in the center; here a special arrangement of rails permits the passage of the cable through the tracks; auxiliary rails are laid outside of the regular rails; at these points the car is carried on the auxiliary rails by means of an extra pair of wheels mounted on each car axle. No rack rail is used, but there is a safety rail along the entire length of the line, which can be gripped by an automatic device located under the car in case the normal speed is exceeded.

NEW ELECTRIC RAILWAYS IN VIENNA AND ITS ENVIRONS. Ziffer. "St. Ry. Jour.," August (International Edition).—He mentions a number of new electric railway enterprises in the neighborhood of Vienna; two in particular, which are to be built immediately, are one from the Praterstern to Kagran and one from Vienna to Baden. The franchise conditions are given in detail, and include the right of the city authorities to take over the property upon paying a price fixed in the concession; the profits above a certain amount are also to be divided equally between the city and company.

THE HALIFAX CORPORATION ELECTRIC TRAMWAYS. Wilmshurst. "St. Ry. Jour.," August.—An illustrated description of the electric railway system, which is about 4 miles in length; about 13 miles in addition will be installed; the costs of construction are given. The steepest grade is 1 in 12.3; power is taken from the electric lighting station owned by the city; the rail used weighs about 98 pounds per yard; the cars are equipped with three brakes, the ordinary hand brake, an electric brake and a track brake. In the station are two 120-kw generators, and a battery of 275 chloride accumulator cells.

THE BROOKLYN ELEVATED RAILWAY MOTOR.—"St. Ry. Jour.," August.—A full description with half notes and efficiency curves. The motor is well ventilated at the sides, as its use on an elevated railway does not require that it be inclosed; the armature core is also ventilated.

THE ST. LOUIS, BELLEVILLE & SUBURBAN RAILWAY.—St. Ry. Jour.," August.—This is a high-speed electric line 14 miles in length, leading out of St. Louis. The rail is a 60-pound T, laid on oak ties resting on a ballast of cinders 6 in. in depth, which in turn rests on a clay bed. The cars measure 43 ft. over all, and make a speed of 60 miles per hour, in places.

THE HOLLAND & LAKE MICHIGAN RAILWAY.—"St. Ry. Jour.," August.—A description of a short line 7 miles in length, in Michigan; it is built across country.

WATERLOO AND CITY RAILWAY.—"St. Ry. Jour.," August (International Edition).—A brief, illustrated description of this underground railway in London, to which several references have already been given in the "Digest."

ELECTRIC TRACTION. Quin. "El'ty," August 3.—A reprint of the paper noticed in the "Digest" July 16.

Installations, Systems and Appliances.

CENTRAL STATION ACCOUNTS. Lond. "Elec.," July 22. [illegible] and the [illegible] [illegible] published each week in that journal, they will not again be noticed; each ar- [illegible]

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Wires, Wiring and Conduits.

[illegible]

gineers; it includes also a number of conventional signs to be used in making drawings. In an appendix it is stated that the specific resistance of copper is to be expressed in ohms for a length of 1 meter and a cross-section of 1 sq. mm. at 15° C.; the reciprocal of this value is to represent the conductivity; copper whose specific resistance is greater than 0.0175, or whose conductivity is smaller than 57, is not to be used for conducting copper; standard copper of 100 per cent. conductivity is that which has a conductivity of 60; in calculating the effect of temperature 0.4 per cent. per degree C. is to be assumed, unless otherwise stated.

SAFETY DEVICES FOR LINES.—"Elek. Anz.," July 10.—Illustrated descriptions of a number of safety devices of the Siemens & Halske Company for overhead lines.

Electro-Physics and Magnetism.

CATHODE JETS. Phillips. Lond. "Elec.," July 22.—Vivid green specks often appear on the bulb of a Crookes' tube after the pressure is so reduced as to make it difficult for a discharge to pass, provided the negative electrode is in a bulb of soda glass; as considerable uncertainty exists concerning the origin of these patches he endeavored to show that the cathode is capable of emitting a radiation which can produce these effects. A bulb is shown in which the cathode could be rotated by means of an external magnet. The best conditions for producing these spots were found to be a low pressure, a sudden stimulation, a particular spark length, and a dry atmosphere. When the cathode was revolved the patches moved with it; they would often remain luminous ten seconds after the discharge ceased to pass; if after the current was stopped the magnet was again applied the patches moved as before, showing that even when no free charge resided on the elctrodes there was still a jet of electrified matter issuing from the cathode. These jets may be deflected electrostatically and magnetically; the patches immediately disappear when an arcing or some such disturbance took place between the cathode and another body near it and within the tube; tin-foil on the outside near the cathode also prevented the formation of the jets. These facts may account for the curious variation in connection with X-rays which has been observed. He concludes that it is probably important to have the concave cathodes of focus tubes well polished, particularly at the edges, especialy if they are highly exhausted bulbs, for the production of X-rays.

FIRE-FLY LIGHT. Muraoka and Kasuya. "Wied. Ann.," 64, p. 186; abstracted in "L'Eclairage Elec.," July 16.—They found that the action of this light on photographic plates was not an electric phenomenon, as was suggested by Stokes; the plates were found to be affected by solid and liquid bodies, and they attribute the effects to the vapors emitted by these.

CONSTANCY OF MAGNETIZATION OF BAR MAGNETS. Mme. Curie. "L'Eclairage Elec.," July 16.—A very long abstract from the "Bul. Soc. d'Encouragement," 3, p. 63. The article gives the results of very extended researches and the abstract reproduces much of the useful data, which, however, is not in such form that it can be given here; the results will doubtless be of considerable value to those interested in the subject; a few of the results are mentioned in the following synopsis of the paper. She endeavored to find under what conditions the magnetization of a bar magnet will remain most constant; she studied the effect of reheating at a slightly greater temperature, with a number of different magnets and under different conditions. It was found that re-heating, even at low temperatures, diminishes the coercive force of the hard steels in proportion as the steel is better for making good magnets; they should not be heated at 200° C. if it is desired to make them constant, as the steel then loses 50 per cent. of its coercive force, and the magnetic qualities are considerably altered; hating to 100° involves a loss of 12 to 13 per cent.; it seems best to heat them for twenty-four hours, for instance, at 60 to 70° C., and then the loss will be only 1 to 3 per cent.; the intensity of the permanent magnetism also varies with the reheating, but the variation is rather complex, the results obtained differing between each other. The action of shocks on a saturated magnet was investigated; the number of shocks required for diminishing the magnetism a certain amount were measured; in general the new value is obtained more quickly as the shocks have less effect, but there were differences in the different bars used; for hard steels the limit is more quickly reached. The effect of shocks was also investigated on bar magnets which were partially demagnetized; the effects of shocks were then less; by a partial demagnetization, therefore, one can make a bar magnet so that it will not be affected by shocks. The effect of reheating at a relatively low temperature, on the state of magnetism, was also investigated; it was found necessary to use bars which were not magnetized to saturation if it is desired that their magnetization remain constant with the variations of the temperature of the surrounding air. The variation of the intensity of bar magnets with the temperature was investigated; a bar of hard tempered steel reheated at [illegible], magnetized to saturation and demagnetized by [illegible] of its maximum permanent magnetization, will then have a magnetization which always has the same value for a given temperature. The variation of the magnetization produced by external magnetic force was investigated, the force required to demagnetize them by 1-10 was measured; the exceptionally high value of [illegible] units was required for a magnet made of [illegible] steel. Finally she discusses the constancy of the state of magnetization; the magnet which was often used as the standard in these experiments remained constant to within one three-hundredth of its value during fifteen months; to make a magnet independent as much as possible of external actions without depriving it of too much of its magnetization it should be reheated at only 60 or 70° C. during a long time, say forty-eight hours, then magnetized to saturation and finally demagnetized partially. For a bar magnet 20 cm long and 1 cm in section one can obtain 0.9 of its maximum permanent magnetization ;it will then stand quite energetic shocks and variations of the surrounding temperature without an appreciable variation of the state of its magnetization; the constancy will be still better if it has been demagnetized still more, but the magnetism then becomes more susceptible to the effect of external fields; it is possible to reach a state in which fields below 5 units do not produce greater permanent variation than 0.2 per cent., and that fields below 16 units do not produce a variation of more than 1 per cent.; it is very necessary to avoid with care bringing it in the neighborhood of other magnets; a pole of 500 units at a distance of 10 cm can produce a dangerous effect; but even when thus treated one cannot be sure that the magnet will not vary thereafter; one can only say that the probability that its magnetism will not vary is very great.

ROENTGEN RAYS. Rollins. "Elec. Rev.," August 3.—A continuation of his long serial. He claims that the wave length depends on the temperature, and describes a tube in which a thermometer was inserted in the stream of water circulating behind the focus plate; by this he found that a higher voltage was required to produce Röntgen rays of a given wave length with cool and with warm water; by using a lower voltage or vacuum and increasing the number of impacts by increasing the current, an uncooled target can be made so hot that it radiates ordinary light and yet the tube will not yield any Röntgen rays; in practice a very high temperature of the target is not desired; with a very high vacuum and voltage a temperature could be produced perhaps higher even than that of the sun, and at this some of the elements can, he claims, be decomposed. He discusses having the target separate from the anode and near the cathode; in an illustrated tube the target is between the terminals, and the velocity should then be greater than when the target is the anode; with a given voltage light of a shorter wave length should be generated, or of the same wave length with a lower voltage, which latter means a smaller generator; if the voltage could be high enough the vacuum tube could be discarded and the Röntgen "light" could be produced without them. He then discusses the size of the cathodes; to overcome some difficulties he claims that it should be 2 inches or more in diameter, instead of being less than 1 inch, as is usual; the size of the cathode should be in proportion to the size of the surges. At some stages of the vacuum only the edges appear active, while at a higher vacuum only the centre seems to be the source, and it has therefore been thought by some makers that a small cathode is as good as a large one, but this, he claims, is a fallacy.

Electro-Chemistry and Batteries.

ALUMINUM ELECTRODES. Wilson. Lond. "Elec. Eng.," July 22.—The continuation of his long Royal Society paper (see "Digest," last week). He continues the description of the tests with continuous currents; a table gives the results with the positive aluminum plate connected successively with one to twenty storage batteries; with one to eighteen cells the currents gradually increased, but with twenty cells and the plate formed in sulphuric acid the electrode gave way with great rapidity, allowing a strong current to pass; the plate formed in alum was more stable with twenty cells. The effect of temperature on the voltage was then examined, and a table of results is given, showing that for a rise of temperature from 13.5 to 70° C. the voltage falls from 30 to 3 volts, from which he concludes that temperature has an effect on the apparently high resistance of the aluminum plate and its film; in practice, therefore, when a high resistance is required it is necessary to cool the cell. Tests were also made with the plates immersed in mercury; the film formed on the aluminum plate is discussed; it is formed by simple immersion in alum and subsequent exposure to the air, and it has the same effect as the film formed with the current. He then begins the discussion of the tests with alternating currents, the object of which was to see if the effect described in the first part has time to properly develop at ordinary frequencies, and also to see whether aluminum is a good metal for condensers. With the ordinary frequencies and the cells he used a uni-directional current was not obtained, even if the time taken to develop the effects was very small compared with the time of the complete period; the results of the tests are tabulated, and show that small currents are accompanied by a large phase difference, but the large ratio between the maximum coulombs in the two halves of a period, mainly develops with large currents for a given frequency, accompanied by high temperature and small phase difference.

CONNECTIONS FOR ELECTROLYTIC WORK.—Lond. "Elec. Eng.," July 22.—A brief mention of a recent paper by Dessauer on the Carlin method of making connections, which appears to be used in the gold fields of South Africa. It consists of a tube filled with mercury, which is accessible for making contacts by having holes drilled through the upper part, into which wires are inserted; the result is said to be most satisfactory; the loss with the former screw contacts was found to be 0.71 out of 3.82 volts, while with this method it was reduced to 0.015 volt.

MOST ECONOMICAL CURRENT IN ELECTROLYSIS. Vogel. "L'Eclairage Elec.," July 16.—An abstract of an article in which he develops, with the aid of simple mathematics, formulas for the energy required per unit of weight of the material deposited and the cost per unit of weight, from which he deduces an equation for the most economical current.

ELECTROLYTIC THEORIES. Edser. Lond. "Elec. Eng.," July 22.—A short article on the relation of these theories to commercial electrochemistry. He calls attention to the recent progress in commercial application and the importance in this development of a better knowledge of the theories; he cites Germany as an example of a country in which theory and practice in this field are developed together.

ZINC EXTRACTION. Threlfall. Lond. "Elec.," July 22.—An abstract of his recent article from the "Elektrochem. Zeit.," describing the Ashcroft process at Cockle Creek, New South Wales. Since the article first appeared it has been announced that the plant was not a success economically and is to be shut down.

MEETING OF ELECTROCHEMICAL SOCIETY. Muller. "L'Eclairage Elec.," July 16.—The beginning of an account of the recent meeting of the German society in Leipsic; it includes long abstracts of the papers. References to German reprints have already been given in the "Digest."

FUSION IN THE ELECTRIC FURNACE. Oddo. "Amer. Jour. of Sc.," August.—Abstracted briefly from the "Real. Accad. Linc.," 5, p. 361.—He investigated the effect produced by heating lime mixed with various proportions of silica and found that whenever there was an excess of lime combinations occurred only in the proportion needed to form orthosilicates.

OSMOTIC PRESSURE AND ELECTROLYTIC DISSOCIATION. Traube. "Amer. Jour. of Sc.," August.—A brief abstract of an article of a theoretical nature from the "Ber. Berl. Chem. Ges.," February.

ELECTROCHEMICAL BEHAVIOR OF CHROMIUM.—"El'ty," August 3.—A reprint of the article noticed in the "Digest" last week.

ELECTROLYTIC REFINING AND RECOVERY OF TIN. Cowper-Coles. "El'ty," August 3.—A reprint of the article noticed in the "Digest" last week.

RELATION OF CHEMISTRY TO ELECTRICAL ENGINEERING.—"Elec. Rev.," August 3.—A reprint of the article noticed in the "Digest" last week.

Units, Measurements and Instruments.

METALLIC RESISTANCES. Scott. Lond. "Elec. Rev.," July 22.—In this continuation of his long article (see "Digest," last week) he gives further tables and data which appear to be quite useful. One of them gives the particulars of the steel alloy "kruppin," which is made in Essen, Germany, and is said to be used considerably on the continent. The makers claim that it can be raised to 600° C. without ill effect. Another table gives the data for the alloy called beacon; its resistance is about forty-eight times that of copper, and it is said to be the highest resistance material in the market; its temperature coefficient is 0.0007007, specific gravity 8.1, specific resistance 85.13 at 20° C.; it is said to have been used for some time for car heating in this country, and that it will not become brittle if run at high temperatures. Another table gives the comparative costs of various alloys, showing the relatively very low cost of galvanized iron wire, which is so very largely used for resistances. The resistance of galvanized iron wire netting of No. 20 B. W. G., with 1 inch mesh and 20 inches wide, has a resistance of about 0.005 ohm per yard, and a safe current capacity of 90 to 100 amperes. The article is to be continued.

PHOTOMETRY OF INCANDESCENT LAMPS.—Lond. "Elec.," July 22.—The translation of the rules which have been approved by the German Union of Electrical Engineers; they have already been referred to in the "Digest."

METER.—"Elek Anz.," July 17.—An illustrated description of the new form of Hummel wattmeter for continuous currents.

METERS. Armagnat. "L'Eclairage Elec.," July 16.—Brief, illustrated descriptions of a number of meters, taken from patent specifications.

VACUUM PUMP.—"Elek. Anz.," July 3.—A brief, illustrated description of a pump made by Greiner and Friedrichs.

ALUMINUM CONDUCTORS. Dunlap. "West. Elec.," July 30.—A short article on the conductors used in one of the plants at Niagara Falls, which has just been finished, connecting the dynamos at the bottom of the shaft with the plant at the top of the cliff. The bars used are 25 feet in length, 6 inches wide and half an inch thick, four being used in parallel; every 25 feet they are bolted and riveted together; at the top they are connected with aluminum cables 1.25 inches in diameter and covered with rubber insulation; the ends are placed into sockets into which melted tin is poured. About 22,000 pounds are used, while the same work would require 48,000 pounds of copper; the conductivity of aluminum compared with copper of the same section is 63 to 64 per cent., and for the same weight more than double.

PHOTOMETRIC STANDARDS.—"Prog. Age," August 1.—A brief editorial discussion of the discrepancies between the various standards, with special reference to the recent determinations of Laporte (see "Digest," June 4 and August 6) and a similar table prepared some time ago by Violle.

ALTERNATING CURRENT METER.—"Elec. Rev.," August 3.—A reprint of the article noticed in the "Digest" July 23; also noticed in The Electrical World, last week.

Telegraphy, Telephony and Signals.

TELEGRAPHY BY MEANS OF ULTRA-VIOLET LIGHT. Zickler. "Elek. Zeit.," July 14 and 21.—A long article in which he proposes a new system of wireless telegraphy, the chief object of which is to overcome the objection to the electromagnetic wave system which lies in the fact that these waves are distributed in all directions, and cannot be concentrated in one direction, all methods for doing this having apparently failed. The principle of his method, which it seems he has tried with success, is based on an observation first made by Hertz—namely, that light rays of short-wave length, especially the ultra violet rays, have the property of promoting electric discharges—and his receiver is based on this fact. The transmitter consists of an arc light, the rays of which are condensed with lenses or reflectors into the direction in which they are to be sent, and at the receiving end the ultra-violet rays promote the discharge in a spark gap, which discharge will give rise to electric waves, which operate a coherer and through this a bell, a telephone or an ink writer; the apparatus is shown by means of diagrams. The condensing lens on the transmitter must be made of quartz and not of glass, as the former will transmit the ultra-violet rays and the glass will not; these ultra-violet rays are shut off intermittently as desired, by means of a glass plate, which is moved rapidly in front of the camera like a shutter on an ordinary photographic camera; the ultra-violet rays will in this way be cut off, while there will be no apparent effect on the light rays, and for this reason the secrecy of the message will be preserved; the ordinary search lights could be arranged to be used for the transmitter. The receiver consists of a glass tube, one end of which is made of a plate of quartz, so as to allow the ultra-violet rays to enter; these fall on a small, slanting plate in the tube, and forming one of the electrodes of the spark gap; 10 mm from this is the other electrode, in the form of a small ball; both electrodes are mounted with platinum; the air in the tube is exhausted to a certain degree, or is filled with a rarefied gas; the electrodes are connected with the secondary of a small induction coil, the knob being the anode and the disc the cathode; the induction coil need only give a spark of 1 to 2 cm, and should be provided with an adjustable resistance for regulating the voltage, so that it will be just insufficient to produce a spark when no rays fall on the gap; whenever the rays are received a discharge will take place; a coherer in the immediate neighborhood may be used to produce a call or any other signals. If the signals are merely to be made audible a telephone in the discharge circuit is sufficient. He begins the description of the results of a very large number of experiments which he has made, mostly with crude apparatus. He found that platinum was by far the best material for the electrodes, the charge between which is to be effected by the light; the question of the best shape of the electrodes was not so easily answered, and no definite results were obtained; the air surrounding the spark gap of the receiver was exhausted to 200 mm, which gave better results; the first tests were made at very short distances, and were then increased to 50 meters, at which very satisfactory results were obtained. Some deductions are then made from this data for greater distances, and he shows how much the light must be increased with the distance; with a 25-ampere lamp provided with a suitable reflector he thinks it will be possible to telegraph in this way to a distance of a number of kilometers; experiments with greater distances are to be carried out.

A short description of this system is also given in the "Zeit. [illegible] July 17.

RELAY RESISTANCE. Hewett. "Teleg. Age," August 1.—[illegible] relay resistance and the laws governing it.

Miscellaneous.

[illegible] July 21.—A reprint of a short article stating that Loemstroem, of Helsingfors, and Bailey, of Cornell, are to begin a series of researches in Finland [illegible] of the growth of plants; they will start with the assumption that [illegible] the direction of the growth of the vegetation in the far northern [illegible] tion in the short summers of these districts was due to the elec- [illegible] investigate jointly.

[illegible] 000 amperes, and probably much higher. He believes the only other determination was the one by Kohlrausch, based on the fusion of copper wires by lightning, from which he obtained values between 52,000 and 9,200 amperes, assuming that the duration was between 0.001 and 0.03 second. "L'Eclairage Elec.," July 16, publishes a brief abstract in French.

GUTTA PERCHA. Obach. Lond. "Elec. Eng.," July 22.—The continuation of the reprint of his lectures, which have already been noticed in the "Digest;" certain tables, which are thought to be the most valuable information in the lectures, are not reproduced.

UNION OF GERMAN ELECTRICAL ENGINEERS.—Lond. "Elec. Eng.," July 22.—The continuation of the running account of the recent meeting; the present portion refers to the plant at Frankford, which was visited.

STANDARD DIAGRAMS. Jones. "West. Elec.," July 30.—A reply to the recent criticism of Jamieson (see "Digest," July 16 and 23) of the proposition made by the Chicago Electric Association. He does not agree with the criticisms regarding dynamos and motors; he does not favor a distinction between zig-zag lines and loops, and thinks the former are neater; regarding the location of the series winding he thinks the committee's diagram is preferable, as Jamieson's winding is liable to be mistaken for a rheostat; circles or heavy dots might well be added, representing the terminals of the machines; he prefers Jamieson's diagram for the motor generator, but not for the storage battery; he favors the committee's diagram for the constantly driven magneto, as Jamieson makes no distinction between a power-driven or a hand-driven one; he prefers the committee's diagrams for the various meters, as letters on the outside are liable to be confused with reference letters; he prefers the committee's diagram for the inductive resistance, and does not favor a distinction between zig-zag lines and loops; the committee's diagram of a ground is preferred; both the forms for incandescent and arc lamps are good, a slight preference being expressed for Jamieson's for arc lamps and the committee's for incandescent lamps; the solid line for the fuse is preferred, as dotted lines are objectionable; the committee's diagram for a telegraph key is more complete, but there is not much choice between the two nor between those for the transformer.

AURORA. Felch. "Pop. Sc. Mo.," August.—An illustrated article of a general character, and describing its properties and giving the different theories to account for it, including historical references. Auroras seem to depend in form and position on the distribution of magnetism; their appearance generally coincides with magnetic disturbance on the earth's surface; the summits are generally near the magnetic meridian; it is concluded that the earth's magnetic forces play the most important part; the bands are nearly perpendicular to the magnetic meridian, and the direction of the rays parallel to it; the auroras consist of electric discharges; the magnetic needle sometimes begins to agitate an hour before the appearance of the aurora, and sometimes lasts as long as twenty-four hours afterward; earth currents and those in grounded wires are often violently affected, occasionally preventing the transmission of messages and sometimes proving a source of danger; it is a purely terrestrial phenomenon without regard to outside influences. The magnetic theory must now yield to the electric theory of its cause; after mentioning briefly the theories which have been advanced, he thinks the one of Edlund is nearer the truth than any of the others; this is based on unipolar induction; the earth in rotating, induces electrification of the atmosphere, the discharges of this electrification producing the aurora; he thinks this theory the most tenable and credible of all of those advanced.

SUBMARINE MINES.—"West. Elec.," July 30.—A brief, illustrated description of the Government exhibits of such mines at the Omaha exhibition.

BIOGRAPHICAL.—"Cassier's Mag.," August.—A full-page portrait of William Henry Preece, of London, accompanied by a brief biographical sketch by Curra.

Book Review.

ATLANTIC CABLE DIRECTORY OF REGISTERED ADDRESSES, AND CODE BOOK. Published by the Atlantic Cable Directory and Code Company, New York and London. [illegible] pages. Subscription price [illegible]

[illegible] all houses having foreign [illegible] names arranged by [illegible] directory, telegraph and [illegible] assistant secretary of the Postal-Telegraph Company. The telegraph and cable code contains about 115,- [illegible] in shape [illegible] to those who may [illegible] correspond- [illegible] and the addition of a code within the same cover affords a convenient means for condensing cable cor- [illegible] The code words have been carefully selected by expert telegraphers with a view to eliminating all words which are likely to be confused with each other in transmission under any telegraph system whatever. These words will be accepted as code words by all telegraph administrations. Thousands of code words [illegible] the book, so that the code is especially adapted as a foundation for the preparation of special codes between [illegible]

Direct Dynamos—I.*

Until man finds how to obtain electricity directly from coal, by combustion. without the agency of machinery, or by "direct conversion," as it is called, dynamos directly connected to prime movers will remain the ultimate and best means for obtaining current.

Such combinations are the most compact, safest, easiest cared for, and simplest of all arrangements of generators, and have therefore merited the most thoughtful attention, with a view to bringing the types adopted up to the highest state of perfection.

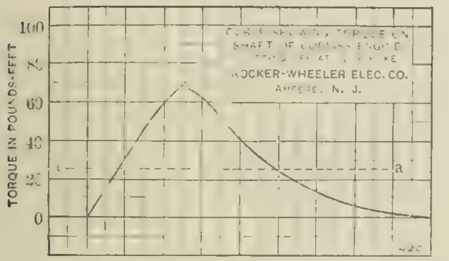

Fig. 1.

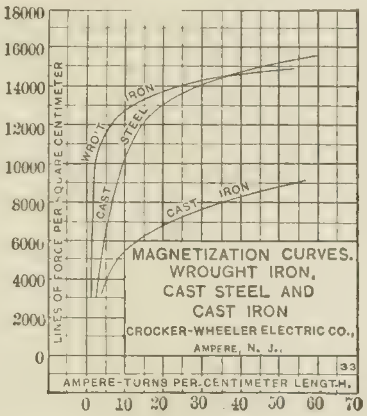

Fig. 2.

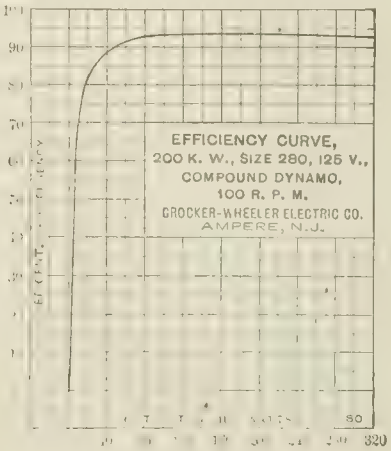

Fig. 7.

At first the direct arrangement was not looked upon generally with favor, and the pioneers in this style of construction had much to contend with in its introduction. The designs made about fifteen years ago by the Bradley Electric Power Company, since absorbed by the Crocker-Wheeler Electric Company, were far, perhaps, the earliest machines of this type brought out. The importance of direct dynamos was thus early recognized, and the type has since been under constant development by the Crocker-Wheeler Company, which, believing that only the best would survive, has made, after considerable remodeling based upon experience, a line of direct machines of the most careful design.

The advantage of direct dynamos and motors lies not in greater efficiency, but in simplicity, economy of floor space, ease of management, quiet running and avoidance of belting, although by improvements since the early machines their efficiency has been increased until it is now practically equal to that of belted machines. The chief factor in obtaining high efficiency in a direct dynamo is the employment of a large diameter of armature, so that its peripheral speed remains high in spite of the low angular velocity of the engine shaft. The greater the diameter of an armature the less must be its length, for a given output, and the greater the number of poles in its field.

In general it may be said that in a proper design the tendency to a "pancake" shape or comparatively large diameter and short length increases as the proposed speed diminishes. Relatively, direct machines are more efficient at full load, and less efficient at light load than those driven by belt.

The characteristics of dynamos are quite different from those of steam engines, and some peculiarities, in respect to their performance when united, are of interest. Engines will slow down and stop when overloaded without injury, and they are therefore not arranged with special extra capacity beyond the regular duty. A dynamo driven by an engine will submit to overload, and suffer injury, if long continued, unless the overload for the dynamo is also such a load for the engine that the latter slows down or is stalled. Dynamos will run through overloads of several hundred per cent. for a limited time with no other effect than excessive heating of their parts and sparking at the brushes.

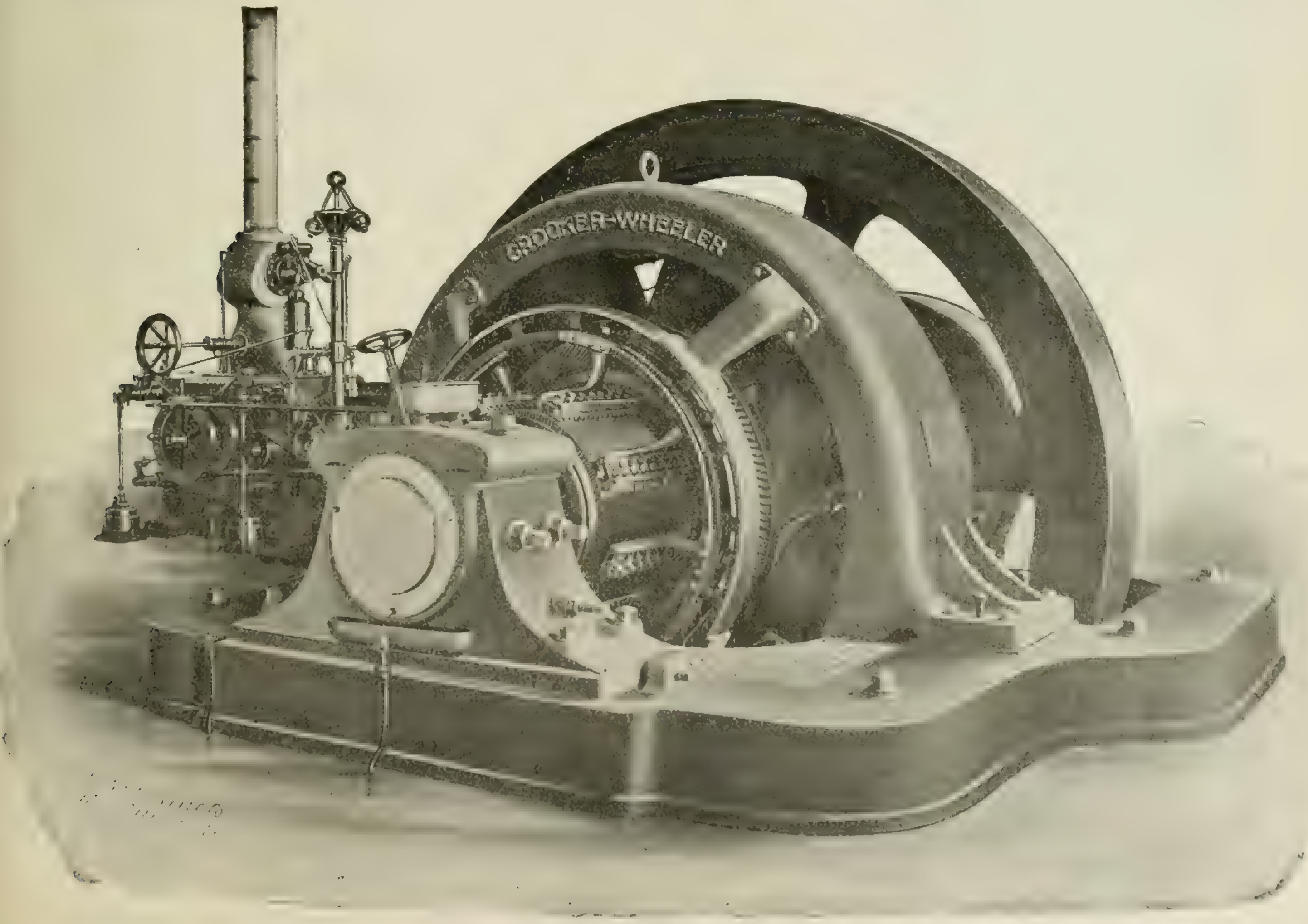

Fig. 6.

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*From advance sheets of bulletin published by the Crocker-Wheeler Electric Company, New York.

A result of this capacity for temporary excessive overloads is that a dynamo is always able, when short-circuited, to stall its engine, no matter how heavy the fly wheel.

As a dynamo absorbs power evenly at all points in its revolution, while the driving effort from any engine is pulsatory, a slight flicker is caused in the current generated, which will be noticeable unless means are provided for keeping it sufficiently small. Take as a simple case a single-cylinder, double-acting engine. As the power is delivered by the engine twice in a revolution, while it is absorbed at a uniform rate at all times, the dynamo slows down to some degree between engine strokes, causing a corresponding fluctuation in the current generated. A variation of more than one-half of 1 per cent. or one-half a volt in an incandescent lamp, being visible, a fly wheel must be used of sufficient weight to prevent the dynamo slowing down more than one-half of 1 per cent. between the strokes of the engine, when lamps are to be supplied from a single dynamo without other dynamos to keep the pressure even. This weight must be determined as follows:

The turning power imparted by the engine varies first with the varying leverage value of its crank, which gives no power when the engine is on its "centres," and gives full power at a point near the half stroke. It varies again in consequence of the changing steam pressure resulting from the expansion behind the piston.

Combining these, we have the actual power supplied by the engine, varying as shown by the curve in Fig. 1, an examination of which shows that the fluctuation of energy in every stroke—namely, that which the fly wheel has to absorb and give out twice in each revolution—is 38 per cent. of the total power of the engine.

Assuming a 200-kw dynamo and an efficiency of 94 per cent., the engine will be required to deliver 285 horse-power or 157,000 foot pounds per second. The speed being 100 revolutions per minute, or 1.67 revolutions per second, there are 3.33 strokes per second. Dividing 157,000 by 3.33, we obtain 48,000 foot pounds delivered per stroke. From the curve we learn that the fluctuation of energy is 38 per cent. per stroke. Thirty-eight per cent. of 48,000 is 17,900 foot pounds, which is the energy stored in the wheel per stroke. We must find the fly wheel which will absorb or deliver this energy without changing speed more than .4 of 1 per cent. The energy stored in a revolving body being equal to one-half its mass multiplied by the square of its angular velocity times the square of its radius of gyration, we readily find that the above condition is fulfilled by a wheel 16 feet in diameter and weighing 22,800 pounds.

All sizes of the Crocker-Wheeler direct dynamos are of the multipolar type. The determination of the best number of poles to use for obtaining maximum efficiency at the minimum complication and cost has been made with great care. It is well known that the fewer the number of poles and field coils the greater is the economy of copper for a given excitation. But in order to run sparklessly, and to give a machine an unchanging neutral space for commutation, it is necesary that the length of the air gap bear a certain ratio to the reactive power of the armature conductors under the pole. The larger the machine the greater this length, until a point is reached where it is more economical to reduce the reaction per pole by an increase in the number of poles, and thereby permit more efficient excitation across shorter air gaps.

The standard windings of all sizes are for 125, 250, and 550 volts maximum. These are the voltages at which the machines are rated; in other words, the full load current is obtained by dividing the kilowatt output by these voltages. The standard working or free voltages are 115, 230, and 500 volts. The machines are designed to give these voltages with the shunt field alone, and with considerable reserve in the field regulator. The standard series field is arranged to overcompound at full load 3 per cent. above the free voltage, though it is possible to overcompound 10 per cent. with special windings.

Compounding curves are never straight, because of the approach of magnetic saturation in the field magnets, which is shown in the curves, Fig. 2. The iron is worked at a point just about the bend of the saturation curve, and it will be seen that the lines of force, hence the voltage, do not increase directly in proportion to the magnetizing force. This means that the voltage will not rise uniformly with increase of load, but will rise more slowly toward full load than at light load. In other words, the compounding curve sags as full load is approached.

This is partially corrected by using a peculiar shunt, which is called a compounding rectifier, in multiple with the series coil of the field. The current of the dynamo divides between this rectifier and the series coil. As the load increases, the currents passing through both the rectifier and the series coil increase. The increased current in the rectifier raises its temperature, which [illegible] resistance. The resistance of the series coil is hardly changed by the increased current because the temperature rise is low. The [illegible] of the rectifier and the series coil are therefore altered as the load comes on and a larger proportion of the total current is compelled to pass through the series field coils. This compensates the tendency to a [illegible] As the standard dynamos are wound [illegible] compounding when [illegible] greater than [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

Section of Armature Core 94.1 Sq. In. Of Pole 175 Sq. In.
Density in Pole 14,000 Gausses. In Yoke 6000 Gausses. Leakage Ratio 1.1.
Flux 14.6 Megawebers per Circuit. M. M. F. at Full Load 30,000 Gilberts.
Inductors on Armature 528.
Total Area of Inductors 1 Sq. In. Resistance .002 ohm.

A Visit to the Westinghouse Works.

On the afternoon of July 30 a large number of prominent engineers, on invitation, visited the works of the Westinghouse Electric & Manufacturing Company and of the Westinghouse Machine Company at East Pittsburg, Pa., to inspect some new engines and electrical apparatus which are about to be shipped to England. Among the principal objects seen were three 2500-hp generators direct-connected to three 2500-hp engines. This equipment was constructed for the Metropolitan Electric Supply Company, London, England.

The engines and generators are so designed that the full output can be obtained at any speed from 116 to 145 r. p. m., this range of speed being necessary in order to provide a variation in the frequency of the alternations, and thus enabling a supply to be given to existing transformers in London.

The engines are of the inclosed vertical compound marine type, and are the most powerful engines yet made at East Pittsburg.

The electrical apparatus built by the Westinghouse Electric & Manufacturing Company, accompanying these engines, consists of three direct-connected alternating-current generators, each having a nominal output of 2000 horse-power and delivering two-phase currents at a pressure of 500 volts. There is one direct-current multipolar exciter to each generator, which is arranged for direct-connection to the engine shaft.

This plant is to supply primarily arc and incandescent lighting to London, but a portion of the power is to be used for operating rotary transformers, which in turn supply current to direct-current motors, and for charging storage batteries by the three-wire direct-current system.

The present contract which the London company has with the Westinghouse people has a further significance for American industry. The Metropolitan Electric Supply Company, of London, is planning new central stations, and newly equipping old ones, and it is likely that the Westinghouse Companies will be called upon to supply many additional engines and generators, of thousands of horse-power capacity, before the work now begun is completed.

Apart from the machines contracted for by the Metropolitan Electric Supply Company, the gas engines and the steam turbines at the Westinghouse Machine Company's works are particularly noteworthy.

A Parsons steam turbine driving a 200-hp alternating-current generator was particularly interesting to the visitors. It runs at 4700 r. p. m. without any perceptible vibration. This speed, however, is not limited in any way. It may be either higher or lower. The bearings, which are a special feature, admit of any rotative speed that might be desired.

The turbine was driving a high-tension generator placed on the main turbine shaft, giving a voltage of 900 and an amperage of 75. This voltage was reduced to 90 for use in driving machinery and lighting electric lamps. The engine consists essentially of (1) a barrel, in the internal bore of which are fitted numerous rows of steel blades; (2) a shaft, which revolves within this barrel, having complementary blades fitted to the periphery.

By far the most interesting machinery to many was the gas engines, some of which were shown in parts, while others were direct connected to the dynamos, the power being used for electric lighting. In the engine room a 250-hp gas engine, which has been completed for some time, was seen, but was not running. The smaller engines, those from 50 to 60 horse-power, which are worked on exactly the same principle and similarly designed throughout as the larger ones, afforded an opportunity of observing the perfect regulation of these engines. The 200 electric lights, power for which was obtained from a generator direct connected to a 65-hp engine, showed absolutely no variation in intensity, thus indicating that the engine was perfectly governed. With each of the gas engines is sent a small compressor, which is belted to the main fly wheel of the engine, and used to store tanks of air for the purpose of starting the engine. For large sizes the tanks are sent to the user stored with sufficient pressure, so that the engine can be started easily and effectually.

The gas engine department is doing a large business turning out engines from 10 to 200-brake horse-power and shipping them all over the country. These engines differ from the ordinary "hit and miss" type in that the governor acts by controlling the quantity of explosive mixture which is taken into the cylinder. This results in an adjustment of the power of each explosion to the amount of work being done; hence the engine runs with the steadiness and regularity of a first-class steam engine. The regulation is so perfect that the company has built many direct-connected machines where the dynamo is mounted rigidly on the end of the engine shaft. Even under this most severe test the lights are said to be perfectly steady.

The Westinghouse Machine Company has successfully built a 650-brake horse-power gas engine. This engine has three cylinders, each 25 inches in diameter, and a 30-inch stroke, and runs at 145 r. p. m. Its economy is very marked, resulting in the production of a brake horse-power for 11 cubic feet of natural gas. It is said to be the largest gas engine in the world, and it operates with complete success.

The 60-hp engine (commonly known as the gas horse) was running at the time, a prony brake being used to absorb the power. This engine was also designed to be direct connected with a generator of equal capacity, and the results of tests made upon the machine show that a perfect regulation can be effected in the even smaller sizes. The gas, which forms about one-twelfth of the explosive mixture, is drawn into the cylinder with the air and exploded by means of an electric spark, the contact being broken at the instant of the explosion. In all the engines of the Westinghouse type an explosive mixture is admitted each revolution. The governor controls the amount of explosive mixture admitted. This departure from the more common "hit and miss" method is believed by some who have been influential in the design of this and other engines to make it possible to regulate them better. The principal ingredient of the natural gas which is used at Pittsburg is marsh gas (CH_4). With this gas about a thousand B. t. u.s per pound can be realized, and in using it one part of the gas is mixed with about 12 parts of air. A simple arrangement by which the proportion of gas and air can be changed as desired is placed near the gas inlet of the engine. By means of this simple device the engineer running the engine can easily determine the best proportion of mixture to be used.

There are no oil cups to lubricate the cylinders. The crank dashes the oil from a dash pot, lubricating the principal moving parts. From results of tests it is found that about 13 pounds of water are required per horse-power per hour to cool the cylinders.

The afternoon at the Westinghouse works was one of uninterrupted pleasure and instruction.

Electric Welding of Street Railway Rails.*

In June, 1893, the Johnson Company, of Johnstown, Pa., which had been for nearly a year previously experimenting with the electric welding of rails, began welding the rails of the West End Street Railway, of Boston, Mass. The apparent success then attained encouraged other roads to try the new method, and in a short time about 50 miles of track had been welded by this method in Boston, Cleveland, Johnstown, Brooklyn, St. Louis, and Detroit.

The approach of winter and with it cold weather caused the rail to contract and resulted in the breaking of many of the joints, usually just to one side of the weld, showing that the breaks were the result of a weakening of the steel consequent upon the intense heat produced by the electric current. The experiments conducted at that time determined quite conclusively that a strength of 100,000 pounds for a 6-inch rail, or thereabouts, was ample to resist the tension resulting from the annual change of temperature; 200,000 pounds was therefore assumed as a necessary joint strength. A series of tests made on short sections demonstrated that welded joints could be made capable of standing considerably more than this figure. As a result of the failure of electric welding in Boston and elsewhere, the Johnson Company refrained from a general introduction of its system and began a series of careful experiments to see if it were possible to produce the weld with its desirable features and still not destroy the structure of the adjacent steel. The solution was found to be very simple, and consists in putting the material at the weld under great pressure just after the weld is made and the current cut off and holding this pressure while the steel cools. In this way, the steel is prevented from crystallizing and losing its elasticity at the point next to the weld. The company, after further experiments to thoroughly test this discovery, is again in the market.

At present one of its equipments is in Brooklyn, engaged in welding about 45,000 feet of double track on the Nassau Electric Railroad. The welding equipment is composed of four cars, as shown in Fig. 1, containing the various electrical machinery instruments, sand blast, water tanks, regulators, etc. This train is transported about the country on flat cars, which land it as near the point where work is to be done as possible. The cars are then run onto the street railway lines, and as each car is equipped with its own trolley and motors they are propelled by their own power to the desired position.

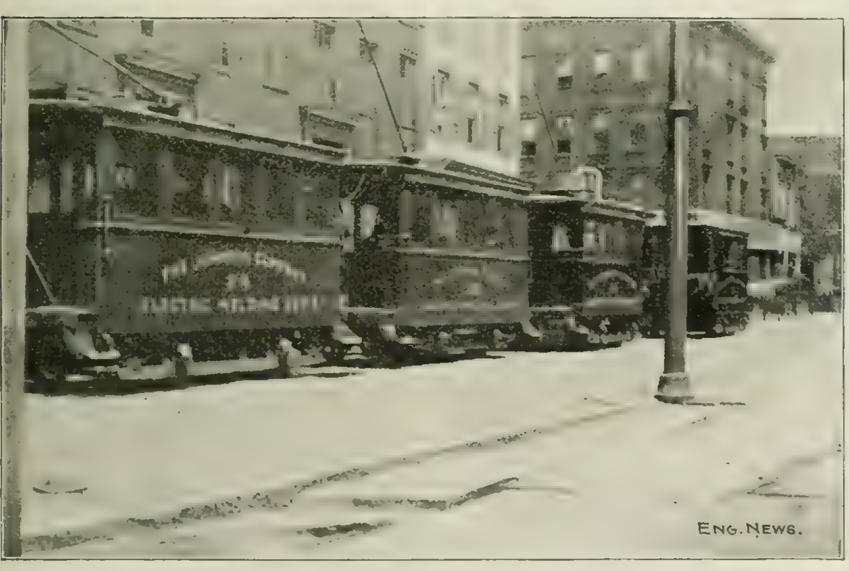

Fig. 1.—Welding Equipment.

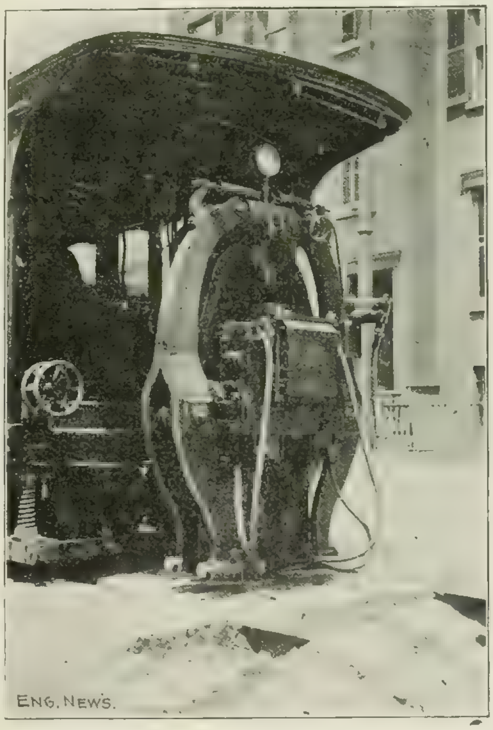

Fig. 2.—Applying Clamping to the Rails.

The car to the left in Fig. 1 contains a booster built by the Crocker-Wheeler Electric Company, of Ampere, N. J. This car complete weighs 28,000 pounds. The booster is a 125-hp, 500-volt, 200-ampere, direct-current electric motor directly connected to a 70-kw dynamo wound for 420 amperes at 175 volts at a speed of 750 r. p. m. Current for operating the booster motor is taken from the trolley wire by an ordinary trolley pole on top of the car and the altered current is carried through flexible cables to the next car where the rotary converter is placed.

In the converter car are the instruments for indicating line and booster voltage and currents in the various circuits as well as resistances for regulating the output. The rotary converter is a four-pole machine, built by the Thomson Electrical Welding Company, of Lynn, Mass. This machine has one armature provided with a commutator on one end and collector rings at the other. It runs 500 r. p. m., taking current on the direct-current side from the booster circuit and converting it into alternating current at 300 volts. The alternating current is taken from two collector rings and passes by flexible cables to the next car, in which is found the main switch, the reactive coil for current regulation, the massive welding transformer and clamp and the mechanism for moving this. Here also are the pumps, tanks, etc., necessary for cooling the jaws of the clamp.

The welder is nothing more nor less than a large transformer, mounted upon a bail, which swings from a heavy arm or crane arranged to be raised or lowered or swung from side to side by means of screws driven by a small electric motor taking current from the trolley. The transformer core is laminated soft iron wound with two primary coils for 300 volts alternating current and about 260 amperes, and insulated with oil. The secondary consists of one turn, which is only completed when welding, furnishes from 30,000 to 50,000 amperes at from 2 to 4 volts. This secondary is made up of the two casings or cast metal jackets, which surround the primary coils. The contact blocks forming the jaws of the welder are hollow and are connected with a small pump which keeps water circulating through the blocks close to the weld and thus prevents their overheating. To obviate carrying a large quantity of water it is cooled by a form of air cooler placed on top of the car, seen in Fig. 1. This is a shallow round galvanized iron tank provided with two bottoms, between which is arranged a spiral strip forming a winding passage at the centre of which air is admitted from a small rotary blower. The upper bottom is full of fine holes, and the water above this is prevented from leaking through by the air which forces its way up through the holes, producing a cooling of about 10 or 20 degrees F., as it passes out through the water.

The amount of current applied at the weld is regulated in two ways; directly, by adjusting the pressure of the jaws; indirectly, by varying the field resistance of the booster. A reactive coil is also placed in series with the primary of the welding transformer. This, however, is only used to prevent excessive sparking at the switch terminals when the circuit is broken. It consists of a simple solenoid in which is suspended a core composed of a bundle of soft iron wire.

The manner of applying the clamping to the rails is quite clearly shown in Fig. 2, in which it will be noticed that two heavy steel levers are pivoted beyond their centres and are connected at their upper ends by a double-acting hydraulic jack. A small hand pump, mounted upon one of the levers, suffices to produce any desired pressure in the jack, which is transferred through the levers to the joint.

Further forward, in Fig. 1, and always in advance of the welding train just described, is the sand blast car, containing a sand blast outfit, made by B. C. and R. A. Tilghmann, 126 South Eleventh Street, Philadelphia, Pa., an emery wheel, electric heaters to dry the sand, an electric motor and a belted air compressor. This car is cut away at the rear and is provided with canvas curtains which permit the joints to be cleaned previous to welding without scattering the sand and annoying passers by. The operator wears a helmet and cape, covering his head and shoulders.

In operation, the cars are run out at night, so as to interfere as little as possible with the schedule, and the sand blast is put to work clearing the rail joints already exposed by removing the paving for a space of about 2 x 2 feet. Shims of sawed rail sections are next wedged into place between the ends of the rails. The welding train is then moved forward until the welder hangs over the centre of the joint. Two steel splice bars, 1 x 3 inches by about 19 inches (Fig. 4), are next clamped into place, so that the central strip (a) of each bar covers the junction of the rails. The pressure on the jaws is run up to 7 10 ton, or about 1400 pounds, by the hand pump, current is turned on and the metal is watched until it welds. The current is broken and the pressure is increased to about 35 tons, under which the joint is kept until it is cooled. The jaws are then loosened and the car moved back just enough to put the jaws over the portion (b) at one end. This kite-shaped raised portion is produced by stamping the bars at the factory, so that a depression is formed on one side and the projection on the other. Into the depression on the back is fitted a flat steel stamping. Its purpose is to insure an even bearing of the clamp blocks. The second welding is next made and cooled under pressure as before, and then the weld on the opposite end of the splice bar. At the end of about fifteen minutes (during which current was on for about six minutes) the rail joint is complete and ready for use.

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*Reprinted from "Engineering News."

The amount of excavation required at the joint is small, considerably less than with the various forms of so-called cast welds. It is claimed that joints made by the welding process meet all the requirements of strength, give a certain amount of flexibility, an amount about equal to that of the rail itself, and afford an electrical bond far superior to any other form of joint.

Regarding the cost, an approximate idea can be obtained by figuring backward. There are three welds, per joint, current being on about two minutes per weld, a total of six minutes, during which close to 100 kilowatts will be necessary to operate the welder and various auxiliary apparatus. This is 1-10 of 100-kw hours, or 10-kw hours per joint. The dollars and cents of this will depend upon the particular road where the welding is in progress, being more or less according to local circumstances and the efficiency of the plant. In any case, five or six men are necessary to operate the train as described and this force will average about eighteen or twenty joints in seven hours, or between two and a half and three joints per working hour. With 30-foot rails double track there would be about 700 joints per mile, which would mean 233 hours or about twenty-four days of ten hours each per mile. To this must be added about 30 cents per joint for cost of splice bars and other pieces used. Such a joint made in the usual way with fish plates and bolts would cost about $1.80 for material, exclusive of copper bonds and all labor. Cast joints—that is, those in which from 50 to 120 pounds of cast iron is poured about the rail ends—vary in cost from $2 to $3 per joint. We are indebted to "Engineering News" for the illustrations which accompany this article.

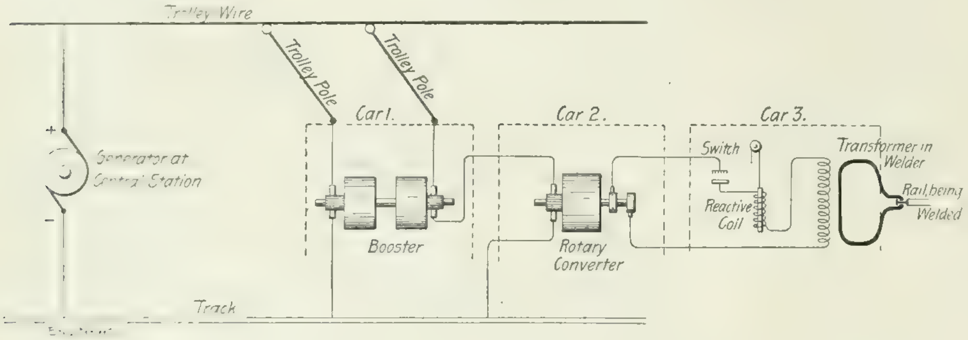


Fig. 3.—Diagram of Connections.

An Electric Bicycle Lamp.

There is an evident demand for a reliable electric lamp outfit for bicycles. The Farnham Electric Company, 616 Ashland Block, Chicago, Ill., recognizing this demand, has brought out a bicycle electric lamp outfit which is offered to bicyclists for their favorable consideration.

The outfit complete includes a small dynamo incased in a nickel-plated cylinder 3½ inches in diameter, with clamps to attach it to either the rear or front fork of the wheel. Insulated wires lead the current to a small incandescent lamp incased between a powerful reflector and lens. The cylinder con-

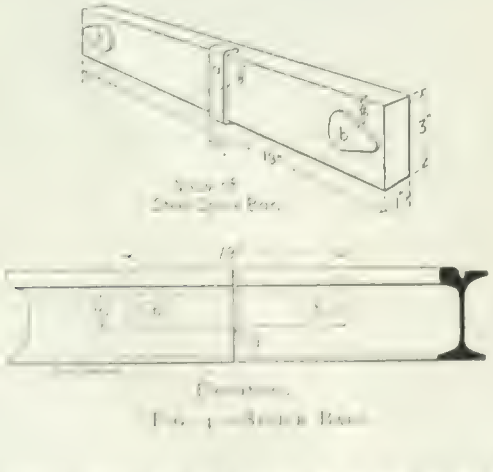


Fig. 4.—Splice Bar.

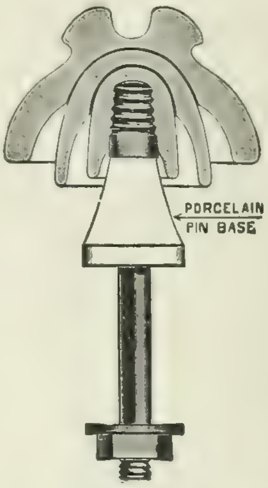
[illegible] The lamp can be [illegible]

[illegible] bright and [illegible]

[illegible] pictures, etc.

Triple Petticoat Porcelain Insulator.

The insulator of which the accompanying illustration is a sectional view is built up from three shells of vitrified china fused together with glaze. The pin has a porcelain base, which enormously increases the resistance between the cross-arm and insulator. It would be manifestly inconsistent to increase the insulating qualities of the insulator itself and not make a corresponding improvement in the insulation between the insulator and the supporting cross-arm. This, however, is completely provided for in this insulator by making the pin base of porcelain.

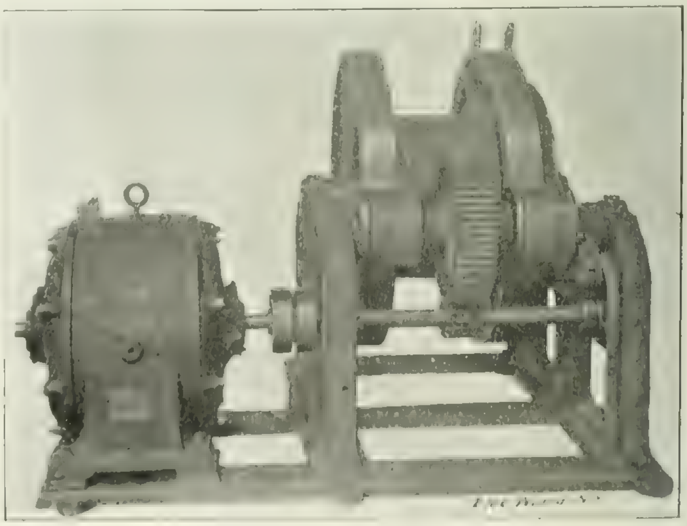


Triple Petticoat Insulator.

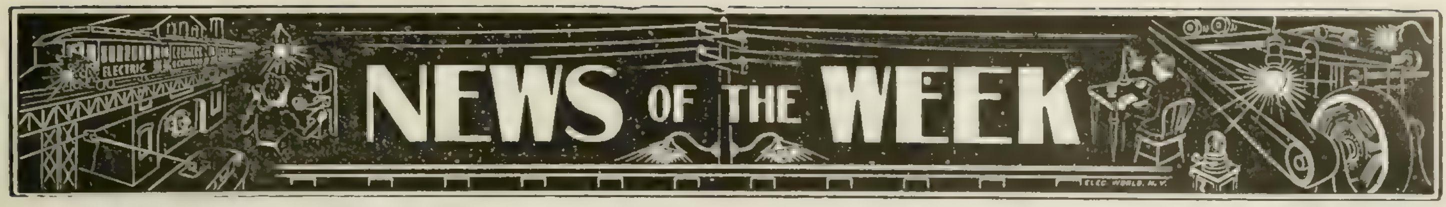
Mr. Fred. M. Locke, Victor, N. Y., manufactures these triple-petticoat insulators in various sizes for potentials, varying from 5000 to 50,000 volts.

Electric Mine Hoist.

The advantages attending the use of electrical machinery in mining work are now generally recognized by mine operators. Especially are the merits of such apparatus appreciated in districts where coal is hard to obtain and is consequently high in price. In many of the mining camps of Colorado plans for power transmission are under consideration, and in some cases plants are being installed. In the famous Cripple Creek district the mines will soon be able to substitute electric power for steam, and it is predicted that after another year few mines in the camp will derive their power from a steam plant. Two large transmission plants are now being installed, one at Goldfield, in the mining district, and the other at Canon City, thirty odd miles distant. Within the next year it is thought a large demand for electrical apparatus will come from the mining camp. The first requisite will be a hoist. In the accompanying illustration is shown a new type of electric hoist, to be installed in the Cripple Creek district, recently constructed by the Hendrie & Bolthoff Manufacturing & Supply Company, Denver, Col. The motor, which rests on the same base as the hoist, is placed on the driving shaft and applies its power by means of a rawhide pinion to a cut gear. On the gear shaft are two paper frictions, which bear against the friction wheels of the hoist. The motor, which is of the two phase type, is of 15 horse power, and was supplied by the Westinghouse Electric & Manufacturing Company. The hoist was built for the Colorado Electric Power Company, of Canon City, and, as already stated, will be installed in the Cripple Creek district.



Electric Mine Hoist.



Financial Intelligence.

THE NORTH SHORE TRACTION COMPANY reports gross earnings for June of $137,101, an increase of $6033, as compared with the same month of last year, and net $60,036, an increase of $6449. For the nine months ending June 30 the gross earnings were $986,791, an increase of $35,289, as compared with the corresponding period of last year, and net $363,985, an increase of $12,009.

THE COLUMBUS STREET RAILROAD COMPANY reports gross earnings for June of $56,502, an increase of $5284, as compared with the same month of last year, and net $28,939, an increase of $1541. For the six months ending June 30 the gross earnings were $324,389, an increase of $41,489, as compared with the corresponding period of last year, and net $167,440, an increase of $20,035.

Special Correspondence.

New York Notes.

Office of THE ELECTRICAL WORLD,
9 Murray St., NEW YORK, August 8, 1898.

CHANNEL ELECTRIC LIGHTS RELIGHTED.—The lights in harbor channels in the lower bay were discontinued soon after the declaration of war with Spain. Since Spain's naval fleet has been destroyed, and there is no longer any danger of attack upon the city by Spanish war ships, the electric lights in Gedney Channel have been relighted, and night navigation is permissible.

ELEVATED TRAINS from the Lexington Avenue line (Brooklyn) are now running regularly across the Brooklyn Bridge to Manhattan. They are drawn from the elevated road through the bridge yards to the bridge railway by electric motor cars. In crossing the bridge a trailer on each train picks up the cable. During the middle of the day the cable is stopped and trains are propelled by electric power. Power is utilized only in ascending the grades, being shut off in descending, the trains then "drifting." The Brooklyn Elevated Railroad Company expects to run its Fifth Avenue line trains over the bridge as soon as the rest of the motor cars have been received and prepared for service.

WORK ON THE NEW UNDERGROUND CONDUIT LINES.—President Vreeland, of the Metropolitan Street Railway Company, has notified the storekeepers in Sixth Avenue that as soon as the new tracks are laid in the shopping districts the company will begin to operate horse cars on the line for the convenience of their customers, until the electric cars are put into operation. The construction work has gone on with exceptional rapidity, and two blocks of the Sixth Avenue line, north of Fourteenth Street, have been entirely completed. A section of the work in Eighth Avenue, from Fifty-eighth Street, south, to Fifty-fourth Street, is also finished. The crossing at Sixth Avenue, Broadway and Thirty-fourth Street, has also been finished, considerable of the work at this point having been carried on at night so as to avoid interruption of traffic at this point.

THE FIRST VOLUNTEER REGIMENT OF ENGINEERS, Colonel Eugene Griffin, has embarked on the United States transport "Chester" for Porto Rico, and may sail at any moment for the front. The regiment went aboard of the ship several days ago expecting to sail at once, but one thing and another has prevented the departure of the ship, which at this writing is lying in the bay about a mile off Liberty Island, and the same distance from Governor's Island. The regiment includes several electrical engineers, who were selected by Colonel Griffin. The experience of the regiment since it embarked on the troopship has not been a very pleasant one, however. The weather has been exceedingly hot, and a crowded ship in hot weather is not the most agreeable place on earth. Colonel Griffin, mindful of the comfort of his men, chartered a couple of excursion barges and moored them alongside the "Chester" in order to afford the men an opportunity to "stretch their legs a bit" and get some more air. Idleness on board a stuffy ship at anchor in a placid bay in torrid heat is not a happy state of existence, and the engineers will be glad to get away.

ECONOMY OF THE UNDERGROUND CONDUIT SYSTEM.—The "New York Commercial America," in a recent issue, gives some interesting facts concerning the economy of operation of the underground conduit system. It says that the saving to the Metropolitan Street Railway on its Broadway line by the replacement of its cable system with electricity will reach 1 cent per car mile in the opinion of an authority in the cost of street railway operation. This will be made up in the increased speed possible by the use of electricity over cable power. The two items of importance to be considered, in estimating the cost of operation per car mile on street railways, are speed and weight. In this case there is little, if any, change in weight, but an additional speed of about 25 per cent. should be shown. The Broadway cable line is operated at a speed of only 6 miles per hour. This is less, of course, than on any other line in the country, because of the congestion of traffic. The present cost of the operation of the Broadway cable is 12 cents per car mile. Of this 7 cents is for labor and the balance for power, maintenance, general expenses, etc. The cost will be about the same by the adoption of electricity as a motive power. The advantage, however, arises from the fact that it will be possible for a car to travel 8 miles per hour operated by electricity, while only 6 miles is now made by cable with the same cost for labor. The Metropolitan Company does not publish its figures showing the number of car miles run during any given time, so it is impossible to give the actual saving, but it is evident that it will be an important item.

Buffalo and Niagara Falls Notes.

BUFFALO, N. Y., August 6, 1898

BUFFALO is preparing to extend the new system of electric lighting two more blocks up Main Street. This denotes a radical chainge of ideas on the part of the authorities, for the principal street of the city, from being the worst lighted of its class anywhere, is now about the best, there being a pair of lights at the curb every 100 feet.

THE CONDUIT COMPANY is enlarging the transformer station at the car barns on Niagara Street, in order to make room for special transformers to modify the current to be taken by the Curtis Malting establishment. There will be three 50-kw transformers, of the self-cooling and oil-insulating type, built by the Westinghouse Company, and to be delivered about September 15. They will reduce the current from 2200 to 450 volts.

Chicago Notes.

Branch Office of THE ELECTRICAL WORLD,
936 Monadnock Building,
CHICAGO, Ill., August 5, 1898.

MR. MARTIN J. INSULL has withdrawn from the firm of Sargent & Lundy, and has opened an office at 1013 Monadnock Block, as manufacturers' agent. He will continue to handle dynamos, motors, incandescent lamps and other appliances.

MR. THOS. S. GORDON has opened a business as manufacturers' agent at 124 Michigan Avenue, Chicago. He will deal in bare and insulated copper wire for all purposes, copper rail bonds, galvanized telegraph and telephone wire and special wire of all kinds, besides goods in other lines of trade. Mr. Gordon is very popular here, and will no doubt do a large business.

MR. I. J. KUSEL, formerly president of the Missouri Telephone Manufacturing Company, St. Louis, Mo., and later connected with the American Electric Telephone Company, has severed his connection with the American Company, and has cast his lot with the new Victor Telephone Manufacturing Company, Chicago. Mr. Kusel has a host of friends who will wish him success in his new field. It might not be out of place here to state that Mr. Kusel started in the telephone business in its early days with one man in his employ, and in a very short space of time had developed the business to large proportions. He is the patentee of the Kusel microphone. The Victor Company will surely meet with success with live, up-to-date, hustling telephone men in its employ, and it will be the company's constant endeavor to place upon the market only the very finest apparatus, The company's factory is equipped with the very latest and improved machinery, and its facilities are second to none. The new Victor express switchboard, with its removable drops and jacks, is destined to take a place in the front ranks, and the company is doing a good business in the same. In telephones it builds a complete line of both series and bridging telephones; also, cross-connecting boards, lightning arresters, double-pole receivers, magnetos, and a complete line of exchange apparatus.

St. Louis Notes.

ST. LOUIS, MO., August 5, 1898.

THE BOARD OF TRUSTEES of Winstanley Park have passed an ordinance granting the St. Louis, Belleville & Suburban Electric Street Railway Company a right of way through their city.

TELEPHONE TO KANSAS CITY.—Manager Burt, of the Missouri & Kansas Telephone Company announces that the line between St. Louis and Kansas City will be completed in from thirty to sixty days.

A PETITION has been filed in the St. Louis County Court by the St. Louis & Kirkwood Railroad Company in the form of a motion to amend the court's order of June 11, 1894, by which it granted a franchise to that company to construct and operate a line between the city limits and Meramec Highlands. That order embraced a franchise which they want changed somewhat as to right of way.

THE CENTRAL TRACTION COMPANY will do little in the way of constructing its roads or selling its franchise until the Supreme Court decides on the Julian law. Under the franchise granted the company by the Municipal Assembly the company is compelled to commence work on the construction of its lines before September 1. Pending the action of the Supreme Court, a little work only will be done to comply with the provisions of the ordinance. Last week the directors increased the capital stock from $100,000 to $5,000,000. Over half the stock has already been paid in, and the secretary says that a sale of bonds will follow.

STRIKE.—Between 300 and 400 linemen and outside workers of all the electric lighting and telephone companies in St. Louis went out on a strike last Monday morning. The cause of the strike was the refusal of the managers of the companies to increase their wages from $2.50 to $3 for ten hours' work. Neither side is inclined to yield, and up to the present time the situation is unchanged. Manager Wagner, of the Missouri-Edison Company, says no concessions will be made by his company. Mr. Ross, of the Laclede Gas Company, said his men had made no requests, nothing having been received but a communication from President A. P. Blackford, of Electrical Workers' Union No. 3. The companies seem inclined not to treat with that body as a whole. The strike, up to date, is a peaceful one.

PACIFIC COAST NOTES.

San Francisco, Cal., July 31, 1898.

THE TOWN of Lakeview, Ore., will have telegraphic communication with Bidwell, Cal., in a short time. A bonus of $1000 had to be raised to secure construction of the line.

MR. W. H. BURKHOLDER has returned from Skaguay, Alaska, whither he went last spring for the Westinghouse Electric & Manufacturing Company. While there he installed and set in operation the first electrically driven overhead tramway in Alaska.

ELECTRIC LIGHT AND POWER COMPANIES doing business in Sacramento and Fresno, Cal., have been seriously inconvenienced by the unusually dry season. Drouths severe enough to dry up the rivers and streams, which supply their water power, are of very rare occurrence.

THE SACRAMENTO ELECTRIC COMPANY, which generates power at Folsom, was compelled to shut down its plant about two weeks ago because of the water shortage. Throughout the State there was a light snow and rainfall, causing a drouth more severe than any in recent years.

THE BIG CREEK POWER COMPANY recently closed a contract with the California Powder Works Company, by which the powder works near Santa Cruz will be supplied with 150 horse-power, electrically transmitted. It is probable that the amount of power transmitted will be increased to 450 horse-power later on.

THE GAMEWELL FIRE ALARM TELEGRAPH COMPANY, through Mr. R. A. Rose, Pacific Coast General Agent, recently put in a bid of $38,500 for the apparatus required for the needed extensions of the San Francisco Police Telegraph system. Five central desks, 150 signal boxes, wire, etc., are included.

THE SNOQUALMIE FALLS POWER COMPANY recently decided to let the contracts for the electric machinery, which will be required at the generating station at the falls and at the distributing stations in Seattle and Tacoma, Wash. President Charles H. Baker is now in the Eastern States on business connected with the letting of the contracts, which will probably exceed $250,000. The city of Tacoma, in granting the company a franchise, purposes to stipulate that the company shall be able to supply the city with 3000 horse-power by August, 1899, the rate to be 1¼ cents per kilowatt hour.

CANADIAN NOTES.

Montreal, Que., August 5, 1898.

QUEBEC, QUE.—It has been decided not to extend the electric railway to Montmorency this year, but everything will be in readiness for the change of the system from steam to electricity early next year.

THE ASHCROFT WATER, LIGHT & POWER COMPANY, Ashcroft, B. C., will erect a power house on the Bonaparte River, about three miles from this place, and install an electric light and power plant.

A DEPUTATION of Toronto gentlemen approached the Paris, Ont., Council on the subject of the construction of an electric railroad between that town and Ayr. It is understood that a charter has been applied for.

VICTORIA, B. C.—It is understood that the Consolidated Electric Light Company is preparing to utilize the water power at Goldstream for the electric lighting and railway systems. The work will probably cost $100,000.

A COMPANY is seeking a charter under the name of the Grand River Electric Light & Power Company, to construct a stone dam across the river, with the object of supplying light and power. Mr. Fair, of Brantford, is the company's engineer.

S. C. DRUMMOND, representing the British Electric Traction Company, London, England, has applied to the City Council, [illegible], B. C., for a charter for an [illegible]. The Council [illegible] to grant application on suitable terms.

AN IMPORTANT CONTRACT has been closed between the Dominion Cotton Company and the Royal Electric Company, of Montreal, whereby the former is to install electricity in its works as motive power. The contract calls for [illegible] with the option of increasing [illegible].

Ottawa, Ont., August [illegible], 1898.

THE OTTAWA ELECTRIC [illegible]

IT IS REPORTED that the Ottawa Electric Railway Company is negotiating for the purchase of the Gatineau Valley Railway and will convert that road from steam to an electric railway. [illegible]

THE [illegible]

about $100,000 less. During the month just closed the figures are unprecedented, over $144,000 having been collected and giving an increase of about $15,000 over the corresponding month last year.

MR. NELSON MOORE, of Guelph, Ont., has completed a model of his overhead electric railway. The hardwood posts from which the cars are suspended, as well as the base and the arms, are incased in steel and strongly riveted to prevent vibration. Two iron sockets are suspended from the arms of the post, and into these steel rails are laid. The wheels of the car are built after the manner of bicycle wheels, with steel spokes and ball bearings, which give strength and lightness and ease of motion. The framework of the car will be of strong iron or steel, and the car is suspended from the wheels to a distance of 3 feet from the ground. The interior is fitted with back-to-back seats which run the entire length through the middle and are suspended from the top. The inventor claims many advantages for his overhead road. No grading or groundwork has to be done in constructing the road; no bridges are required to span streams or cross ditches and ravines—a material consideration. Then in the winter time there would be no cleaning away of snow from the track, and, for the same reason, no washouts. Mr. Moore claims that less electric power would be required to operate the cars compared with the present systems; that greater speed would be obtained, and more effective locomotion secured.

General News.

NEW INCORPORATIONS.

CLEVELAND, OHIO.—The Sandusky & Inter-Urban Electric Railway Company has been incorporated, with a capital stock of $500,000. The incorporators are: H. O. E. Everett, E. W. Moore, B. Mahler, C. H. Stewart. Besides operating street railways already existing in Sandusky, Huron, Vermillion, and Cleveland, it will construct and operate an electric line connecting these points.

CHARLESTON, W. VA.—The Rivesville & Montana Telephone Company, of Rivesville, Marion County, with an authorized capital of $50,000, has been chartered to construct and operate telephones from Fairmont to Rivesville, and to Catawba, Montana, Hault, Luther and other points in Marion County. The incorporators are: C. E. Gaskill, J. C. Gaskill, F. B. Clayton, J. S. Koogle, J. D. Arnett, F. F. Prickett, A. S. Prichard, J. S. Cox and J. G. Floyd.

THE TELEGRAPH AND TELEPHONE.

WESTFIELD, N. Y.—The Westfield Telephone Company has voted to increase its stock from $5500 to $15,000.

CHIPPEWA FALLS, WIS.—The Northwestern Telephone Company, of Shawano, is building a line to Green Bay.

NORTH EAST, PA.—The Mutual Telephone Company and the North East Telephone Company are now working together. There is a lively contest for business between the Mutual and the Bell Companies.

BRIGHTON, MICH.—The new State Telephone Company has decided to build a line from Brighton via Hartland to Fenton. This much-needed improvement will be the first public outlet Hartland has ever enjoyed.

CHESTER, PA.—The Delaware County Telephone Company has about perfected arrangements for extending the line to the Borough of Upland. The work of connecting the two places will be pushed along as rapidly as possible.

COOPER, TEX.—The Southwestern Telephone & Telegraph Company filed suit here to condemn the right of way along the Texas Midland Railroad from Commerce via Cooper to Paris, and the line is expected to be built through by August 15.

NELSONVILLE, OHIO.—The Central Union Telephone Company is making arrangements for the construction of a line which will go from this city to New Lexington. The new line will pass through Murray City, New Straitsville, Shawnee, Corning and intermediate points.

BALTIMORE, MD.—The stockholders of the Interstate Telephone & Telegraph Company elected the following directors: L. A. Carr, J. S. Carr and G. W. Watts, of Durham, N. C.; Dr. P. D. Fahrney and James E. Walter, of Frederick; Robert L. Carr and C. S. Watts, of Baltimore.

BATTLE CREEK, MICH.—The Calhoun County Telephone Company reports that it is now installing the telephones and expects to open the exchange within two weeks. It is said to be putting up a model independent exchange, building it full copper metallic construction and equipping it with the Stromberg-Carlson central energy system.

PROVIDENCE, R. I.—The Providence Telephone Company is building a trunk line from Woonsocket to Pascong. The route will be from the present Providence line in Oakland to Forestdale, over Nigger Hill to Waterford, thence down River Street, Woonsocket. The line will be metallic circuit and will probably be completed by September 1.

CARLISLE, PA.—The directors of the Cumberland Valley Telephone & Telegraph Company have organized by electing D. K. Appenzellar president, Dr. J. O. Skinner, vice-president; H. B. McNulty, secretary; Dr. David McLay, treasurer. Work will be commenced next month. The line will extend to all points in Franklin and Cumberland Counties.

CHATTANOOGA, TENN.—The East Tennessee Telephone Company has filed a mortgage of [illegible] in the register's office in favor of the Nashville Trust Company, on all of its property in Tennessee and Kentucky. The mortgage has been recorded in every county where the company does business, and it is understood that the money thus secured will be used in extending the long-distance lines and building new lines.

KANSAS CITY, MO.—By September 1 Kansas City will be able to hold conversations with St. Louis, and through that place with Chicago, New York, Boston, Philadelphia and all the large Eastern cities. By that time the Missouri & Kansas Telephone Company expects to have its through wire between

Kansas City and St. Louis in working order. A large force of men is at work on the line, which is completed nearly to Jefferson City.

ROCHELLE, ILL.—The Ogle County Telephone Company intends to extend its lines to all the principal cities and towns in the county at the earliest possible moment. It is now making arrangements to build a line from Rochelle to Davis Junction, connecting Lynnville, Mõnroe, Kings and Holcomb. As soon as this work is completed, it will continue the line from Davis Junction to Stillman Valley, Byron, Forreston, Polo and Oregon.

SCHENECTADY, N. Y.—The Hudson River Telephone Company has just completed a very important addition to its service. The new line runs from Albany to Thompson's Lake and passes through Delmar, Normansville, Clarksville and East Berne. Another and somewhat longer line is being strung from Albany to Cobleskill. It is distinct from the Thompson's Lake loop and passes through Berne and Gallupville and at Schoharie; a branch runs to Middleburg, the main line continuing through Central Bridge, Howe's Cave and Stone Quarry to Cobleskill.

BOSTON, MASS.—The American Bell Telephone Company's monthly statement of the output of instruments for the month ended July 20 is as follows:

	1898.	1897.	Changes.
Gross output	21,551	15,859	Inc.... 5,692
Returned	10,011	7,241	Inc.... 2,770
Net output	11,540	8,618	Inc.... 2,922
From December 21 to July 20:			
Gross output	187,884	127,778	Inc.... 60,106
Returned	83,306	51,847	Inc.... 31,459
Net output	104,578	75,931	Inc.... 28,647
Total outstanding July 20	1,023,699	848,558	Inc.... 175,141

GRAND RAPIDS, MICH.—The annual meeting of the members of the Independent Telephone Association of Michigan was held in Grand Rapids, when the following were elected officers: President, J. B. Ware, of Grand Rapids; vice-presidents, W. L. Holmes, of Detroit; C. K. Monroe, of South Haven; George W. Finch, of Escanaba; secretary, Alexander McLeod, of Detroit; treasurer, W. H. Fildew, of St. Johns; executive council, the president, secretary, treasurer, F. B. Johnson, of Lansing; R. F. Johnson, of Saginaw; J. Williams, of Adrian; Hugh Park, of Muskegon; W. C. Osborne, of Kalamazoo; P, H. Parker, of Detroit. The reports presented showed that on the eastern side of the State, the new State company has, during the year, completed toll lines to over 150 towns, and has some 7000 telephones in its system, the Detroit exchange having 5600 telephones in service. The Valley Telephone Company has just begun service in its Saginaw exchange, and has recently completed exchanges in Flint and Bay City, and will have over 2000 telephones in service before September. The Central Telephone Company, of Kalamazoo, has built during the past nine months over 600 miles of toll lines, principally long-distance copper, connecting Grand Rapids with all points on the G. R. & I. Railroad as far south as Sturgis, and on the Michigan Central Railroad from Eaton Rapids to Albion westward through Kalamazoo to Niles and Buchanan and intervening points. It is said the independent companies have some 16,000 telephones in operation, and the Bell Company nearly 14,000.

ELECTRIC LIGHT AND POWER.

PLEASANTON, KAN.—The question of municipal lighting is being agitated.

ALBANY, N. Y.—The passenger coaches on the limited trains on the New York Central & Hudson River Railroad are cooled by electric fans.

HAGERSTOWN, MD.—The Hagerstown Electric Railway Company has purchased a piece of property on Summit Avenue, on which it will erect an electric light plant.

BRATTLEBORO, VT.—Brattleboro people are talking of establishing an electric power plant on West River, six or eight miles from the village, and the extension of the line of the Brattleboro Street Railway Company.

KOKOMO, IND.—By the explosion of a boiler at the power house of the Citizens' Electric Light Company the plant was badly wrecked on the night of July 28, leaving the town in darkness. George Dunning, the engineer, was instantly killed.

WESTERVILLE, OHIO.—A private plant is to be installed here immediately with a 40-kw, 220-volt dynamo and a 60-hp engine. Mr. E. T. Aldrich, No. 11 Wesley Block, Columbus, Ohio, will be glad to receive estimates on material for the same.

MINERAL POINT, OHIO.—Sealed proposals will be received August 22 for the construction of an electric light and water works plant in Mineral Point City, Tuscarawas County. Specifications can be had on application to T. H. Edwards, clerk.

SALT LAKE CITY, UTAH.—The Dexter Company has about completed necessary preliminary arrangements for the construction of the new electric power line and plant for the operation of its forty-stamp mill at Tuscarora, Nev. When completed the works will give more than the required power for the running of the mill and the company will have power to sell.

FRESNO, CAL.—Fresno was in darkness one night recently because of a lack of water in the north fork of the San Joaquin River to generate power sufficient to run the plant of the electric company to its full capacity. The water is not sufficient for the company to supply its patrons with the usual service, which amounts to from 800 to 1000 horse-power. There is a great shortage of water in the mountains, as many of the streams have dried up. The snow has disappeared and the springs have quit running. The north fork of the San Joaquin, where the power plant is located, is low, and the big reservoir, some 25 miles further back in the hills, affords but little water.

DETROIT, MICH.—The Edison Illuminating Company, of this city, has prepared plans for the rebuilding of its station, at the corner of Washington Avenue and State Street. The present building, which is partly two stories high, will be raised to the uniform height of four stories and be made strictly fireproof. The building will be of steel frame construction, having a frontage of 70 feet on Washington Avenue and 40 feet on State Street. There will be two fast-running elevators—one each for passengers and freight. The building will be equipped with the most approved modern electrical machinery, the intention of the owners being to make it one of the best plants of the kind in the United States. Work will commence at once.

THE ELECTRIC RAILWAY.

CONCORD, N. H.—The street railway company is to install a generator in the power house immediately for the purpose of lighting the park independently of the power circuit.

CINCINNATI, OHIO.—Receiver Cone sold the Delaware (Ohio) Street Railway on July 30 at public outcry to B. W. Brown and others, of Delaware, for $13,525. The road originally cost $40,000.

NORWICH, N. Y.—It is now asserted that the Sidney-Franklin Electric road will be built if $20,000 is guaranteed by local capitalists, the money not to be paid until the completion of the road.

FALL RIVER, MASS.—The railroad commissioners have authorized the Providence & Taunton Street Railway Company to increase capital by $15,000 to $75,000 and to issue $175,000 first mortgage 5 per cent. bonds for construction.

LOUISVILLE, KY.—The Richmond, Nicholasville, Irvine & Beattyville Railroad, which is in the hands of John MacLeod as receiver, will be put up for sale for the second time on September 6, through the failure of Adolph Segat, of Philadelphia, to make his purchase good by July 23. The upset price will again be $160,000.

NEW YORK, N. Y.—It is reported that leading interests in the Pennsylvania Railroad Company have become large stockholders in a number of the trolley companies in cities and towns through which the Pennsylvania runs. This is thought to be preliminary to a possible control of the trolley lines for the sake of the steam roads.

NILES, MICH.—The Michigan & Indiana Electric Railroad Company has filed articles of association with the Secretary of State and will build an electric railroad from South Bend, Ind., to St. Joe, Mich., connecting with Niles and other Berrien County towns. Work will begin next spring, and power will be derived from a dam at Berrien Springs.

PITTSBURG, PA.—The Pittsburg & West End Traction Company has just completed the installation of two 1000-hp engines, connected with Westinghouse generators, in its new power house on West Carson Street. The company is now making extensions to Robinson Park, on Mt. Washington, and to Bridgeville. It will soon connect with the Neville Island line at Island Avenue, McKee's Rocks.

ALBANY, N. Y.—A certificate of an increase of the capital stock of the Nassau Railroad Company, of Brooklyn, from $6,000,000 to $15,000,000 was filed with the Secretary of State, the increase having been approved by the State Railroad Commission. The increase is to be expended in pay for road extensions and improvements already made and to be made, and to retire the bonds of leased roads.

NEW YORK, N. Y.—Negotiations are in progress between representatives of the Brooklyn Rapid Transit and the Nassau Electric Companies which look to a merger of the two properties on a basis which will give to the Brooklyn Rapid Transit a complete monopoly of surface street railway business in and about Brooklyn. It is intimated that a consolidation agreement is close to execution, though insiders decline to discuss the matter.

CHESTER, PA.—It is stated that the Media, Middletown & Aston Trolley Company is about to pass into the hands of a Philadelphia syndicate. Ex-Congressman John B. Robinson, who is president of the company, with the others interested, has endeavored for several years to bring about the consummation of the connection of the city of Chester with Village Green, Rockdale and other thriving places in Aston and Middletown townships.

JEANNETTE, PA.—Extensive improvements are under consideration by the new owners of the Greensburg, Jeannette & Pittsburg Electric Street Railway. It is understood that the Hempfield & Greensburg branch, running from Greensburg to Huff Station, will be widened to the standard gauge and continued on to Mt. Pleasant. The road, which now terminates at Manor Station, will be pushed on to Wilmerding, where it will connect with the Second Avenue line, and by this route enter Pittsburg.

NEW YORK, N. Y.—There is a proposition under consideration by the Brooklyn Heights Railroad Company for the refunding of the bonding indebtedness of the Brooklyn, Queens County & Suburban Railroad. The company has $3,500,000 first mortgage 5 per cent. gold bonds outstanding, due in 1916, and $4,500,000 first consolidated bonds due the same year, and $240,000 first mortgage bonds due in 1930. If the interest on these issues could be reduced from 5 per cent. to 4 per cent. there would be an annual saving of $65,000 to $80,000.

ALBANY, N. Y.—The State Railway Commissioners on August 3 granted an application to the Third Avenue Railway Company, of New York City, for permission to change its motive power to the underground conduit system on all its lines now operated by cable. The board declined to pass on the application for the use of compressed air motors and storage battery cars, in addition to the underground conduit system. It is stated that when the company is ready to use either of these methods of propulsion it may apply to the board for approval in each case.

BLOCK ISLAND, R. I.—The event of this summer at this remote spot in the sea is the opening of a horse-car line. The natives of the island look upon the innovation with much favor, and use the same expressions in hailing the cars that they use at sea in their boats. The common form of hail is said to be "Avast there," or "Heave to," and to bring the car to a stop in order to get off some such command as "Haul down your jib, and let go your anchor, till I get off," is likely to be applied to the situation. The native islanders are enthusiastic over what is to them a modern improvement. If the horse cars pay this season electric power will probably be installed next year.

NEW YORK, N. Y.—The third order for iron trolley poles has just been received by a firm in this city from Liverpool. The first order, about two months ago, called for 200 poles, the second for 300 and the one received by last mail called for 500. At an average price of $15 apiece, the value of these poles is $15,000. The larger the order the cheaper they may be bought. Yet about three months ago an order for 20,000 poles for the Japanese market was not placed in the local market on account of the British price being from 10 to 15 per cent. cheaper than the American. The local shippers to Liverpool are at a loss to understand, under the circumstances, why their firm in Liverpool keep sending orders for poles over here.

NEWPORT, R. I.—It is not very long ago since an indignation meeting was held in this city by the prominent wealthy summer residents of this famous watering place to express their disgust and abhorrence at the suggestion of introducing a trolley road in this city. The meeting was presided over by Mr. William Waldorf Astor, and "Society" almost went into a fit over the mere thought of an electric railway invading the sacred precincts of Newport. But the idea would not down. It grew, and it grew; and finally the electric railway came, and people here are now wondering how they ever got along without it. But curious changes have been wrought by the innovation. Those who most bitterly opposed the introduction of the electric railway here are now its most prominent supporters, and trolley parties among the "upper ten" is the coming fad. Mr. and Mrs. O. H. P. Belmont gave a trolley party on the evening of August 2. Now the pace has been set in this direction these select trolley parties will unquestionably become very fashionable.

Legal Notes.

THE ILLINOIS SUPREME COURT has handed down a decision which will result in curtailing the powers of the street railways in condemning private property. The court holds that the street railway companies have not the same rights as steam railroads in condemning land for track routes. The street railways must stick to the highways and streets, except where this is absolutely impracticable. It was held by the street railway companies that the Allen law allowed them to select any route and to condemn property wherever they saw fit. When the Aurora & Geneva Railroad Company started in to lay a road bed over the private property along the Fox River to Batavia, the owners made a protest. One of them, Jennie D. Harvey, brought suit to restrain the company. She was defeated in the lower courts, but has just won a decisive victory in the Supreme Court.

DEFEAT FOR THE BELL COMPANY IN WASHINGTON.—A press dispatch from Washington on August 4 announces that Judge Hagner, in the District of Columbia Supreme Court, rendered a decision against the Chesapeake & Potomac Telephone Company, and granted an order restraining it from removing instrments from the premises of subscribers who refuse to pay more than $50 per year rental. The last Congress enacted a law limiting the charges to $50 per year for each instrument in the District of Columbia. Subscribers in Washington refused to pay more, and the telephone company attempted to remove the instruments. James F. Manning & Co. commenced legal proceedings to restrain the telephone company from such action. The latter alleged that the act referred only to Government service, and that as otherwise applied it was unconstitutional. Judge Hagner overruled all of the company's objections and granted a temporary restraining order.

Personal Notes.

MR. EDWARD WESSELS, formerly managing director of the Standard Air Brake Company, and the owner of the illustrated weekly newspaper, "The Universe," has just purchased all right, title and interest in "Sunbeams Magazine," which has been in existence seven years. Mr. Wessels will merge "Sunbeams" into "The Universe," and the publication offices will be at 150 Fifth Avenue, New York City. "The Universe" has rapidly worked its way into favor, and it now goes to all parts of the world.

MAJOR J. O. KERBEY, who has recently returned from a trip to Brazil and other South American countries in the interest of the development of the [illegible] Pa. Major Kerbey is concerned in a projected electric railroad in Amazonia, and desires to arrange with an electrical engineer to visit Amazonia and go over the line of the proposed road for the purpose of obtaining data and other information to determine the feasibility and practicability of such a line. Major Kerbey is deeply interested in the sub[illegible] the existence of gutta [illegible]

Trade and Industrial Notes.

[illegible] Street to [illegible] Broad [illegible] solicitor of Amer[illegible]

[illegible]

[illegible]

[illegible]

MESSRS. FELIX SINGER & CO., manufacturers of electrical machinery, [illegible]

[illegible]

latest improved machinery. With these additional facilities the company expects to be able to take care of all orders in a prompt and efficient manner.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Chicago, is announcing a divided circuit toll line telephone system that is claimed to be entirely free from the broad claims of the Carty patent on the bridging system, recently upheld in Pennsylvania as valid. It is said to have some new and improved feature, compared with the regular bridging or series systems.

THE WESTINGHOUSE MACHINE COMPANY, Pittsburg, Pa., has already begun to reap some benefit from the recent brilliant successes of American arms in Cuba. Its New York office has received the initial order for a complete steam plant, including a 100-hp Westinghouse engine and Westinghouse generator, together with boiler, pump, piping, etc. This plant to be installed in Santiago de Cuba.

PATTISON, GOTTFRIED & HUNTER, 146-150 Centre Street, New York City, have just gotten out an interesting and complete illustrated catalogue of machine tools, lathes, shapers and stamp presses of special interest to manufacturers of electrical specialties. Their universal hand milling machine is especially adapted for use in electrical repair shops and in shops connected with nearly every large central station. A copy of the catalogue will be sent to anyone interested on application to the firm.

"TRIPS BY TROLLEY AND AWHEEL AROUND HARTFORD" is the title of an attractive little booklet just issued by Elmer M. White and Herbert O. Warner, Hartford, Conn. Various trolley trips about the city of Hartford, New Britain and other places in that section of the country are described and excellently illustrated with half-tone cuts. Some very artistic taste is displayed in the selection of the views. Judging from the illustration the towns and country about the neighborhood of Hartford are extremely attractive.

THE SHOPS of the Walker Company, Cleveland, Ohio, are running night and day on existing orders, and the recent large additions to the plant, it is stated, will be taxed to the utmost to produce the immense amount of work now in hand. Prof. S. H. Short recently secured a duplicate order for alternating apparatus from the Union Carbide Company, Chicago. The order, as it now stands, comprises over 20,000 horse-power in generators, and forms what is stated to be the largest contract for electric machinery of any kind ever awarded.

THE ALLGEMEINE ELEKTRICITATS-GESELLSCHAFT, Berlin, Germany, has published a list of electric railways installed by it in many of the principal European cities and a list of roads in process of construction. The list also includes various projected roads. The total length of the lines completed and under construction is 1095 kilometres; number of motor cars, 1861. The system of this company is installed on all of the roads referred to. The list gives considerable data in tabular form concerning the roads, and will be valuable to electrical engineers for reference.

HOISTING PLANTS.—The Denver Engineering Works, Denver, Col., in its catalogue No. 6, just issued, describes and illustrates electric and steam hoists made by that concern. The standard electric mining hoist is operated by a railway-type motor and controller. The drum, motor and controller are mounted on one bed plate. With slight changes the motors can be adapted to present hoists. A table shows that the standard hoist is made in nine sizes, based on hoisting capacity. The sizes of motors used range from 7 to 100 horse-power, and the hoisting capacities from 1200 pounds at 150 feet per minute to 5000 pounds at 500 feet per minute.

THE AMERICAN ELECTRIC TELEPHONE COMPANY, Chicago, writes to say that the recent decision in Pittsburg on the bridging bell patent has no bearing on the bridging telephones manufactured by it. It claims that its system is about the only non-infringing multiple system in existence. The reason for this is that its bells are not wired as shown in the Carty patent. The ringers are wound to suit the requirements of the different lengths of line and the ringer magnets are not permanently "bridged" on the line, being disconnected from it when the telephones are in use, and re-connected with it automatically when conversation is discontinued.

MONTAUK MULTIPHASE CABLE has been successively introduced in Australia. Mr. E. H. Kirkby, an electrical engineer of Williamstown, which is the port of Melbourne, in July last gave a practical test of the application of the cable for fire alarm purposes before a company of prominent citizens. The demonstration produced a marked impression. Mr. Kirkby is convinced that if this cable had been used in Melbourne the recent great fire there might have been averted. The Montauk Multiphase Cable Company, New York, is proud of the fact that its cable has made its mark at the Antipodes, and this without any direct influence from the home office. The results prove the well-known fact that a meritorious article is soon recognized.

THE NEW WORKS of the Warren-Medbery Company, Sandy Hill, N. Y., are now running to their utmost capacity, day and night, in order to fill the orders for the company's apparatus. It is reported that business has increased over 100 per cent. within the last sixty days, the demand for inductor machines reaching far beyond the company's utmost expectations. The company has recently made a large addition to its works, and the new machinery is now being installed. It is manufacturing a full line of standard white marble switchboards, and a full line of "Medbery" and "Standard" switches. The "Medbery" insulation and overhead equipment, for electric railways, is now being manufactured by this company, which is prepared to furnish this high-grade material promptly.

METROPOLITAN INJECTORS.—The Hayden & Derby Manufacturing Company, No. 111 Liberty Street, New York, has just issued its 1898 catalogue of Metropolitan injectors and H. D. ejectors. Several new features have been introduced in its make-up. In the ratings of injectors the horse-power is given [illegible] on the basis of [illegible] gallons of water per horse-power per hour, which has [illegible] been the standard basis of figuring the horse-power of injectors, but the [illegible] pounds evaporation of water per horse-power per hour [illegible]. Injectors with flanged as well as screwed connections are shown for the first time, and all the various forms of injectors manufactured by this company are shown in dimension diagrams, which enables the piping to be laid [illegible] data thus given. The catalogue also describes new forms of ejectors, [illegible] heaters and special injector fittings.

ELECTRICITY FOR MACHINE DRIVING.—The Westinghouse Electric & Manufacturing Company, Pittsburg, Pa., has just issued a very handsomely illustrated brochure under the title above named. The object of the company in producing this work is to point out a few of the many advantages to be secured by the use of electric current, instead of long lines of shafting and connecting belts, for the transmission of power. The advantages as enumerated and discussed are: Reliability, convenience and flexibility, saving of power, sanitary improvement, increased output, decreased cost of maintenance, and concentration of generating units. The illustrations are artistically executed and include one of a rotary planer driven by a Tesla polyphase motor; a 1000-hp two-phase generator direct-connected to a Pelton water wheel, and an electric 30-ton crane operated by 500-volt direct-current motors.

THE CLONBROCK STEAM BOILER COMPANY, Brooklyn, N. Y., has just issued a very handsome catalogue on the Morrin "Climax" vertical water tube boiler. A very complete description of this well-known boiler is given, and its advantages pointed out. The catalogue contains, besides, a large number of excellent half-tone illustrations, a large number of testimonial letters from different concerns using the Clonbrock boiler in their steam generating plants, and reports of various tests of Clonbrock boilers, showing excellent results. At the back of the book considerable engineering information and data are given which will be found very valuable for reference. Among the illustrations are shown views of the Climax boiler plants at the World's Fair, and the Tennessee Centennial Exposition at Nashville, and various other plants in operation and in course of construction. The Climax boiler is made in sizes from 50 to 1000 horse-power.

Directory of Scientific Societies, Associations, Etc., and Meetings of the Same

CHICAGO ELECTRICAL ASSOCIATION.—Meetings, third Friday of each month; J. R. Cravath, secretary.

THE NEW YORK ELECTRICAL SOCIETY.—President, Gano S. Dunn; secretary, George H. Guy, New York.

ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA., Pittsburg, Pa.—Meetings, third Tuesday of each month.

CANADIAN ELECTRICAL ASSOCIATION.—President, William H. Browne, Montreal; secretary, C. H. Mortimer, Toronto, Ont.

FRANKLIN INSTITUTE (Electrical Section), Philadelphia, Pa.—Secretary, William H. Wahl.

MASACHUSETTS CHARITABLE MECHANIC ASSOCIATION, Boston, Mass.—Exhibition of Motor Carriages, October 10 to December 3, 1898.

NORTHWESTERN ELECTRICAL ASSOCIATION.—President, F. A. Copeland, La Crosse, Wis.; secretary, Thomas R. Mercein, Milwaukee, Wis.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.—F. W. Putnam, secretary, Salem, Mass. Next meeting, Boston, Mass., August 22-27, 1898.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, New York.—President, Dr. A. E. Kennelly; secretary, Ralph W. Pope. Meeting, third Wednesday of each month.

NATIONAL ELECTRIC LIGHT ASSOCIATION.—President, A. M. Young, Waterbury, Conn; secretary, George F. Porter, New York. Next meeting, New York, May or June, 1899.

AMERICAN STREET RAILWAY ASSOCIATION.—President, A. E. Lang, Toledo, Ohio; secretary, T. C. Penington, Chicago, Ill. Next meeting, Boston, Mass., September 6, 7, 8 and 9, 1898.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS.—President, W. W. Ryder, Chicago; secretary, P. W. Drew, Milwaukee, Wis. Next meeting, Wilmington, N. C., June 19, 1899.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK.—President G. Tracy Rogers, Binghamton, N. Y. Next meeting, Hotel St. George, Brooklyn, N. Y., September 13 and 14, 1898.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES.—President, Samuel Insull, Chicago; secretary, Wilson S. Howell, Harrison, N. J. Next meeting, Sault Ste. Marie, Mich., September 12 and 13, 1898.

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION.—Dr. C. R. Dickson, Toronto, Can., president; Dr. John Gerin, Auburn, N. Y., secretary. Next meeting, Buffalo, N. Y., September 13, 14 and 15, 1898.

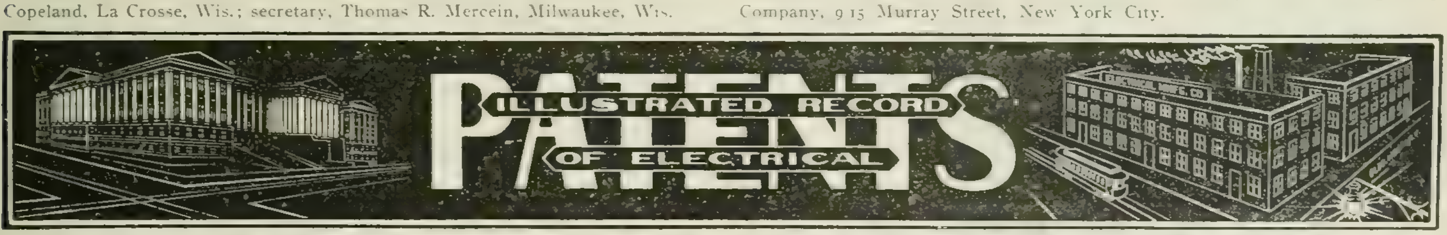
THE OHIO ELECTRIC LIGHT ASSOCIATION.—President H. K. Wood, Piqua; vice-president, Emil C. Schmidt, Sandusky; secretary and treasurer, Samuel Scovil, Cleveland. Next meeting, Sandusky, Ohio, August 18 and 19, 1898.

ASSOCIATION OF FIRE AND POLICE TELEGRAPH SUPERINTENDENTS AND MUNICIPAL ELECTRICIANS.—President, Will Y. Ellett, Elmira, N. Y. Next meeting Hotel Langewell, Elmira, N. Y., August 9 and 10, 1898.

INDEPENDENT TELEPHONE ASSOCIATION OF THE UNITED STATES.—President, Judge James M. Thomas, Chillicothe, Ohio; secretary, W. J. Vesey, Fort Wayne, Ind. Next meeting, June, 1899. Place to be named hereafter.

Business Notice.

THE ILLUSTRATIONS in this issue were made by the Photo-Engraving Company, 9-15 Murray Street, New York City.



UNITED STATES PATENTS ISSUED AUGUST 2, 1898.
[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

608,175. RECIPROCATING ELECTRIC DRILL; H. Casler, of Canastota, N. Y. App. filed March 18, 1898. In a reciprocating drill, the combination with energizing coils and a magnetic core within the same, of a casing for the coils composed of an exterior shell, heads or ends and an interior lining tube all of iron or steel, and united by water-tight joints.

608,178. ELECTRICAL RAIL BOND AND METHOD OF SECURING SAME IN PLACE; W. R. Cock, of Plainfield, N. I. App. filed Dec. 7, 1897. The method of securing a hollow, preferably slightly conical, electric bond terminal in place in a rail, which consists, first, in forcing the terminal into a perforation in the rail and then expanding it and clenching it against the edge of the perforation in the rail by progressively expanding the hollow bond terminal by means contacting and acting at one time only on a narrow annular section of the bond terminal, but successively on all portions of the bond to be expanded.

608,211. SYSTEM FOR HEATING BY ELECTRICITY; Jas. F. McElroy, of Albany, N. Y. App. filed Nov. 16, 1892. In an electric-heating system, the combination and arrangement of a plurality of heaters, consisting respectively of a plurality of heating sections, with single heaters, consisting of but one heating section, so connected that the single heaters may be placed in either circuit in which the heating sections in the heaters containing a plurality of heating sections may be placed, with means for varying the connections.

608,216. BATTERY ZINC; Dora Ogden, of Columbus, Ind. App. filed April 12, 1897. The combination of a battery cell, having a cover provided with an opening therethrough for the introduction of the electrodes, two or more electrodes with stems, and means for securing said stems within said opening, whereby the said electrodes may be suspended within the cell.

608,228. GALVANIC BATH; C. E. Schnee, of Carlsbad, Austria-Hungary. App. filed Sept. 14, 1897. A galvanic bathing apparatus composed of upper and lower tubs, insulating bases for supporting the same, a pair of electrodes projecting into each of the tubs, wires connecting the upper tubs and leading to the negative pole, and wires connecting the lower tubs and leading to the positive pole of a source of electric energy.

608,234. INSULATING CASTER AND ELECTRIC SWITCH COMBINED; A. W. Slayton, of Tecumseh, Mich. App. filed May 18, 1898. An insulating caster, the wheel of which is made of glass combined with a metallic contact arm pivotally secured to the metallic frame or support of the caster and adapted to form an electric connection with the floor.

608,246. ELECTRICAL SIGNALING APPARATUS FOR TRANSMITTING COMMANDS; C. Arldt, of Berlin, Germany. App. filed Dec. 29, 1897. In an electrically actuated signaling apparatus, the combination of a transmitting instrument comprising a closed wire coil, two diametrically opposite rotatable contacts supplying current thereto, three leads connected to the coil at points 120° apart and a receiver consisting of three coils connected to the leads and acting upon a central rotatable magnet, having a pointer whereby variation of resistance in the transmitter caused by the change of position of its rotatable contacts will effect the movement of the pointer in the receiver to the corresponding position quite independent of any variations in the tension of the current supplied.

608,249. ALTERNATING-CURRENT INDUCTION MOTOR; C. S. Bradley, of Avon, N. Y. App. filed Oct. 22, 1895. An alternating-current motor provided with two armatures of relatively high and low resistance, and independent field magnets wound to develop rotary magnetic fields of different densities co-operating therewith.

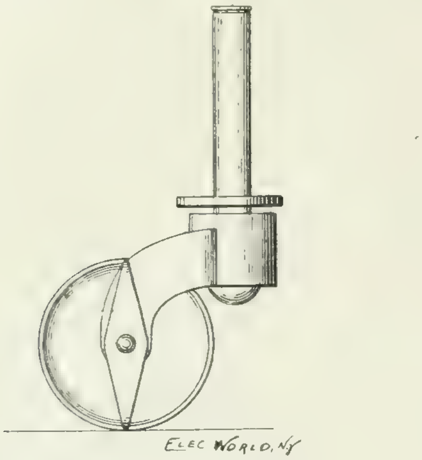
608,258. ELECTRIC BOND FOR RAILWAY RAILS; S. H. Harrington, of New York. App. filed Dec. 10, 1896. In an electric bond for railway rails, the combination of an iron or steel rail, having a perforation performed in its web at an acute angle to the plane of the web with a bond ferrule formed of metal having greater conductivity than the metal of the rail, said bond ferrule being inserted in and brought into close contact with the sides of the perforation in the rail web, and a bond body also formed of metal of greater conductivity than that of the rail, said bond body being inserted in the ferrule.

608,269. ELECTRIC ARC LAMP; C. A. Pfluger, of Chicago, Ill. App. filed Aug. 7, 1895. In an arc-lamp hanger, the combination of a fixed box or case with current-controlling devices therein, tubes downwardly projecting therefrom and carrying each one conductor, and means associated with such fixed box and adapted to engage the carbon-rod tube of the lamp, so as to hold such lamp in position.

608,277. ARMATURE FOR DYNAMO-ELECTRIC MACHINES; E. H. Anderson and D. P. Thompson, of Schenectady, N. Y. App. filed Jan. 8, 1898. In a dynamo-electric machine, the combination of a field magnet, an armature, a toothed core therefor separated from the field magnet by an air gap, and air gaps in the armature core arranged to divide the field flux into two parts.

608,281. TROLLEY; F. E. Case, of Schenectady, N. Y. App. filed June 30, 1897. In a trolley, the combination of a base, a combined lifting and buffer spring extending in one direction only from the base, and a pole socket pivoted to the base at a point below the centre line of the spring.

608,299. COMMUTATOR; W. B. Potter, of Schenectady, N. Y. App. filed April 27, 1898. In a commutator, the combination of a plurality of segments separated from each other by a layer of insulating material, each segment having substantially a slot straight across the outer or face side, and provided with an armature-lead slot and a lug for securing it to a support, and a circumferential groove into which the lead slots extend at a point below the wearing surface of the commutator.



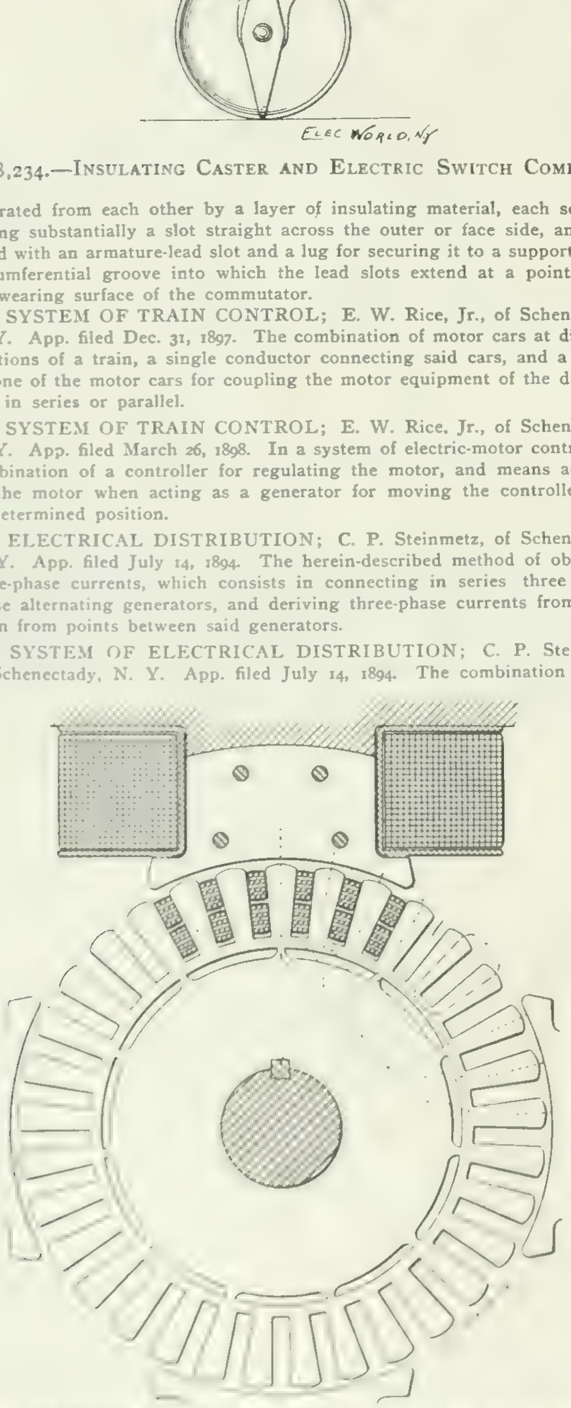
No. 608,234.—Insulating Caster and Electric Switch Combined.

608,301. SYSTEM OF TRAIN CONTROL; E. W. Rice, Jr., of Schenectady, N. Y. App. filed Dec. 31, 1897. The combination of motor cars at different positions of a train, a single conductor connecting said cars, and a switch on one of the motor cars for coupling the motor equipment of the different cars in series or parallel.

608,302. SYSTEM OF TRAIN CONTROL; E. W. Rice, Jr., of Schenectady, N. Y. App. filed March 26, 1898. In a system of electric-motor control, the combination of a controller for regulating the motor, and means actuated by the motor when acting as a generator for moving the controller to a predetermined position.

608,307. ELECTRICAL DISTRIBUTION; C. P. Steinmetz, of Schenectady, N. Y. App. filed July 14, 1894. The herein-described method of obtaining three-phase currents, which consists in connecting in series three single-phase alternating generators, and deriving three-phase currents from mains taken from points between said generators.

608,308. SYSTEM OF ELECTRICAL DISTRIBUTION; C. P. Steinmetz, of Schenectady, N. Y. App. filed July 14, 1894. The combination with a [illegible] of generating [illegible] leading therefrom to a [illegible] a [illegible] alternating electromotive force [illegible] the [illegible] to a predetermined [illegible].



No. [illegible].—Armature for Dynamo Electric Machines.

[illegible] MACHINES; C. P. Steinmetz, of Schenectady, N. Y. App. filed [illegible]. The method of [illegible] which [illegible] the [illegible] circuit at a predetermined flux.

608,319. ELECTRO-MECHANICAL CLOCK; H. G. Carleton, of New York, N. Y. App. filed Sept. 9, 1897. The combination with a door lock and an electric circuit for operating the same, of a hand-operated combination mechanism in said circuit comprising a rotative disc, provided with means for indicating the position of the combination mechanism, an indicating finger piece on the outer side of the door yieldingly coacting with said disc, and a circuit closer hand-operated from the outer side of the door.

608,321. ELECTRIC LOCK; H. G. Carleton, of New York, N. Y. App. filed May 24, 1898. In an electrically controlled lock, the combination with a movable magnet, and its armature, of one of the engaging parts of the lock, such as the latch or keeper, the parts being so constructed and arranged that when the magnet attracts the armature the magnet armature and the engaging parts will move together.

608,333. TELEGRAPHIC TRANSMITTING AND RECEIVING APPARATUS; B. Hoffmann, of Paris, France. App. filed May 5, 1897. In a printing-telegraph instrument, the type wheel of which carries a double series of characters disposed in alternate order around its periphery, and capable of displacement upon its spindle to an extent equal to half the advance of the spindle at each movement, mechanism for shifting and locking the type wheel, consisting of the combination with the type wheel and spindle of two spring catches adapted to lock the type wheel and spindle together, in their respective positions, inclines carried on the type wheel in two positions corresponding to shifting blanks or spaces, and the printing lever having a bevel adapted in either of said positions to disengage the spring latch, thereby unlocking the type wheel, and having a nose adapted thereupon to engage the inclines upon the type wheel and turn the latter to its other position, whereupon the other spring catch engages and again locks the type wheel and spindle together.

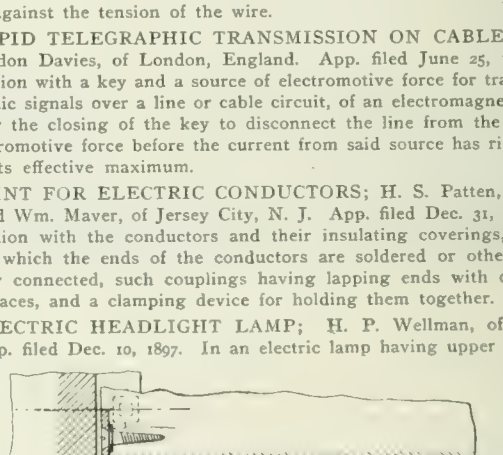
608,340. AUTOMATIC SWITCH FOR REGULATING ELECTRIC AIR COMPRESSORS; M. Moseley and P. Funck, of Rochester, N. Y. App. filed Nov. 15, 1897. The combination with an electric motor and compression pump of the automatic switch for controlling the motor circuit, consisting of two communicating cylinders provided with pistons, suitable insulated contacts, one of which is movable, and operated by the movement of one piston produced by the admission of air to its cylinder by the movement of the other piston.

608,343. ELECTRIC HEATER; J. F. McElroy, of Albany, N. Y. App. filed April 6, 1895. In an electric heater, the combination of a central core piece carrying radial arms at either end, and encircling spring placed about encircling springs and extending longitudinally parallel with the core piece, a resistance wound upon said insulating bars and straining the encircling springs against the tension of the wire.

608,389. RAPID TELEGRAPHIC TRANSMISSION ON CABLE LINES; C. Langdon Davies, of London, England. App. filed June 25, 1896. The combination with a key and a source of electromotive force for transmitting telegraphic signals over a line or cable circuit, of an electromagnet actuated following the closing of the key to disconnect the line from the source of the electromotive force before the current from said source has risen in the line to its effective maximum.

608,412. JOINT FOR ELECTRIC CONDUCTORS; H. S. Patten, of Montclair, and Wm. Maver, of Jersey City, N. J. App. filed Dec. 31, 1897. The combination with the conductors and their insulating coverings, of couplings to which the ends of the conductors are soldered or otherwise permanently connected, such couplings having lapping ends with closely fitting surfaces, and a clamping device for holding them together.

608,497. ELECTRIC HEADLIGHT LAMP; H. P. Wellman, of Ashland, Ky. App. filed Dec. 10, 1897. In an electric lamp having upper and lower carbon rods, brackets supporting said rods, one of said brackets having an electric terminal, and overhanging ears, an insulating disc with which one of said rods engages, having an arm for contacting with said terminal, and also arms for engaging said ears.



No. 608,321.—Electric Lock.

608,[illegible]. TELEPHONE TRANSMITTER ARM AND ITS ATTACHMENT; W. J. Barr, of Ashtabula, Ohio. App. filed Oct. 30, 1897. The combination, with the base having a mouth and trunnions, the transmitter arm and a bearing cap, of a spring secured between said cap and arm, and bearing on the trunnions.

608,[illegible]. BATTERY ELECTRODE; H. W. Wilkinson, of Mount Vernon, Ohio. App. filed June 10, 1897. A grid having pockets formed in plate sections, said sections being secured side by side vertically to a supporting plate.

The Electrical World.

Vol. XXXII. NEW YORK, AUGUST 20, 1898. No. 8.

PUBLISHED EVERY SATURDAY BY

The W. J. JOHNSTON COMPANY,

9 Murray Street, New York.

Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York.

New England Office, 620 Atlantic Ave., Boston.
Western Office, 936 Monadnock Block, Chicago.
Philadelphia Office, 929 Chestnut Street.

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Vol. XXXII. NEW YORK, AUGUST 20, 1898. No. 8.

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A FRENCH ELECTRIC LIGHT STATION.

A brief description is given on another page of the new central station of the Paris Compressed Air Company, a concern which is one of the largest concessionaires for electric lighting in the French capital. The general plan on which the lighting system of this company is laid out is one which has never come into use in this country, being what is known as the five-wire system, making use of an extension of the three-wire principle. Current is generated at 500 volts and distributed on two-wire feeders to substations wherein are storage batteries connected across the mains, from which run five-wire distribution systems, the pressure being equalized between the four 10-volt circuits of the distribution system in series with each other by means of batteries. In this way a great economy of copper is effected over the ordinary three-wire system, the outside wires being for the same load, drop and distance but one-quarter the size of those required with 220 volts, and no neutral is used between the substations and the main generating plant. The battery substations, of course, require some attendance, but storage batteries are now recognized as a profitable accessory in all direct-current systems with a fluctuating load curve, and undoubtedly the location of the batteries at the centres of distribution instead of at the generating station is a great advantage in that it improves the load factor on the feeders.

The system is interesting in that it occupies a position somewhere between the low-tension direct-current systems and the high-tension alternating-current systems, requiring, in common with low-tension systems, a greater amount of copper than do the latter, and in common with first-class alternating systems the substations not required with simple low-tension plants. Compared with the latest American practice of alternating current generation and transmission with rotary substations and direct-current distribution, it appears at quite a disadvantage. The latter allows the use of a transmission voltage ten times as high as is used in the French station referred to, resulting in a reduction of the copper used in transmission by 99 per cent., and also allows the use of larger, more efficient and less complicated generators. The large number of units (23) planned for in the French station is undoubtedly due to the inexperience in the construction of larger sizes of direct-current machines than that adopted, which is 1000 horse-power. Rotaries appear somewhat at a disadvantage in comparison with the motor-driven boosters used in the French system, while storage batteries may or may not be used with a rotary plant. A five-wire distribution may be used with the latter, if the corresponding economy of copper outweighs the disadvantage of higher voltage in the distribution circuits, or a three-wire system may be used if the reverse is the case.

ENGINEERING EDUCATION AND CHARACTER.

The objects of education are to provide the student with useful information, to train his mind to habits of orderly thought, and to form his character in the mould of propriety. The curricula of schools have suffered a gradual but widespread evolution during the last century, many subjects that once formed the essentials of a school course having disappeared entirely, many more having sunk into relatively unimportant esteem, while new subjects have taken their places and new ideas permeated the communities of learning. It has not been very long since the compulsory study of Greek was a feature of our college courses. It is only within very recent years that engineering and technical education have appeared as part of the programme of institutions of learning.

It is not possible to make any general statement as to the relative values of various sorts of instruction, because so many factors enter the problem presented by each case; but it can be said that some sorts of instruction have a better effect for the formation of character and the founding of principles of morality than others, and conspicuous among these is instruction in engineering. That this claim should be urged may seem strange at first, but when it is considered that engineering means the adaptation of natural laws to beneficent purposes; that high accuracy and absolute honesty of thought are essential to the success of an engineering career; that least of all men may the engineer deceive himself or argue himself into belief in dogmatic assertion—then it will be seen at once that proper training in this profession contains just the discipline needed for the foundation of the highest character. Furthermore, the very materiel of his profession brings the engineer into contact with the unchanging laws of nature, makes him familiar with the operations of absolute principles, teaches him to reason his conclusions with perfect honesty from known grounds, and hence makes him think straight and think the truth—the first essentials to good character.

The admirable essay of Mr. H. G. Prout on this subject, from which an extract was printed in the last issue of The Electrical World, contains much worthy of serious thought. Long have the "humanities" been extolled as the proper food for growing minds, and generations of boys have plodded over the same weary course of classics and fable, of history and grammar, of myth and speculation. Are these things as good as the study of nature? Is a rule of syntax a more excellent basis for mental training than Ohm's law? Is a chemical formula less interesting than a conjugation? Are we not, after all, beginning to acknowledge the mistake that has bound generations to waste their youth in the contemplation and study of purely human inventions of law and government and language, when the whole cosmos has appealed to them to study that which is eternal and natural?

Good character is inability to do willful wrong. The nearer that one can come to emulating the precision and accuracy of natural law in his own conduct, the nearer he will approach to that perfection of character which is, or ought to be, the object of education. In no country has engineering and technical education been so widespread as in this, and nowhere is there a finer national character. The engineer must, willingly or not, be a man of precise deportment. To quote Mr. Prout: "Nature, calm and unrelenting, always stands looking at him. No other man in the world has such stern and unceasing discipline"; and so, therefore, no other man has so good a chance for the development of a firm and just character, based on the actualities of things and founded upon the immutable laws of nature.

[illegible] occupation, more [illegible] the laws of nature. The duty falls to the physicist, the chemist, the engineer and others. While the [illegible] a large extent selfishly upbuilding his own interests by tearing down those of his competitors, the engineer's self-interest is best attained by work [illegible]

THE DEVELOPMENT OF HIGH FREQUENCY CURRENTS FOR PRACTICAL APPLICATIONS.

[illegible] of high-frequency currents. Oscillatory currents with a frequency of several hundred thousand alternations per second are fortunately easily generated by the simple discharge of a condenser through an inductive path, the main difficulty in producing them being the means of again starting the oscillations whenever they die out, as, of course, they do in a very small fraction of a second. The electrical method by means of a discharge is, of course, extremely wasteful, and mechanical devices for this purpose have heretofore been very troublesome, particularly in the contacts.

Mr. Tesla has been working at this problem for some years, recognizing that its solution was essential to the success of the commercial application of such currents. The results of this work appear in these recently issued patents. In general he uses a jet contact for the make and break device or circuit interrupter similar to the jets used in laboratory work for brief contacts in the determination of the wave form of alternators, etc. Mercury is preferred, owing to the high specific resistance of its vapor, and the low resistance of the liquid and a form in which jet meets jet possesses advantages, as in this case there is no sparking to or from a solid metal. Further, the contacts are made in an inclosed chamber filled with some inert gas, if necessary under considerable pressure. If atmospheric pressure is used, the apparatus is simply hermetically sealed, the small amount of oxygen contained within being soon absorbed by oxidation, leaving an inert insulating medium of nitrogen. If pressure is desired—and high pressure cuts down the arcing of such devices even more than does a high vacuo —anhydrous liquid ammonia may be used, the minute sparks gradually dissociating the ammonia into its elements, hydrogen and nitrogen, the former diffusing through the containing walls, leaving inert nitrogen under pressure.

The designer states that these machines run satisfactorily, without apparent change in the liquid, and requiring a surprisingly small amount of attention, small instruments transforming several horse-power continuously for long periods with no attention whatever. More than this, he also states that the efficiency of conversion between the direct current supplied and the high frequency current obtained, the latter being measured by calorimetric methods, is as high as 95 per cent. This being the case, the use of such currents for lighting purposes may be expected as soon as the luminous efficiency of exhausted bulbs or tubes under the action of such currents approaches or exceeds that of the incandescent filament, the fulfillment of which condition Mr. Tesla confidently promises. Such currents may also find a wide application in other fields, one of which is the electro-chemical, for the production of such compounds as ozone, in which high-frequency currents are said to give a much greater output per unit of energy than those of frequencies now used. Other chemical conversions are also readily accomplished by the same means, a promising one being the oxidation of atmospheric nitrogen, giving, if commercially practicable, promise of an enormous use of electrical energy in the production of nitrates and other nitrogenous substances, for which there is a great demand in the arts.

The Growing Importance of the Storage Battery.

In a paper read before the Engineers' Club of Philadelphia Joseph Appleton states that in the history of the electrical industry in the United States there is probably no branch which has shown such a rapid growth as in the case of the storage battery during the last three years. The following figures show the enormous increase during this time; they have been carefully compiled and represent the actual weight of storage battery plates installed. The weight is that of plates alone and does not include containing cells, acid, etc.

[illegible]	[illegible] lb.
[illegible]	[illegible]
[illegible]	[illegible]
1897	3,607,300

A Parisian Electric Light Station.'

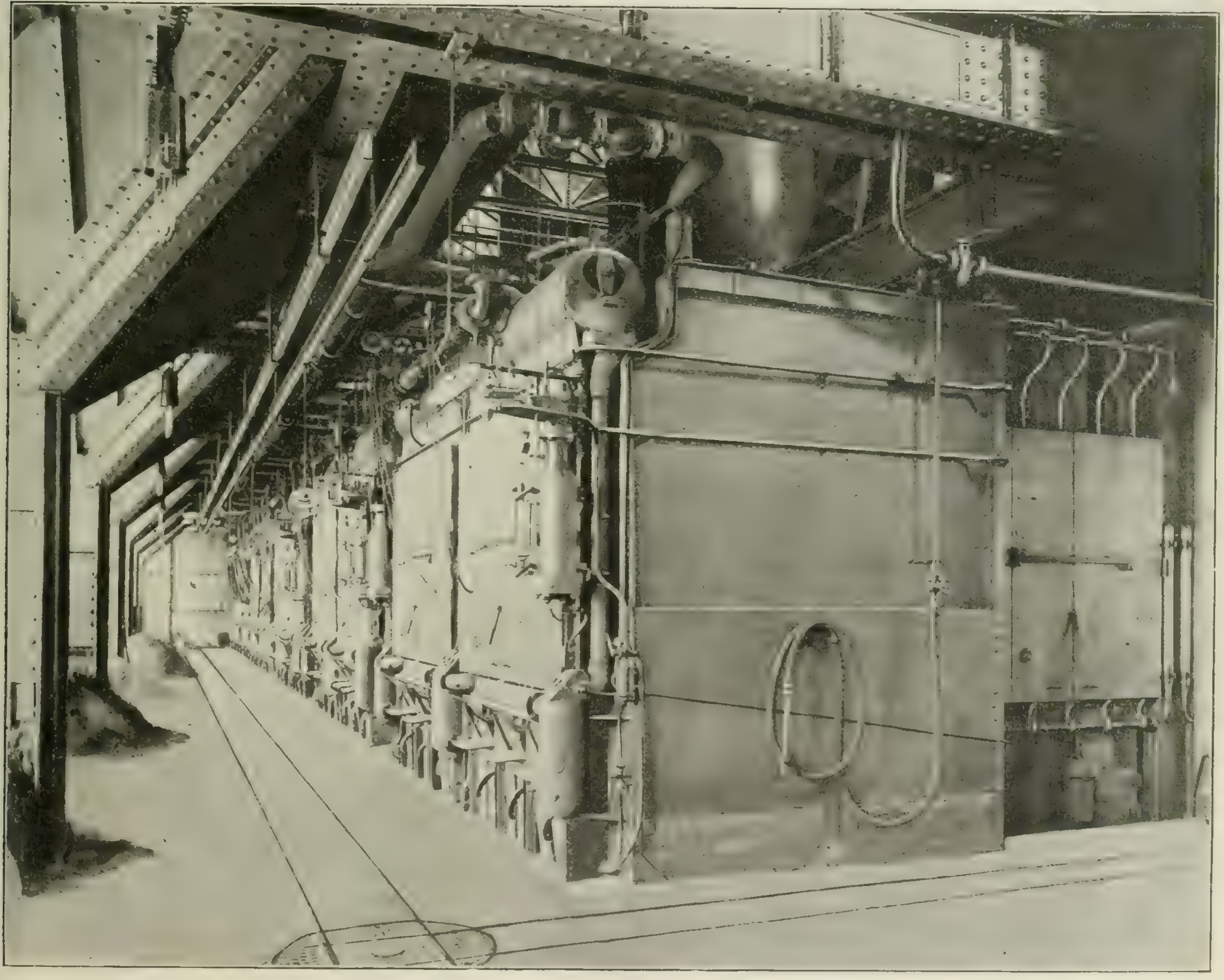
THE Paris Compressed Air Company has recently put in operation one of the most elaborate electric lighting installations in Europe. In many respects this installation is entirely different from American practice, notably in the methods of conduction and distribution and in the arrangement of the engines and generating machinery.

The new plant, situated on the Quai de Jemmapes in order to receive its coal direct from boats on the St. Martin Canal, occupies a site about 190 x 290 feet, which is entirely covered by a building of considerable height, shown in the accompanying initial. This building is divided into twenty-three practically similar parts or bays by vertical divisions, each part forming a complete generating unit and containing coal and water supply, boilers, engines, dynamos, etc. A storage battery of considerable size is also installed to aid in steadying the load and for other purposes, and provision is made for a supply of filtered water and some storage of coal.

Coal arriving in boats at the front of the building is taken by a conveyor to a point in the cellar, where it is delivered to elevators and carried to a distributing conveyor in the roof. This distributes the coal among the twenty-three bins of the various units of the generating plant. All the elevating and conveying machinery is operated by electric motors. An auxiliary supply system consisting of an elevator in which coal in carts can be taken up to the boiler level also provides an insurance against delays due to the breakage of the coal-conveying system.

Feed water is taken, through meters, from the city supply, and is pumped [illegible] an underground reservoir containing a reserve of 330,000 gallons of the filtered water is under the floor of the pump room. Both electric and steam pumps are used for raising the water to the level of the boilers, and a reserve supply of 20,000 gallons of unfiltered water is kept in a tower surmounting the buildings. Condensation water is taken from the canal in front of the buildings through a 4-foot conduit and circulates in a sort of race-way around the building, returning to the main canal through two 35-inch pipes.

Each of the twenty-three divisions of the building contains four boilers of the water-tube variety, each producing 5500 pounds of steam per hour at a presure of 115 pounds. Three of these boilers can take care of one of the generating sets to which they are attached, and the danger of stoppage due to accidents to them is thus much diminished. Steam pumps are used for feeding, each battery of boilers having two pumps, either of which is sufficiently large to supply the four. A common stack for each battery of four boilers is provided, so that there will be in all twenty-three stacks rising from the building when the entire plant is installed. At present but seven of the groups are in place, four more being in course of construction.



The Boiler Room of a Parisian Electric Light Station.

Coal from the storage bins above the boilers descends by gravity to the floor in front of the fire doors and is stoked by hand. A tramway on the same level is used for the carrying away of ashes, and can be used for coal in an emergency.

Each of the generating sets consists of a vertical two-cylinder compound engine direct connected to a direct-current dynamo of about 750 kw capacity. A Corliss valve gear is used on both cylinders, with detachable cut off on the high-pressure cylinder only. The high-pressure cylinder is jacketed with steam at the boiler pressure, 115 pounds, and the jacket of the low-pressure cylinder forms the intermediate receiver. The engines run at the low speed of 70 r. p. m. and at this velocity give 1200 horse-power. The dynamos are of the internal field Gramme-ring type, similar to the familiar Siemens-Halske machine, the outer elements of the armature winding forming the commutator. The field magnet, of twelve poles, is bolted to the bed plate of the machine, the armature carried on a spider overhanging it. On the smooth core of the armature the winding of bar copper is laid up of parts consisting of straight bars for the outer surface and U-shaped pieces surrounding the other three surfaces of the ring. All joints are heavily swaged and soldered. Twelve brushes carried on a star-shaped casting complete the machine. At the normal speed and excitation the output can be either 1500 amperes at 500 volts or 1200 amperes at 600 volts. The exciting winding is of the simple shunt variety, 1500 watts being used in the field. At full load the efficiency is stated to be above 92 per cent.

The system of distribution is by sub-stations containing accumu[illegible] from the main plant [illegible] switches connecting the dynamos to the bus bars. These are controlled by [illegible] If the speed of the machine falls so that the current reverses in it and tends to "motor" it the switches automatically open. In disconnecting [illegible] the magnetic switch opening as soon as the speed is sufficiently reduced.

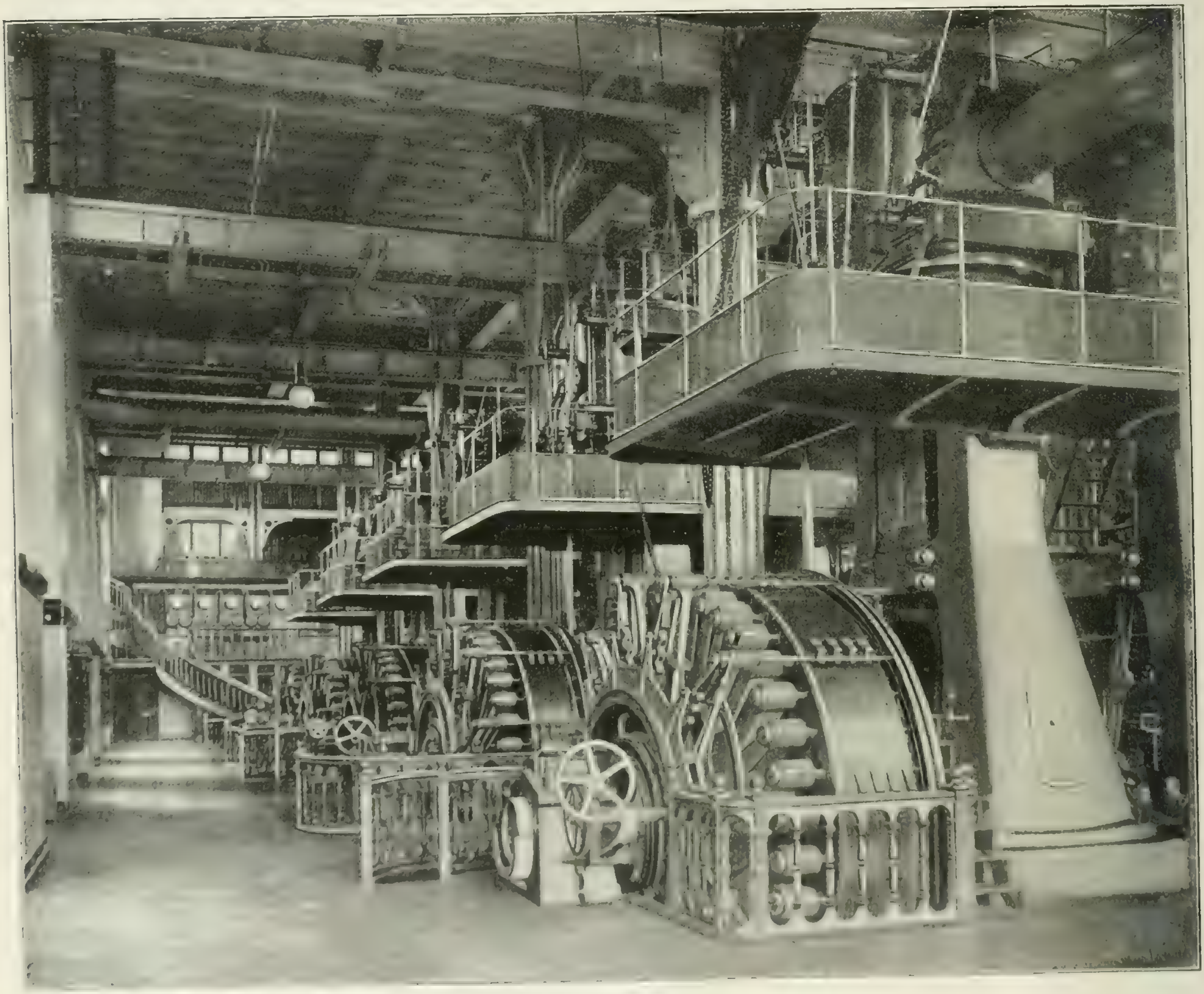
In a plant of such size the need for some signal system between the main switchboard and the dynamos is apparent. On each panel of the main board is mounted a number of buttons connected with an annunciator at the corresponding machine.

For the various sub-stations the pressure at the bus bars in the central plant is not the same. Pressure wires are run from each of these to the distributing board and the voltage governed in accordance with the requirements of the sub-station. Several independent cables connect each station with the central plant, and these are cut in or out as the load rises and falls in order to maintain the drop as nearly constant as possible.

On account of the fluctuations of voltage at the bus bars an independent plant is used for lighting the station. This consists of a 220-volt 50-kw dynamo driven by a motor on the main circuit, and a battery of accumulators.

Of the several sub-stations the most important is that of the Rue de Mauconseil. This contains twelve batteries of 280 elements each, each battery having an output of 2200 ampere-hours at the normal discharge of 300 amperes. Charging is accomplished by the aid of boosters, which may also be used to charge independently any quarter of the batteries that may be run down. The boosters are motor driven, of four poles, and giving from 10 to 100 volts lift in the charge under currents up to 300 amperes. From the sub-station a five-wire circuit having 110 volts between each pair of wires is distributed. For this purpose armored cables are used, laid directly in the earth, the only precaution taken being to surround them with a layer of sand so that water drains away from them easily.

The illustrations shown herewith are published by courtesy of [illegible]



The Engine Room of a Parisian Electric Light Station.

Mr. Tesla's Circuit Interrupters.

For the production of intermittent currents for use in obtaining oscillatory currents of very high frequency by means of charging a circuit possessing capacity and self-induction, Mr. Nikola Tesla has designed a large number of interrupters or make and break devices embodying many ingenious features. These interrupters, or, as Mr. Tesla calls them, circuit controllers, were patented in a group of patents issued August 16, 1898.

In order to make clear the purpose of these devices it may be well to give an untechnical explanation of the means of producing high frequency or oscillatory currents. Whenever a charged condenser is short circuited through a circuit containing self-induction the sudden rush of current, by an action analogous with mechanical inertia, over-discharges the condenser, charging it up in the reverse direction; this again discharges the other way, again reversing the charge in the condenser, and so on, the oscillations gradually dying out at a rate dependent on the resistance of the circuit. With ordinary Leyden jars and the small self-induction obtained by a few turns in air, these oscillations have a frequency of several hundred thousand alternations per second, this frequency running up as the capacity of the condenser or the amount of the self-induction is diminished, being, in fact, inversely proportional to the square root of the product of the capacity and the self-induction. To start such an action the condenser must first be charged and then closed on its discharge circuit. The simplest way of accomplishing this, and the means most commonly used, is to insert a spark gap in the circuit and in shunt with this spark gap connect the secondary of a high-voltage transformer supplied with ordinary alternating current, or the secondary of an induction coil. The action, then, is as follows: As the voltage rises in the transformer the condenser is gradually charged until the pressure gets so high that it jumps across the spark gap. The spark or arc here formed is of such a low resistance that the condenser and its discharge circuit are practically short circuited through it, and the oscillations continue for a short while, until the arc dies out, the action being repeated at the next reversal of the alternating current supplied.

Such a method is extremely wasteful of power, for two reasons. First, because the secondary of the transformer is short circuited just at the peak of the wave; and, second, because the arc or spark offers some resistance to the high-frequency oscillations, which, therefore, die out more quickly than they would if they were not opposed in this way. A far better plan, therefore, is the use of a mechanical interrupter, such as those described below, the action of which can best be understood by a reference to Fig. 3. Here *A A* are the terminals of the source of supply, which may be either direct or alternating current at commercial pressures, 100, 200, 500 or 1000 volts. *A'* is a highly inductive coil which should be wound on iron. *A''* is the condenser, *B* a small self-induction, and *C* the interrupter. The action is as follows: When the circuit is open at *C*, the pressure applied from the source of supply acts through *A'* and *B* to charge the condenser, *A''*. Suddenly *A''* and *B* are short circuited through the interrupter, *C*, and the condenser discharges with oscillations, occurring perhaps several hundred thousand times per second. These gradually die out, becoming negligible after perhaps 200 or 300 oscillations, when the circuit is suddenly opened again at *C*. It should be noted that *C*, besides short circuiting the condenser through its slight self-induction, *B*, has also short circuited the source of supply connected to the terminals, *A A*, through the inductive coil, *A'*. This short circuit is so brief, however, that the incoming current has not had time to rise to an undesirable strength, but has been held back by the self-induction of *A'*. It has also while rising been storing up, so to speak, a certain amount of energy in the magnetic circuit of *A'*. Now, when the circuit at *C* is again opened, this current, passing through *A'*, tends to persist, owing to the self-induction therein, and charges the condenser *A''* up to a voltage considerably higher than that of the source of supply, the energy absorbed in the magnetic circuit of *A'* passing out thus into the condenser *A''*, charging it to a high voltage, the interrupter, *C*, afterward short circuiting this and allowing the current to oscillate again through the discharge circuit, *B*.

Thus the interrupter, *C*, inductive coil, *A'*, and the source of supply act to open the condenser circuit for a brief instant and charge the condenser by a sort of electrical blow, immediately short circuiting it again and allowing it to discharge in oscillations. If the condenser discharge circuit is tuned to a frequency of, say, 300,000 per second, and its resistance is such that 300 oscillations take place before they die down to a negligible value, the interrupter, *C*, should make and break the circuit about 1000 times a second. There will then exist in the condenser discharge circuit, *B*, a cycle somewhat as follows: A sudden surging charge followed by an oscillatory discharge, starting with high waves, which gradually die down until interrupted by the next surging charge, etc. Owing to the enormous frequency of these oscillatory discharges, they can be transformed by ordinary double-winding, stationary alternating transformers, with a very small amount of material for their capacity, since the capacity of any transformer is proportional to the rate of change of lines of force, and is hence proportional to the frequency of the alternating currents therein. So high is this frequency that an air magnetic circuit is all that is necessary, iron, in fact, being a disadvantage, owing to the energy lost within it in eddy currents and hysteresis, with such a high frequency. In the figure, *B* represents the primary of such a high-frequency air transformer, *B'* being the secondary, with a winding of more turns to obtain higher tension, the output of which is delivered to any translating devices, as *B''*.

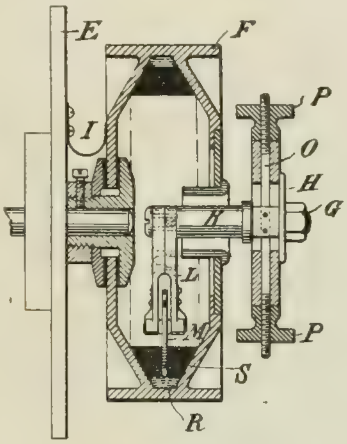


Fig. 1.

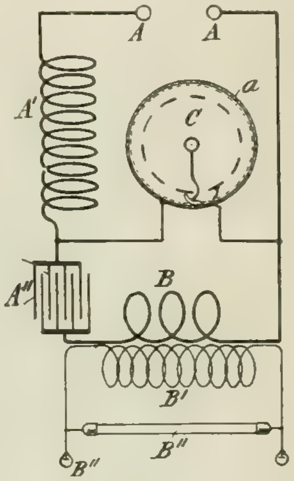


Fig. 3.

The distinguishing feature of the devices described below is the use of a liquid for one or both of the contacts of the make and break devices, this liquid preferably being mercury, acting in some instances in the form of a jet and in other cases as a surface with which a solid conductor makes and breaks a contact. Ingenious applications are also made of other principles, such as the use of a liquid dielectric between the contacts, inert gases under high pressure, jets meeting each other, etc.; and all the instruments are worked out with great perfection of detail for continuous and practically frictionless running, such as to require a minimum of attention.

The requirements of such an instrument are well stated in the patent specifications, as follows: The capability of effecting an extremely rapid interruption and completion of the circuit, the latter being positive and abrupt; the apparatus not to be liable to derangement, and capable of prolonged use without attention or adjustment.

Of the various types described the first is that shown in cross section in Fig. 1. This consists of an inclosing shell, *F*, arranged to be rapidly rotated by means of a motor coupled to the shaft shown at the left, and containing two liquids of different specific gravities, that with the higher specific gravity being a conductor and the other an insulator; preferably the conductor is mercury, the insulator being some hydrocarbon. When the shaft and shell mentioned are rapidly rotated the mercury flies to the periphery by centrifugal force and forms a ring shown at *R*, the other liquid forming an inner ring, as shown at *S*. Within the shell is an arm, *L*, supported on a non-rotating shaft, *H*, carrying a wheel, *M*, with projecting points sufficiently long to touch the mercury, *R*. As the liquids revolve they rotate this wheel at high speed, the points of which successively and repeatedly dip into the mercury rim and leave it again, the relative motion being a hypo-cycloid. The insulating liquid, under considerable pressure, owing to centrifugal action, forces itself between the mercury and the points as the latter recede and extinguishes the arcs which tend to form across these gaps. Other figures attached to the same patent show the machine assembled with a motor, condenser and transformer.

The next patent describes the waste of energy which occurs during the periods of make and break, or both, due to the passage of the current through an arc formed between the terminals; this loss of energy is said to be generally such as to render impossible a practical and economical conversion of considerable amounts of electrical energy by means of ordinary make and break devices, particularly in cases where a high frequency is required. Experiment and investigation have led Mr. Tesla to recognize the following laws governing this waste of energy: First, that the loss in any device for making and breaking a circuit, other conditions being the same, is inversely proportional rather to the square than to the first power of the relative velocity of the terminals in approaching and receding from one another in case the current curve is not so steep as to materially depart from one which may be represented by a simple sine function of the time; but such a case seldom obtains in practice; on the contrary, the current curve resulting from a make and break is generally very steep and particularly so when the circuit controller effects the charging and discharging of a condenser, and consequently the loss of energy is still more rapidly reduced by increased velocity of approach and separation.

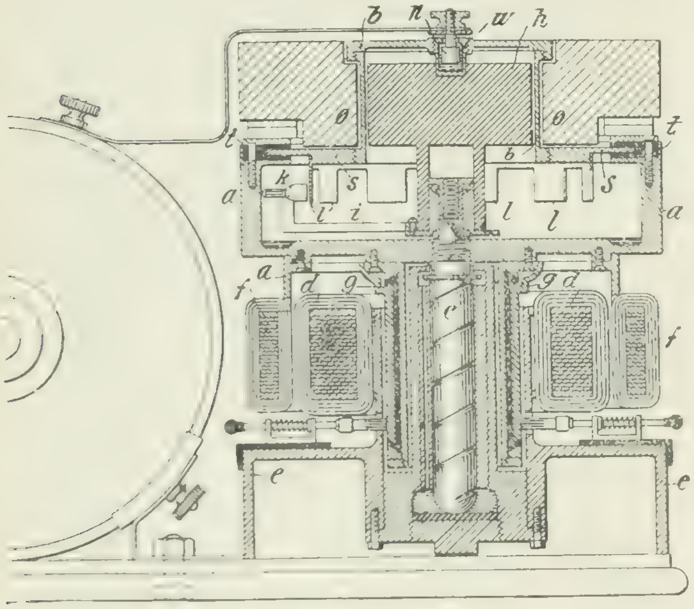


Fig. 2

[illegible] the relative speed of the terminals but also the frequency of the interruption should be very high, the instrument shown in Fig. 2 was [illegible] to the [illegible] commutator, g, and field magnets, d, by which means the shell, a, is rotated at high speed on a self-oiling spindle, c. Projecting downward from [illegible] teeth; the nozzle is attached by means of an arm, i, to an armature, h, which is prevented from rotation by means of the field of force of an external non-rotating magnet, o, this field acting [illegible] When mercury is placed within this case and the latter is revolved [illegible]

[illegible]

tion or is, in other words, prevented from expanding laterally, and is therefore more quickly raised to a high resistance, choking back the current to such an extent that the arc is more promptly extinguished.

Fig. 4 shows an apparatus designed to make use of this principle. Here *F* is the laminated field ring or primary of a rotary field motor, the secondary of which is wound upon the rotatable core, *E*, mounted on the shaft, *D*, within the gas-tight shell, *A*, which is closed by the insulated and gas-tight cover, *B*. The rotating field of force obviously acts through the shell, *B*, which should be an insulating material or high-resistance metal, and rotates the parts within which carry a crown of downwardly projecting teeth, *H*, and on the lower end of the shaft a screw pump, *I*. This screw pump acts upon the mercury in the lower part of the vessel, forcing it outwardly through tubes, *J*, from which it emerges in jets against the teeth, *H*; these jets and teeth make and break the current as in the apparatus described above, the whole being kept under pressure by an inert fluid shown in the cup, *M*, at the top of the apparatus; this liquid may be such a one as anhydrous ammonia, giving at ordinary temperatures a high pressure due to its restricted evaporation and low boiling point. The gas is admitted down into the chamber through the tube, *N*, in the fixed internal part of the ball bearing, *C*.

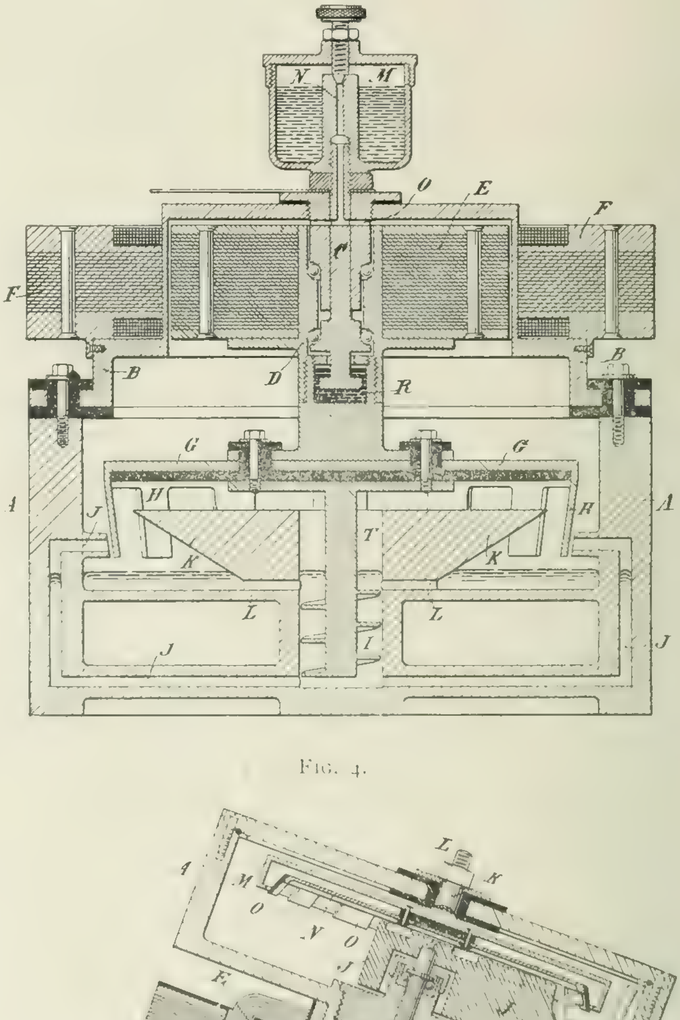


Fig. 4.

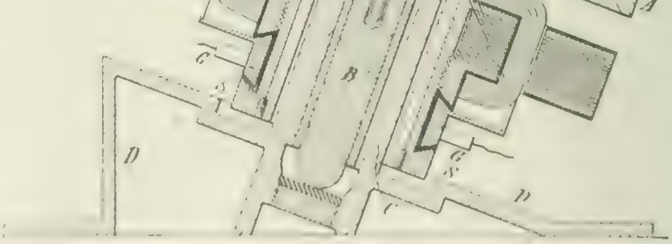


Fig. 5.

A means of accomplishing the same result without the use of a magnetic field acting through a fixed gas-tight wall, utilizing instead the force of gravity, is shown in Fig. 5, where *A* is again a gas-tight case supported upon an inclined spindle, *B*, and arranged to be rotated by a direct-current motor with outside armature similar to that shown in Fig. 2. Within this case is an eccentric weight, *K*, mounted on a self-oiling spindle, *J*, with a ball thrust bearing to avoid its being dragged around by friction. Owing to the inclination of the rotating axis of the system from the vertical, this weight, *K*, tends to remain at the low side and not to revolve with the case. Attached to this non-rotating weight, *K*, is an arm, *L*, carrying another ball bearing shaft, *N*, supporting a number of vanes, *Q*. When the case is revolved the mercury contained therein is maintained by centrifugal force in the form of a ring against the outside wall, into which ring the vanes, *Q*, dip and are rotated at high speed, making and breaking a contact between themselves and the mercury.

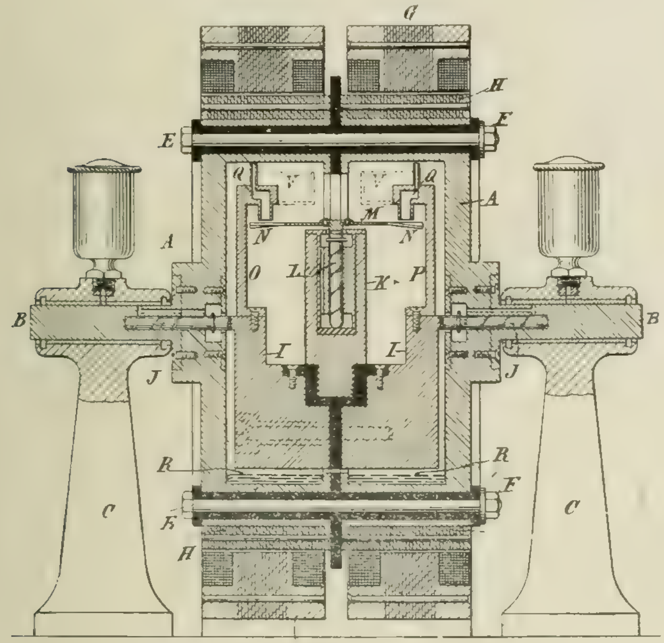


Fig. 6.

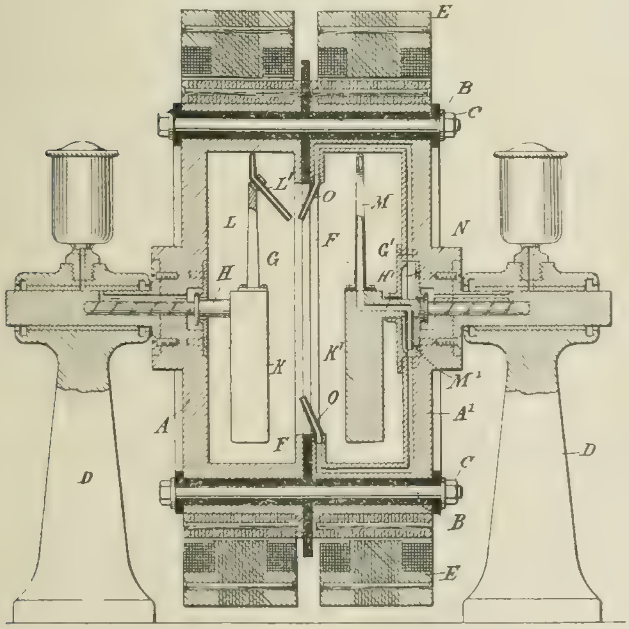


Fig. 7.

Still another device for obtaining a rapid make and break in a gas-tight chamber, this time utilizing both the rotary field and the eccentric weight, is shown in Fig. 6, where *G G* are two stationary primaries of the induction motor, which in this case is arranged in a vertical plane of rotation, *H H* being two secondary rotors, the necessity for two elements being the division of the rotating part by insulating gaskets into two sections. Within this rotating chamber, *A*, are mounted two eccentric weights, *I I*, fastened together by an insulating joint and supported on the spindles, *J J*. Fastened also to them is the central vertical journal, *K*, in which rotates the spindle, *L*, carrying a wheel, *M*, and inclined helically bent blades, *N N*. As before mercury placed in the revolving case is carried around by centrifugal force and, meeting the spouts attached to the nozzles, *Q*, is driven by its own inertia through them against the blades, *N N*, which, owing to their inclination, are given a rapid rotary motion about the spindle, *L*. The claims of novelty made for this combination are the facts that the action of the jets themselves puts in motion the solid terminals of the make and break device, with a speed very high compared with that of the shell, and that the motion of the vanes acts gyroscopically to prevent oscillation (and hence variation of the frequency) of the eccentric weights, *I I*.

A similar make and break device, in which, however, both terminals are liquid jets, is shown in Fig. 7. Here, as in Fig. 6, are the two rotary field motors rotating in a vertical plane with eccentric weights, *K K'*, the scoop attached to the former directing a jet from the nozzle, *L'*. The scoop attached to the other is intended to direct the liquid through the tube, *M*, to the axis of rotation, whence it is distributed through passages in the rotating case to the nozzles, *O O*. These jets striking that from *L'* make and break the circuit between the two insulated halves of the shell, thus giving liquid contacts at both terminals of the make and break device.

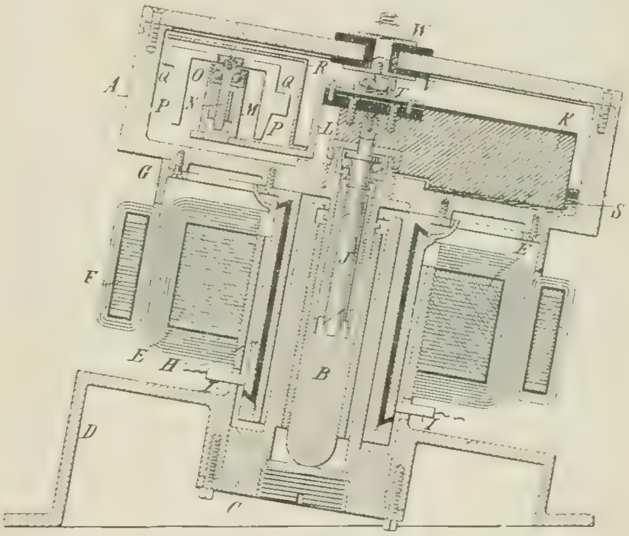


Fig. 8.

Another interesting variation of the inclined axis arrangement shown in Fig. 5, giving mercury terminals in another way, is shown in Fig. 8, the essential features of which are a rotating shell, *A*, eccentric weight, *J*, carrying a tube, *P*, with scoop and nozzle and an unbroken solid metal terminal, *M*, with which the mercury makes contact. Rotating with the shell is a crown of downwardly projecting teeth, *O O*, these teeth being in this instance insulators preferably non-organic and vitreous. These insulating teeth cut off the stream of mercury intermittently, giving a rapid make and break with mercury terminals.

A further modification by which higher frequency is obtained is shown in Fig. 9, the frequency being doubled by means of rotating both terminals of the make and break device in opposite directions. This is effected by means of one rotary field generated by the primary, *H*, actuating the rotatable secondary, *G*, which carries on spindle, *C*, the gas-tight shell, *D*, through the upper part or cap of which, *F*, still another rotary field acts upon the secondary wound upon *Q*, which in turn is rotatable on spindle, *P*, and carries by means of arms, *T*, the mercury scoops and jets, *V*. These move in one direction while the teeth, *L L*, rotate with the case, *D*, in the opposite direction, thus giving double the frequency obtainable with the same angular velocity and one member stationary.

A most curious modification is shown in Fig. 10, in which the winding of the secondary of one of the elements, instead of being a copper short-circuited squirrel cage, as in the induction motors described above, consists of the mercury itself, this being arranged in two rings, *B B'*, forming the two terminals. A powerful rotating field, generating Foucault currents in these rings, will rotate them with a high velocity, the field completing itself through the stationary core, *E'*. Above is another rotary field actuating the secondary, *N'*, which carries the star wheels, *L' L''*, whose teeth dip into the mercury rings below. The element carrying these wheels is supposed to rotate in the opposite direction from the rings of mercury, giving the star wheels a high peripheral velocity and a correspondingly high frequency of make and break.

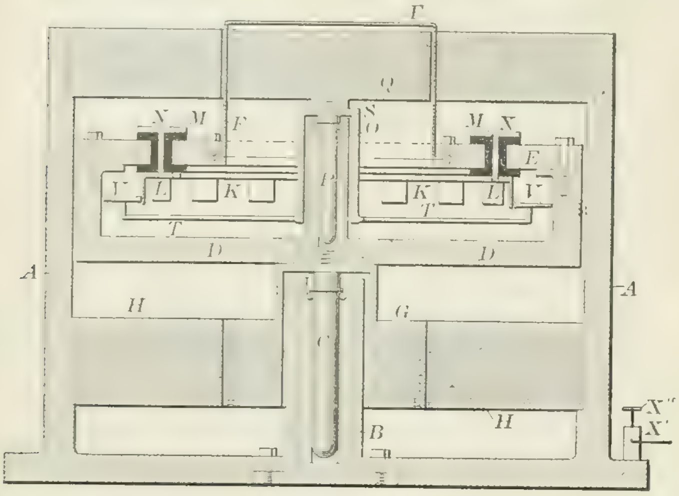


FIG. 9.

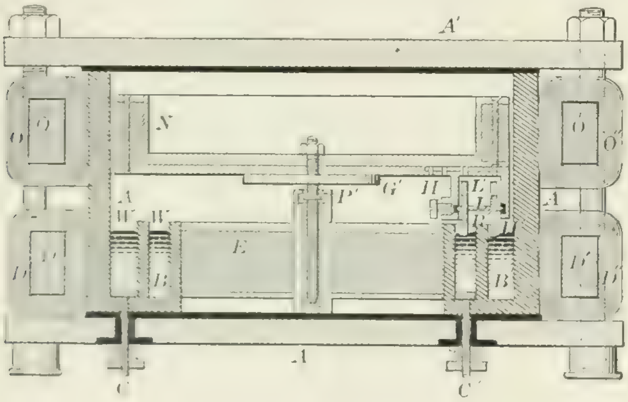


FIG. 10.

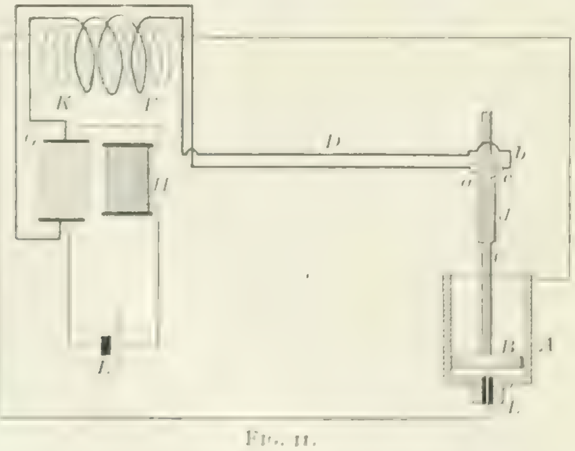


FIG. 11.

Another patent issued [illegible] with those described above and by the same inventor covers an improvement in electrical igniters for gas engines, as shown in Fig. 11, the principle being the use of an oscillatory discharge in the cylinder of the engine, the primary circuit being [illegible] at the proper instant from a contact actuated by the motion of the engine parts.

In the figure, *T* is the source of current, *D* an inductive coil, *C* a condenser and *K* the transformer, [illegible] [illegible] the contact for short-circuiting the primary and condenser at the proper time, thus causing a discharge from the secondary between the terminal, *L*, and the piston, *B*.

Remarkably broad claims on these various mechanical combinations have been obtained, the most important being briefly as follows: a rotating receptacle and independently mounted terminal, making contact with the fluid therein; a jet making contact with spaced conductors in combination with self-contained means for maintaining a circulation of the fluids (the use of a jet contact being well known in the art was not broadly patentable); an interrupter surrounded in a closed receptacle by an inert insulating medium under pressure; the use of jets for both terminals and the use of a jet intercepted intermittently by insulating solids.

The Introduction of Hard-Drawn Copper Wire.

The Committee on Science and the Arts of the Franklin Institute has awarded a medal of merit to Mr. Thomas B. Doolittle, of Branford, Conn., for his efforts in advancing the use of hard-drawn copper wire.

The report refers to the fact that Mr. Doolittle, in the year 1877, suggested the use of hard-drawn copper wire for telephone and telegraph uses, and in the same year, at the works of the Ansonia Brass & Copper Company, Ansonia, Conn., succeeded, after many experiments, in producing about 500 pounds of this material, which was employed on a telephone line connecting these works.

The method, which is now well known, consists in using drawing-plates containing a larger number of holes than the ordinary plates used in copper wire drawing, and increasing the number of passes for a given reduction of area. By this means it is possible to draw copper wire from the beginning to the end of the operation without any annealing, and at the same time to avoid the crystallizing of the metal. The wire thus produced is sufficiently flexible to permit of the formation of standard telegraph wire joints without breaking or cracking.

The hard-drawn copper wire made by the Doolittle method has its tensile strength doubled and its elongation reduced to about 1 per cent., while its electrical conductivity is not materially impaired.

The report dwells upon the great utility of such hard-drawn copper wire for aerial conductors on account of its high conductivity and great tensile strength and reliability in prolonged service, which were amply demonstrated by Mr. Doolittle in his efforts to secure its adoption by the electric line builders; and it was due entirely to his persistent endeavors that hard-drawn copper wire was at length adopted for telegraph and long-distance telephone purposes.

Hard-drawn copper wire has now become a staple article of manufacture, not less than 80,000,000 pounds having been produced in the United States alone in 1896. It is now frequently employed for all kinds of electric conductors, and especially for long-distance telephone lines, the successful operation of which, the committee of investigation admits, is in large measure due to its introduction.

The report concludes that Mr. Doolittle is entitled to recognition:

(1) For having been the first to recognize the value of hard-drawn copper wire; and for having, by his persistent endeavors, in the face of adverse conditions, succeeded in establishing its use for electric conducting wires; and

(2) For his long-continued experiments and labor in overcoming the many difficulties encountered in producing, on the commercial scale, a hard-drawn copper wire suitable for electric conducting wires.

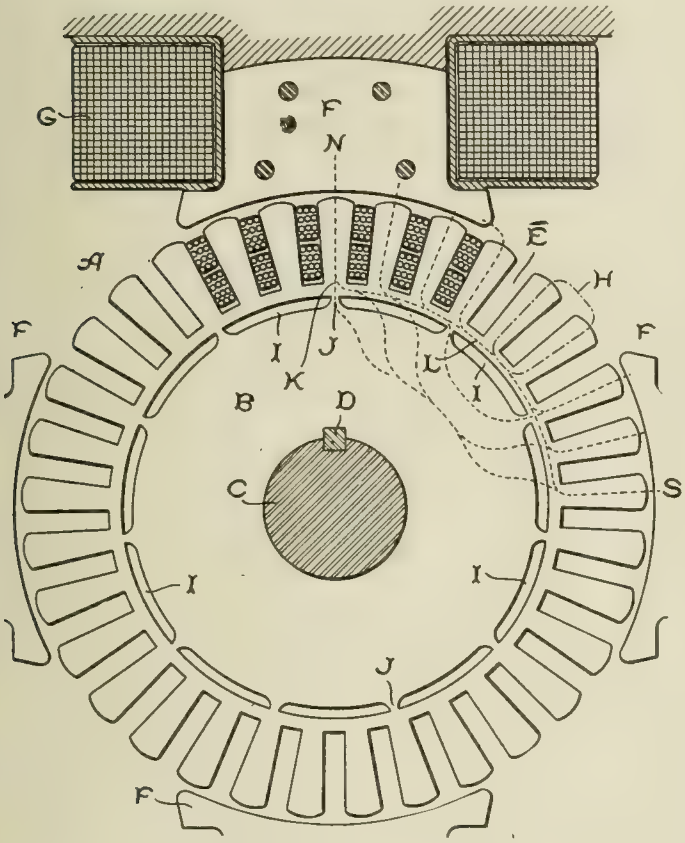
An Acceleration Indicator.

In a paper read before the Engineers' Club, of Philadelphia, Mr. Wilfred Lewis describes an indicator for measuring the horizontal effort applied to traveling cranes, the purpose of the measurement being a determination of the necessary lateral strength of the runway. The instrument, when calibrated, makes a most simple device for measuring the acceleration or retardation of cars or trains. It consists of a tube somewhat similar to a spirit level, but curved somewhat more than the instrument, the curve being greater for the measurement of higher accelerations. Properly calibrated it can be made direct-reading whenever placed in a horizontal position and can be properly corrected for grades if their inclination is known. With an increasing study of the train motion problem a simple indicator of this kind will probably prove to be a valuable instrument.

The Reduction of the Self-Induction of Armature Coils.

Patent No. 608,277, issued to E. H. Anderson and D. P. Thomson, of the General Electric Company, on August 2, 1898, describes an ingenious method of reducing the self-induction of armature coils and hence the tendency to spark at the brushes.

By the construction claimed in this patent and shown in the accompanying illustration it is proposed to increase the reluctance of the local magnetic circuit in the teeth and around the slots without proportionately increasing the reluctance of the main magnetic circuit through the armature and fields. This is accomplished by providing air gaps, *I I*, in the laminated armature core separated only by bridges, *J J*, for mechanical strength. The effect of these air gaps is to cause the main flux entering the armature teeth from any pole, as *N*, to divide between two paths to the teeth under pole *S*, one path being between the bottoms of the slots and these gaps, *I I*, and the other across the latter gaps and through the main body of the core *B*. The latter path, in which the lines of force are compelled to crowd into the junctions, *J*, or cross two air gaps, *I I*, is of comparatively high reluctance, crowding the alternative path, *L*, between the slots and the gaps, *I I*, which is of comparatively small cross section, to a high magnetic density. On account also of the large cross section in the core plate between the shaft and the auxiliary gaps, *I I*, the density in this part is comparatively low.



An Air-Gap Armature Core.

By this arrangement the path of the local lines of force, such as *H*, up one tooth across to the next tooth, down the latter and completing itself under the bottom of the slot, is already crowded, or saturated at the latter point with the lines of force from the main field, and its cross section at that point is also considerably reduced, for both of which reasons the magneto motive force tending to set up the local self-inductive flux around the armature coil has a comparatively small effect.

A similar principle has been used hitherto, especially in railway motor work, by reducing the radial depth of the armature core from the slots to its inside face, and thereby running up the density of the magnetic flux in this portion and reducing the self-inductive effect of the teeth by crowding out, so to speak, the local lines of force tending to complete themselves around the slots. This requires, however, the working of all the iron in the armature core at a high density and increases considerably the iron losses. By the improved construction proposed in this patent, only the narrow rim of the core immediately under the slots is run at a high density, the main body being worked at a comparatively low density.

The specification of the patent describes a comparative test of two armatures, one provided with a narrow core and the other with the improvement described in the patent, which is aptly termed "an air gap core," both armatures being of the same size and similarly wound. The tests showed that the core loss of the former amounted to 2350 watts and that of the improved core amounted to 1550 watts, the maximum efficiency of the air gap core motor being 2 per cent. greater than that of the other.

A New Use for Electric Heat.

The boring of the tunnel for the Jungfrau railroad, in Switzerland, has been progressing steadily in spite of the severe climate of the high Alps in winter, and as electricity is used not only for light and motive power, but for heating as well, where this is necessary, some new developments in the heating line have been worked out with great success. One of them is the warming of high explosives.

On this work blasting gelatine is used, an explosive which freezes at about 40° Fahr., and which is, in its frozen condition, very dangerous to handle, being unlike dynamite in this respect. The contractors who are blasting out the Jungfrau tunnel keep their explosive in a sort of safe heated by electricity so that the danger of the gelatine freezing is entirely obviated.

Dynamite or some other derivative of nitroglycerine is in very common use for blasting and other purposes, and is commonly frozen for safety, as this explosive is very inert at low temperatures. It is usual to thaw it out before it is used, and scarcely a week passes that the newspapers do not chronicle an accident from carelessness in the use of heat for this purpose. A dynamite thawer operated by electricity would be safe and perfectly regulable, as well as very convenient in use, and some manufacturer of electric heaters might find it worth while to investigate the needs of those using the explosive.

Society for the Promotion of Engineering Education.

The sixth annual meeting of this society was held in Boston, August 18, 19 and 20, in connection with the Convention of the American Association for the Advancement of Science. The following papers of interest were read:

President's Address, by John B. Johnson; The Mutual Adjustment of Class-room and Laboratory Instruction, by Gaetano Lanza; The Mounting of a Spherical Blackboard, by A. E. Haynes; Notes on the Organization of an Engineering Laboratory, by H. B. Smith; The Correct Theory and Method of Organization and Conduct of Professional Schools, by R. H. Thurston; Report of the Committee on Entrance Requirements, by H. W. Tyler, chairman; Some Phases of Engineering Education in the South, by J. J. Wilmore; Report of the Committee on Uniformity of Symbols, by T. C. Mendenhall, chairman; The Study of Electricity in Courses Other than Electrical, by J. P. Jackson; A Course in Industrial Chemistry for Technical Schools, by F. L. Dunlap; A New Laboratory Apparatus for Illustrating Longitudinal Impact, by W. K. Hatt; The Direct Study of Thermodynamics, by S. A. Reeve; Laboratory Instruction in Electrical Engineering, by R. B. Owens; A Course in Highway Engineering for Civil Engineers, by W. R. Hoag; Notes on some Methods in Use in an Engineering Laboratory, by F. C. Caldwell; Sanitary Science as a Part of Every Science Course, by W. T. Sedgwick; The Conduct of Thesis Work, by Edgar Marburg; The Construction of Models by Students as an Aid in Teaching Descriptive Geometry, by H. S. Jacoby; The Training of Engineers for the Maintenance of Way Department on Railroads, by J. C. Nagle.

A Benevolent Fund for Electrical Engineers.

The Institution of Electrical Engineers of England has established a benevolent fund for the benefit of needy members and their families, or the families of deceased members, the amount so far collected having been about $5000. The donations and subscriptions are to be considered as capital until the sum of $50,000 has been invested, the interest of which will be distributed as mentioned, the names of recipients being kept secret.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE
AMERICAN AND FOREIGN
By Carl Hering

Dynamos, Motors and Transformers.

ELECTRIC GENERATORS. Parshall and Hobart. Lond. "Engineering," July 29.—A continuation of their long serial. The leakage coefficient is discussed; this coefficient is the number by which the flux which reaches the armature and becomes linked with the armature turns must be multiplied in order to give the total flux generated by the field coils; it is in most cases considerably greater than unity, and should increase with the load. Six diagrams give the values of these coefficients as determined from actual measurements in a number of different types of machines, some with and some without current in the armature; they give the coefficients in different parts of the frames. The armature core reluctance is generally fixed by thermal conditions, depending on the density and the periodicity, the reluctance being chosen as high as is consistent with the permissible core loss. The air gap reluctance is briefly discussed; it is determined by the space required by the armature conductors and the necessary mechanical clearance; it is frequently asserted that the sparking limit is a function of the depth of the air gap, and this is true in so far as this depth affects the inductance of the coils under commutation, but experiments show that the inductance of the armature coils in many cases is appreciably diminished by increasing the depth of the air gap, and the latter, therefore, has no relation in these cases to the magnetic sparking output; all the conditions which they mention may be included broadly by saying that for a given output there is a certain minimum reluctance in the air gap having regard both to the distortion and self-induction; sparkless commutation should be considered not only in its relation to the inductance of the armature coils and the strength of the reversing field, but also with respect to the nature of the collecting brushes; generally speaking, visible sparking external to the brushes is least injurious to the commutator. The gap reluctance is next discussed; the magnetomotive force expressed in ampere turns, expended in maintaining a flux of *D* lines per square inch across an air gap of length *L* in inches, is equal to 0.313 *D L*; the proof of this is given. The reluctance of the core projections is then discussed, and the importance of the magnetic forces required for a given flux across this part of the magnetic circuit is pointed out; a method of calculating it is described, but cannot be reproduced here; auxiliary tables and curves are given; in practice the width of the tooth is generally from 50 to 80 per cent. of the width of the slot; 25 per cent. of the length of the armature is frequently taken up by the insulation and ventilating ducts; although the iron path through the teeth has a higher permeability the air path has sufficiently greater cross-section that it takes a considerable portion of the flux; the magnetomotive force required may be greatly less than that for sending the entire flux through the projection.

MAGNETIC LEAKAGE IN DYNAMOS. Sumec. "Elek. Zeit.," July 28.—A short analytical discussion. If the magnetic leakage with two opposing magnetomotive forces is treated analogously to a case of electric currents, then the Kirchhoff laws give the same results as the well-known Blondel-Heyland diagrams. He applies this to the case of the induction motor in which the leakage is of more importance than in any other apparatus. He also shows a polar diagram, which represents the equations which he deduces; [illegible]

DYNAMOS. Guilbert. "L'Eclairage Elec.," July 30.—Illustrated descriptions of recent improvements taken from patent specifications.

Lights and Lighting.

[illegible] ALLOY FOR LEADING IN WIRES.—[illegible] that of [illegible] [illegible] carefully tested by the [illegible] completely substantiated.

[illegible]

Power.

[illegible]

[illegible]

Traction.

ELECTRIC TRACTION IN SWITZERLAND.—"L'Eclairage Elec.," July 23.—A full-page table of statistics with a short descriptive text. In 1897 the total length of electric railways was 110.5 km (about 66 miles); on 14.2 per cent. in length steam power was used, on 64.5 per cent. water power and on 21.3 per cent. gas power; all the lines, without exception, are operated by the trolley system. There are 12 lines under construction, representing a total length of 103 km, and twenty-five lines, representing 323 km, have been projected. The number of km of line per unit of population is probably the greatest of that on the continent.

ACCUMULATOR TRACTION IN PARIS. Drouin. "L'Eclairage Elec.," July 30.—An abstract of a paper read before the French Society of Civil Engineers on the rapid-charging system used in Paris; the abstract is very brief, and gives but little information. The total weight of a car is 14 tons, of which 3600 kg is the weight of the accumulators. He refers to experiments made to determine the traction resistance; the car was started on a level or known grade and the current then cut off; by means of a contact on the axle the distance run over was recorded on a chronograph cylinder, as a function of the time, and from this the traction resistance was then calculated. It was found that this resistance, including the revolving of the motor unloaded, between the values of 5 and 25 km, is given by the formula that the traction resistance in kg per ton is equal to 3 plus the product of the speed in km per hour, times 0.16.

MIDDLESBROUGH.—Lond. "Elec.," July 29.—An illustrated description of the electric road from this town to Stockton and Thornaby. See THE ELECTRICAL WORLD, August 6, 1898.

BRADFORD.—Lond. "Elec. Rev.," July 29.—An illustrated description of this municipal tramway, which has just been started.

AUXILIARY ELECTRIC LOCOMOTIVE.—"Elek. Anz.," July 28.—A note stating that, according to "Génie Civil," the Northern Railway of France is considering the construction of a locomotive which is to be attached to the trains drawn by steam locomotives; it contains a battery of accumulators and a motor; when the train is running down hill the motors are made to charge the accumulators, and the energy stored in them is then to be used to assist the train up hill.

TRACTION MACHINERY. Chenet. "L'Ind. Elec.," July 25.—Illustrated descriptions and results of tests made with the motors and controllers of the Steel Motor Company, which are said to be used largely in America; these are claimed to be the first tests of these motors made in that country.

CAST-WELDED RAIL JOINTS.—Lond. "Elec.," "Elec. Eng.," "Elec. Rev.," July 29, and Lond. "Lightning," July 28.—An illustrated description of this (American) method as applied to an English railway.

CONTROLLER.—Lond. "Elec. Rev.," July 29.—An illustrated description of an improved controller intended to be used on electric vehicles, including also motor cars. The handle is like that of a spade, and it is operated by twisting it; the advantages claimed are simplicity, ease and quickness of breaking the circuit, and reliability of contact. It is thought to be often necessary to start at a quick speed, and this can be done with this controller, in which the circuit is broken by merely depressing the handle or completed by raising it, both without interfering with the speed combination. It has no drum, all the contacts being on a slab perpendicular to the shaft. It is known as the Elieson-Naylor controller.

AUTOMOBILES. Reyval. "L'Eclairage Elec.," July 23 and 30.—Illustrated description of the Milde Mondos carriage and delivery wagon, and of the Patin carriage, all of which were exhibited at the recent exhibition in Paris.

CHARGING STATION FOR AUTOMOBILES.—"Elec. Eng.," August 11.—A brief, illustrated description of one of the charging stations in Paris, showing also the light, portable, switchboard with its meters, rheostats, signals and connections; it appears that the batteries are charged on the carriages, while in this country they are replaced by fresh ones.

AUTOMOBILES. "Elec. Eng.," August 4.—An abstract, with a number of illustrations, of the article noticed in the "Digest" August 6.

Installations, Systems and Appliances.

STANDARDIZING ELECTRIC PLANTS.—Lond. "Elec. Rev.," July 29.—An editorial criticism of the recent report to the [illegible] by its committee; the comments are very [illegible]. No reason is seen why bearing friction should have been [illegible] as difficult to measure [illegible] other losses; it had better have been combined with other losses. It is not stated how the brush friction and contact losses should be measured; it is not clear why the loss in the regulating rheostat should not be included in separately excited machines as it is in the self-excited; the whole energy required to drive the exciter should be debited to the separately excited machine. It is thought preferable to determine the efficiency under load by driving the machine as a motor, the efficiency of which has already been determined. The position of the thermometer in the room will greatly affect the temperature measurements. The duration test for determining the dielectric strength is thought to be too short, as there are cases where some apparatus stood the high pressure test for more than five minutes, but broke down in fifteen; a half hour is suggested instead of five minutes, and it is thought that 1.5 times the working pressure for half an hour instead of two or three times that pressure for five minutes, would be better. In the Board of Trade Rules the draught rules, after discussion, were changed so as to reduce the test voltage to 1.5 times, in place of twice, the working voltage. It is thought a pity that the standard voltages for alternating-current systems should not have been the same as those for continuous currents; also that the higher ones are not multiples of the lower.

DISTRIBUTION OF ELECTRICITY IN EUROPE. Lauriol. "L'Eclairage Elec.," July 30.—A very long abstract (fourteen pages) of his report to the municipality of Paris on his examination of the electric lighting systems of the principal cities of Europe, to aid in the adoption of a scheme for Paris; a list of the cities visited is given, together with references to the numbers in that journal, in which descriptions of the respective plants have been published. In the last part is a similar, although much more brief, report on street railways.

OFFICE-BUILDING PLANT.—"West. Elec.," Aug. 6.—An illustrated description of the light and power plant in the Land, Title and Trust Building, the tallest office building in Philadelphia. The Arnold quill-drive system is used to enable either engine to run either one or both dynamos; there is also a storage battery plant, which is so connected that the charging circuit is independent of the discharging one. See The Electrical World July 9, 1898.

BOSTON.—"Elec. Rev.," August 10.—A reprint of the annual report of the Boston Electric Light Company.

Wires, Wiring and Conduits.

RULES AND REGULATIONS.—"Elek. Zeit.," July 28.—A reprint of the adopted German rules and regulations for high-tension insulators in which the voltage between any two wires is 1000 or over. It concludes with a table of simple diagrams to be used as conventional signs in drawings; these are all remarkably simple and easily drawn.

Electro-Physics and Magnetism.

COHERER. Arons. "Wied. Ann.," No. 7; abstracted briefly in the Lond. "Elec.," July 29.—He studied the occurrence in coherers under the microscope in order to find what change takes place when it responds to an electric wave. On exposure to waves a full contact was as a rule immediately produced; violent commotions and a play of sparks were observed; there was a destruction of contacts by a repetition of the vibrations which produce them; in all cases the coherers showed signs of wear after repeated use, especially those of the embedded type.

MOTION OF THE ETHER. Wien. "Wied. Ann.," No. 7; abstracted briefly in the Lond. "Elec.," July 29.—A valuable review of the present state of the ether problem, with special reference to the question of whether it is movable or not.

FLAME GASES; HIGH CHIMNEYS. Wesendonck. "Wied. Ann.," No. 7; abstracted briefly in the Lond. "Elec.," July 29.—High factory chimneys are relatively less subject to damage by lightning; he made some observations in which he reproduced as closely as possible the conditions in question, in order to find whether this is due to the hot gases. It is concluded to be nearly certain that flame gases are not the causes of the immunity of chimneys, though they may be an indirect cause by producing an ascending current of air.

WAVES IN METALLIC INCLOSURES. Branley. "L'Eclairage Elec.," July 23.—A reprint of an Academy paper in which he shows that a metallic envelope does not allow Hertzian oscillations to traverse it; the passage of such oscillations is very much easier through long openings, even very fine, than through bored holes; the length and direction of the opening takes an important part.

LAW OF INDUCTION. Breslauer. "Elek. Zeit.," July 28.—A reprint of a paper read before the German Union of Electrical Engineers. There are two well-known laws concerning the induction of a current in a wire, one being based on the cutting of lines of force and the other on increasing or diminishing the number of lines inclosed by a loop; while in practice either may generally be used, there are, he claims, important limits of each, and in these cases only the other law can be used; moreover, under certain circumstances one of them is claimed to lead to very incorrect results; one of them fails in the case of unipolar machines, and the other in the case of transformers, there being no loop in the former, while in the latter no lines of force are cut. With the aid of simple mathematical relations he then deduces a single law which he claims includes both of the others; the area inclosed by the wire should not be the whole area of the loop, but only that part which is traversed by the lines of force; he offers the following law: An electromotive force is produced when the number of lines of force increases or diminishes in the area described by the wire, whether by its motion or by its form; this, he claims, covers all the cases. He shows a case in which he claims one of the original laws leads to quite incorrect results, the case being that of a single loop on a drum armature in which a direct current would be produced by a uniform motion, if the field were suddenly reversed while the wire was in its neutral position. (As was explained some years ago by the compiler, the unipolar machine may be explained by the theory of the inclosed lines of force, by assuming that the sliding brush contacts are the equivalents of an elastic wire capable of being indefinitely stretched or of wires which are being wound up on the shaft. The case of the transformer can be explained by the assumption that the lines of force move outward from the wire which produces them, when they are formed, and moved in the reverse direction, vanishing in the wire which produced them, when the current becomes zero.)

ELECTRIC RESISTANCE OF STEELS. Chatelier. "L'Ind. Elec.," July 25.—A reprint of the Academy note noticed in the "Digest" July 23.

ARC BETWEEN ALUMINUM ELECTRODES. Lang. "Wied. Ann.," December; abstracted briefly in "L'Eclairage Elec.," July 30.—He determined the counter E. M. F. of the arc between aluminum electrodes.

X-RAYS. Smith. Lond. "Elec. Eng.," July 29.—A short article in which he claims that there is some connection between the materials used for the anodes and cathodes, and the material which is to be examined by means of the X-rays. Every element or combination gives a certain definite ray or tint; whatever this tint or ray when heated in the Bunsen burner, it will be the same when given off in the X-ray tube; the vapor ray given from flesh is yellow-green, and the yellow-green ray from the platinum must therefore pass through the flesh, but not the bone; if the ray should penetrate the bone the anodes and cathodes should be made of a compressed phosphate of lime or a clean piece of bone; if it is desired to see through steel the electrodes should be steel, brass for brass, etc. (It appears to be merely a suggestion, as no proofs are given.)

DARK CATHODE SPACE. Wehnelt. "Wied. Ann.," No. 7; abstracted briefly in Lond. "Elec.," July 29.—He investigated the nature of the discharge in the dark cathode space, by means of a coherer. The results go to prove that the discharge through the dark space has a disruptive character, just as though this space was a dielectric like paraffin oil.

DISCHARGE BY X-RAYS. Sagnac. "L'Eclairage Elec.," July 23.—An Academy note on the mechanism of the discharge by X-rays.

ATMOSPHERIC DISCHARGES. Montel. "L'Eclairage Elec.," July 30.—When lightning strikes near a closed circuit the latter becomes the seat of a temporary current, representing a certain amount of power; in the present article, which is of a theoretical and highly mathematical character, he discusses the power developed in that closed circuit; this is based on the known laws of discharge of condensers. He concludes that if in the case of an atmospheric discharge it is possible to measure two integral values of the square of the current by the differential of the time induced in each of two circuits, in one of which the ratio of the resistance to the coefficient of self-induction is very small, while in the other it is very large, it becomes possible to find out, by comparison of these two integrals, the nature of the atmospheric discharge.

EARTH CURRENTS.—"Zeit. fuer Elek.," July 31.—A short article of a general character. Extended researches were made by the Sodankyla polar expedition; the results arrived at were similar to those made by Wild—namely, that the earth currents at short distances of 1 km are not continuous currents of variable intensities, but change their directions; the component in the east-west direction is in general larger than in the north-south direction. It cannot be stated whether the earth current is the cause of the earth's magnetism even though there may be a connection between the two; Lemstroem supposes that the earth is like the iron core inside of a coil through which a current flows, and in this way explains the observations. There are, however, variations in the earth currents which do not coincide with those of the earth's magnetism, and vice versa; the magnetic variations which do not correspond to those of earth currents may be caused either by earth currents in other parts of the earth or by atmospheric currents.

MAGNETIC VISCOSITY. Klemencic. "Wied. Ann.," 63, p. 61; abstracted briefly in "L'Eclairage Elec.," July 23.—Descriptions of his researches made with intense fields, former observations having been made only with rather weak fields. The viscosity depends on the magnitude of the variation of the field and follows the same law, whether this variation is due to the reversing of the current or to the opening or closing of the circuit; its absolute value increases with the intensity of magnetization, and tends toward a maximum, which is reached probably before the maximum of magnetization.

ELECTRIC AND MAGNETIC WIND. Lehman; Arrhenius; Warburg. "L'Eclairage Elec.," July 23.—Very long, illustrated abstracts of three articles from the "Wied. Ann.," 63, p. 285, 305 and 411, respectively; some of these have already been referred to in the "Digest."

MAGNETIC PROPERTIES OF STEELS. Mme. Curie. "L'Eclairage Elec.," July 23; abstracted, with curves and tables, from the "Bull. Soc. d'Encouragement p. L'Ind. Nat.," 3, p. 58.—

She studied the magnetic properties of tempered steels in the form of rings; the hysteresis curves and the data are reproduced in the abstract for five different kinds of steel. She found the agreement was not as good as in the case of bars, and therefore gives a preference to investigations made with the latter. The intensity of remanent magnetization increases at first with the percentage of carbon and reaches a maximum for 0.5 per cent., after which it decreases; the hysteresis increases with the percentage of carbon; the addition of various other metals changes the intensity of remanent magnetism of these rings only slightly; it increases the coercive field and the hysteresis and diminishes the maximum induced magnetization.

. DISCHARGES IN MAGNETIC FIELDS. Paalzow and Neesen. "Wied. Ann.," December; abstracted in "L'Eclairage Elec.," July 23.—Descriptions of researches made to study the influence of the magnetic field on the intensity of the discharge in rarefied gases.

INFLUENCE OF SHOCKS ON MAGNETIC SUSCEPTIBILITY. Fromme. "Wied. Ann.," 63, p. 314; abstracted in "L'Eclairage Elec.," July 23.—He studied the effects of electric oscillations and mechanical shocks on the magnetic susceptibility.

MAGNETIC SCREENS. Du Bois. "Wied. Ann.," 63, p. 348; abstracted in "L'Eclairage Elec.," July 23.—He calculates the effect of spherical or double cylindrical envelopes such as are used for the protection of galvanometers.

ZEEMAN PHENOMENON. Righi. "Rend. Accad. Lincei.," June 11; reprinted in "L'Eclairage Elec.," July 23.—A kinematic interpretation of this phenomenon.

CATHODE JETS. Phillips. "El'ty," August 10.—A reprint of the article noticed in the "Digest" last week.

Electro-Chemistry and Batteries.

OZONE. Kershaw. Lond. "Elec. Rev.," July 29.—A short article in which he gives brief descriptions of the different forms of ozonizers now before the public, and examines the financial aspects of the use of ozone for various purposes. Andreoli's ozonizer is of the open type, the air being in direct contact with the metallic electrodes, which are made of aluminum (this has recently been referred to in the "Digest"); they work from the secondary of a transformer the current in which is 0.13 ampere at 2800 volts; it is said to yield 125 grams of ozone per kw hour; no cooling is required, but the air must be perfectly dry and free from dust. The Otto apparatus is composed of a thin sheet of metal laid on a sheet of glass or fixed between two glass plates; in the oblong form the air enters at one end and travels in a zig-zag manner between the electrodes; in the circular form it enters at the centre and passes away at the circumference (an illustrated description of his apparatus is published in the "Zeit. f. Elektrochemie," July 28); his chief discovery is said to be the fact that the output of ozone is proportional to the frequency of the current; it is also stated that the output per electrical hp-hour is a maximum for a frequency of 80; he then obtains 155 grains of ozone per electrical hp-hour. The Yarnold apparatus consists of a flat-shaped box containing horizontal glass plates coated with gold leaf on one side, the films being connected alternately to the two poles of a transformer; the air does not come in contact with the films; the voltage is 15,000, and the frequency 83; no cooling is required; the yield is claimed to be 175 grams per electrical hp-hour. The Siemens and Halske apparatus consists of a number of concentric tubes, one of metal and the other of glass, coated on the opposite side with tinfoil; water is led through the inner tube to keep down the temperature, and the air is passed between the inner metal and the outer glass tube; the output is 20 grams per electrical hp-hour; it has been in use since 1894. He then discusses the applications of ozone; in some of these, however, other oxidizing agents are applicable, and ozone then comes in competition with these; he discusses the bleaching action of bleaching powder, sodium manganate and sodium bichromate, which are the three most commonly employed; with ozone, generally only one-third of the oxygen takes part in the reaction. In a table he gives in condensed form the figures on the amount of ozone and the cost of 1 kg, the latter is 17.12 cents for the Yarnold, 19.98 for the Otto, 31.80 for the Andreoli system; the cost per kg of active oxygen is just three times this; the cost of electrical energy has been taken as 3 cents per electrical hp-hour. In another table he compares these figures with those for bleaching by other chemical methods, showing that bleaching powder is cheapest, then sodium bichromate, then ozone; wherever bleaching powder is satisfactory it is absurd to use ozone, and the latter will be restricted to those operations for which the two sodium salts or atmospheric air are the customary agents. With regard to cost, ozone occupies a fairly favorable position, while its [illegible] and the [illegible] production of solid or liquid by [illegible] there is every reason to expect [illegible] that the use [illegible] manufacture of oils, fat and [illegible] chemicals will rapidly extend. The advantages of ozone [illegible] in cases where the oxygen of the atmosphere [illegible] the only [illegible] in a decrease in the [illegible] proved to be too active and its use [illegible] is therefore less certain.

ALUMINUM ELECTRODES. [illegible] Lond. "Elec. Eng.," [illegible]—The [illegible] of the [illegible] paper [illegible] "Digest" [illegible]. The description of the experiments with alternating currents is continued and the curves of the currents are given; Graetz's paper (described in the "Digest" some time ago) is briefly referred to, and the current curves in the circuit where a direct current is produced are given; these resemble a distorted alternating current curve, almost all of which lies above the zero axis. An important point in connection with these cells is the wearing away of the aluminum; thin plates become perforated with small holes; the evaporation of the electrolyte also needs consideration. He then describes experiments undertaken to find what effect this metal, with its film, has as a condenser, with varying frequency, temperature, and current; two plates were used in a saturated alum solution; he finds that such plates are suited for condensers. Other experiments were made with soda, ammonia and potash alums, and the results are given in a table; with a low frequency of 7.5 the results are not as good as with a high frequency of 92.4; non-saturated solutions show a better result with regard to efficiency at the higher frequency. His general conclusions are that the effect investigated in his paper takes time to develop and is not fully developed with alternating current frequencies of 16 and 98; it can be increased by increasing the current density for a given film, and it is greatly influenced by temperature; the metal with its film is suitable for condenser plates if due regard is given to current density and temperature; it might in some cases be found useful as an equivalent for a metallic resistance.

AMMONIUM AMALGAM. Pocklington. Lond. "Elec.," July 29.—If a strong solution of ammonium chloride is electrolyzed with a mercury cathode a pasty substance is produced, which is either ammonium amalgam or a mere froth of mercury with hydrogen and ammonium gases. He describes experiments undertaken to settle this question, and he did so by constructing a Daniell cell in which the zinc was replaced by this substance; the experiments and results are described and he comes to the conclusion that this material is at the moment of its formation a true amalgam of the radicle ammonium in its free state; but it rapidly dissociates into mercury, hydrogen and ammonia gases, which latter caused the mercury to froth.

ALUMINUM MANUFACTURE. Ristori. Lond. "Engineering" and "Elec. Eng.," July 29.—A reprint of a recent paper on its manufacture and properties, and a description of the rolling mills and foundry at Milton. The former journal publishes also the illustrations and the discussion. A reprint without the illustrations is begun in "El'ty," N. Y., August 10.

CALCIUM CARBIDE WORKS.—Lond. "Elec.," July 29.—A note from the London "Engineer." There are now twenty-two works in Europe and America, producing carbide in large and small quantities, and four others under construction; the production in America was 1925 tons in 1897, valued at $140,000; there are no figures available concerning the products from the European works. The output per electrical hp-day of twenty-four hours is reported to be 9.12 kg; most of that on the market contains about 80 per cent. of the carbide.

SULPHATING OF NEGATIVE ACCUMULATOR PLATES. Jumau. "L'Eclairage Elec.," July 23.—A discussion, with the results of numerous experiments, concerning the objectionable sulphating due to local action on the negative plates. This local action is shown by the evolution of hydrogen, and is due to two causes, the chemical action of spongy lead and sulphuric acid, and the electrochemical action of the couple formed by the lead and the alloy of the grid; the former action increases with the concentration of the acid, and is very rapid at a density above 1.45; the E. M. F. between the lead and the grid at a density of 1.27 varied from 0.49 to 0.54 volts, according as the grid is made of soft lead or antimony lead; the spongy lead is electropositive and the sulphating therefore means a loss of the charge of that plate. To determine the extent of this action he made some tests, the results of which are given; the plate was formed of pastilles originally obtained from chloride of lead, and these were analyzed after various periods of rest, and at two different densities of solution; the results are also given in curves; they show clearly the great effect of the density of the acid on this local action; also that densities not exceeding 1.32 can still be used, provided the cell does not remain inactive too long. Sometimes the sulphating is much greater and it is then due to particles of peroxide detached from the positive plate or to copper, antimony or iron, even though the antimony is only very slightly soluble in the acid; researches were made with antimony as the impurity and the results are given in tables and curves, showing its enormous influence in this local action for high densities of about 1.31; the action of iron is less energetic at first, but after longer periods of rest it becomes more active; the antimony is the material which is to be feared most; the tests showed that it is found mostly on or near the surface, 40 per cent. of it being in the outside layer of 0.1 mm; the E. M. F. of lead and antimony in sulphuric acid is about 0.5 volts, the lead being positive. His conclusions are that to avoid this local action the positive plate should be made of soft lead, as pure as possible; when the positive plates are made of a lead antimony grid the local actions are reduced by avoiding as much as possible the peroxidation of the antimony, and by using an electrolyte of low density; to put the negatives in the best condition they ought to be taken out often and have their outer layer rubbed off mechanically, notwithstanding the resulting slight reduction of the capacity.

PRIMARY BATTERY. Lond. "Elec. Eng.," July 29; more briefly in Lond. "Elec. Rev.," July 29.—An article on the Row botham primary battery, which is being promoted by a syndicate in England; the former journal contains a brief report by S. P. Thompson and a longer one by Harrison; in both the editorial articles it is discussed somewhat unfavorably. The electrodes are carbon and iron, the former being in porous tubes through which a strong acid solution is circulated; the iron elements are placed between a series of these tubes and water is kept running through that portion containing the iron plates; there are, therefore, two circulating solutions; the acid is a mixture of sulphuric and nitric acid with water; the cells are mounted on an inclined plane, so the electrolyte passes in turn from one to the other; the gas given off from the cathode exerts a pressure in the air-tight compartment, forcing the solution to penetrate through the pores of the tube in about the same proportion as the energy is taken from the generator, and this is claimed to lower the internal resistance and maintain the voltage constant; the open circuit E. M. F. of a cell is said to be 1.35, and it appears that it remains constant at 1.05, while the battery is giving 100 amperes; Harrison's report contains a description of the cells and tests, according to which the total cost is below 10 cents per kw hour; it is shown editorially, however, that this is simply for the raw materials consumed; a corrected estimate made in the former journal gives the cost as more than three times this. The battery is intended to replace steam-driven dynamos. The former journal also contains an editorial article on this battery.

FULMEN ACCUMULATORS.—Lond. "Elec. Rev.," July 29. —A brief description of the results of Hospitalier's tests of these cells, the original of which was referred to in the "Digest" August 6 (under automobiles); see also June 18 and 25. (They were the cells which were used on the automobiles in the recent Paris tests.)

ELECTROMETALLURGICAL PROCESSES. Tommasi. "Elec. Eng.," August 11.—A description of his electrolytic process for the reduction, separation and refining of metals, which is claimed to be of universal application, and has the following advantages; no polarization, removal of the metal as soon as it is deposited, equal density of the liquid throughout, it being continuously in motion. The electrolyzer is described and illustrated; the application of the process to the desilverization of lead is described, with estimates of the cost. References to other descriptions of his process have already been given in the "Digest."

Units, Measurements and Instruments.

MEASURING THE POWER OF POLYPHASE CURRENTS. Blondel. "L'Ind. Elec.," July 25.—An interesting summary of the various methods suggested at different times by him, the general principles of which were described by him in his Chicago congress paper. The only instrument with which these measurements can be made is the two-coil wattmeter, such as his universal wattmeter, a brief illustrated description of which he gives; it has one movable coil and two fixed coils, one on each side; it is strongly dampened magnetically, and the two fixed coils are conveniently mounted, so that they may be connected in parallel, in series, differentially, or in separate circuits; in the methods described this instrument is used. The formulas concerning the polyphase currents are summarized briefly; the measurement of the total power is then described; it suffices to make two measurements by finding the power consumed in each of the two bridges, which are formed by the three wires, considering the one or the other as the common return; when the power in each circuit is to be measured separately the method depends on whether the star or the triangle system of connections is used; in the case of the former he uses an artificial neutral point by connecting the movable coil to all three through equal resistances. These three circuits being connected to a common point give a mean of the three voltages; the series coils are connected in the circuit to be measured; these connections are similarly made with each of the three circuits, in order to measure the power in each separately; if the centre connection of the system is accessible the artificial neutral point need not be used and the measurement becomes very simple; another method is the so-called fork method, in which the movable coil is connected with one end to the circuit to be measured and with the other to two equal resistances connected with the other two circuits; the movable coil is shunted by another having the same resistance in order to reduce the current to one-half; the power should be multiplied by two-thirds in that case, in order to give the correct reading; for the triangle arrangement the currents in the two conductors are made to pass in opposite directions through the two fixed coils, while the movable coil is connected between them. He then discusses the application to the measurement of power of the whole system; if it is desired only to know the total power it is simplest to use a double wattmeter formed of two ordinary wattmeters mounted on the same axis and giving directly the sum of the two readings; instead of this, two instruments may be used connected as described in one of the above methods; in a three-wire system, if it is desired to know the power on each circuit, it is necessary to have three wattmeters. Laboratory measurements are then discussed; when the circuits are not equally loaded the best method is to use a single apparatus, which is successively switched into each branch or bridge, depending on whether the star or triangle method is used; but there is great liability then to make an error in the connections; to simplify such measurements he describes a resistance box in which three-plug resistances are connected by the star system; also a multiple switch arrangement resembling somewhat a car controller, and having three sets of contact blocks, which are so arranged that the instrument may be switched onto any of the three circuits by the mere turning of a crank. The article is well illustrated with clear diagrams.

GRAPHICAL METHOD FOR MEASURING DIFFERENCE OF PHASE BETWEEN TWO SINE CURRENTS. Rossi. "Nuovo Cimento," December; abstracted in "L'Eclairage Elec.," July 30.—It appears to consist in the use of a polarized chronograph on which are recorded the oscillations, together with those from a tuning fork, the frequency of which is very nearly that of the current to be measured; he shows how the phase difference can then be determined.

MEASURING INSULATION RESISTANCE OF A THREE-WIRE SYSTEM.—Lond. "Elec. Eng.," July 29.—An answer to a request to deduce formulas, accompanied by graphical illustrations, for enabling the insulating resistance of the three respective wires to be determined by connecting each in turn to the earth through an ammeter.

DIFFERENTIAL TELEPHONE FOR MEASURING ELECTROLYTIC RESISTANCES. Federico. "Zeit. f. Elektrochemie," July 31; abstracted briefly from "Nuovo Cimento," 6, p. 161.—The vibrating diaphragm is placed between two opposite electromagnets, which can be adjusted by a micrometer screw; each one is in series with one of the two resistances to be compared; when they are equal there is no sound. The use of such a telephone is said to be surer and takes less time than when the ordinary telephone is used.

MIRROR FOR GALVANOMETERS.—"Elek. Zeit.," July 28. —A brief description of an improved form of mirror for galvanometers and like instruments with which a beam of light is used. To give a true picture of the source on a transparent scale a mirror, which is convex on one side and concave on the other, silvered on the former, is generally used; a cheaper mirror, and one which is more easily made, is one that is plain on one side and convex on the other, being silvered on the latter; if *n* is the index of refraction of the glass, then 2*n* times the focal distance is equal to the radius of curvature of the curved side. A short, analytical discussion is given, with some recommendations regarding scales.

DIRECT MEASUREMENT OF ELECTRICAL QUANTITY. Blondlot. "L'Ind. Elec.," July 25.—A reprint of the Academy paper noticed in the "Digest" August 6.

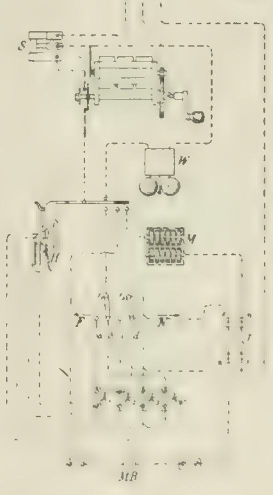
WATTHOUR METER. Lotz. "Elek. Anz.," July 31.—An illustrated description of his universal meter for continuous or alternating currents.

MEASURING APPARATUS. Armagnat. "L'Eclairage Elec.," July 23.—Brief, illustrated descriptions, taken from patent specifications.

CONDENSER FOR INDUCTION COILS. Tulbizuno. "L'Ind. Elec.," July 25.—An abstract, with the curves, of the article noticed in the "Digest" May 28 (where the author's name is Mizuno, which is probably correct.) See also "Digest," June 18.

Telegraphy, Telephony and Signals.

NEW CONNECTIONS FOR VERY LONG DISTANCE TELEPHONY. Schwensky. "Elek. Zeit.," July 28.—To increase the distance with present systems it is either necessary to use larger line wire, which is not always practicable, or to improve the microphones, in which direction improvement is not likely; he therefore endeavors to increase the distance by a change in the connections; in the present paper he describes a system which was suggested in 1896, and has proved to be very successful. In this the receiver is used alone, without its microphone, and the transmitter is used without the telephone, the microphone of the receiver and the telephone of the transmitter being cut out of circuit when not in use; the necessary switching is accomplished by means of a small lever attached to the telephone, and which, in its natural



position, cuts out the induction coil, while when it is depressed it cuts out the telephone; this results in a very appreciable increase in the strength and clearance of the transmitted speech; this is due to the fact that in the usual method the current curves are flattened and shifted in phase by the apparatus, which is not really essential. The only objection to the system is that the persons talking cannot interrupt each other, but it is thought that they would soon get used to this. It has the further advantage that especially active microphones can be used, which formerly was not possible, as they affected the incoming waves too much. To make the system most effective these switch arrangements should be at both the receiver and the transmitter, but for distances below 1000 km (600 miles) the sound would be too loud, and the arrangements are therefore made that either the old or the new system can be used as desired. A method of accomplishing this, as also the complete connections, is shown in the diagram on page 189, which will explain itself; the small switches marked *f* are in the position shown in the figure for short distances, while they are moved to the left to connect with the wires *a* and *c* when the instrument is to be used for long distances. The lever *H* on the telephone then makes the connections for receiving or transmitting respectively as described above. A test was made with a metallic circuit of 3000 km (1800 miles) by connecting the longest 4 mm and 3 mm long-distance lines in the German circuits, and the results were surprisingly good; it was also tried over the cable from Berlin to Copenhagen, and gave very good results, far better than the usual arrangement.

DISTURBANCES IN TELEPHONES. Meyer. "Elek. Anz.," July 28.—A brief description of a method for preventing railway currents from producing disturbances in neighboring telephone wires. This is accomplished by merely connecting a condenser to the terminals of the armature of the motor on the car. Trials were made by a well-known company in Germany, and it was found that when the condenser was connected the sounds in the telephone suddenly ceased or were only very weak.

Miscellaneous.

THE HUMAN BODY.—"Elek. Anz.," July 31.—A note stating that according to a French Academy paper by Dubois the human body is a condenser with a liquid dielectric and a capacity of 0.105 microfarads.

ELECTRIC FURNACE. Gin and Leleux. Lond. "Elec. Rev.," July 29.—An abstract of a French Academy paper, noticed in the "Digest," March 19.

EXAMINATION QUESTIONS.—Lond. "Elec. Eng."—This journal publishes occasionally the examination questions of the City and Guilds of London Institute, for the department of magnetism and electricity; the issue of July 29 contains one set of these.

TURIN EXHIBITION. Montel. "Elek. Zeit.," July 28.—The beginning of a report on the electrical exhibits at this exhibition; brief descriptions are given, with some illustrations, the present portion being devoted to continuous current machinery.

PREVENTING COLLISIONS AT SEA. Herberts. "Elec. Eng.," August 4, and "El'ty," August 10.—An illustrated article in which he suggests the use of a thermopile on board ship for detecting the presence of an object such as a vessel, iceberg, etc., in case of a fog. Any object which has a higher or lower temperature than the surrounding atmosphere will radiate or absorb heat; he proposes to detect such heat radiations by mounting a horizontal thermopile on the two sides of a ship, revolving it slowly around a vertical axis and connecting it with a galvanometer which operates an alarm; it must be carefully protected from the heat radiations of the vessel itself and the sun; the object of revolving it is to give some idea of the direction of the approaching object; the strength of the current will give some idea of its distance; the successive alarms will show whether it is approaching or receding.

MICA.—"Elec. Rev.," August 10.—A short article on the mining and [illegible] of mica.

Directory of Scientific Societies, Associations, Etc., and Meetings of the Same

CHICAGO ELECTRICAL ASSOCIATION.—Meetings, third Friday of each month. [illegible], secretary.

NEW YORK ELECTRICAL SOCIETY.—President, Gano S. Dunn, secretary, [illegible], New York.

ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA. [illegible]

CANADIAN ELECTRICAL ASSOCIATION.—President, [illegible] H. [illegible]; secretary, C. H. Mortimer, Toronto, Ont.

FRANKLIN INSTITUTE [illegible] Philadelphia, Pa. Secretary, William H. Wahl.

[illegible]

[illegible]

[illegible]

[illegible]

NATIONAL ELECTRIC LIGHT ASSOCIATION.—President, A. M. Young, Waterbury, Conn; secretary, George F. Porter, New York. Next meeting, New York, May or June, 1899.

AMERICAN STREET RAILWAY ASSOCIATION.—President, A. E. Lang, Toledo, Ohio; secretary, T. C. Penington, Chicago, Ill. Next meeting, Boston, Mass., September 6, 7, 8 and 9, 1898.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS.—President, W. W. Ryder, Chicago; secretary, P. W. Drew, Milwaukee, Wis. Next meeting, Wilmington, N. C., June 19, 1899.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK.—President G. Tracy Rogers, Binghamton, N. Y. Next meeting, Hotel St. George, Brooklyn, N. Y., September 13 and 14, 1898.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES.—President, Samuel Insull, Chicago; secretary, Wilson S. Howell, Harrison, N. J. Next meeting, Sault Ste. Marie, Mich., September 12 and 13, 1898.

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION.—Dr. C. R. Dickson, Toronto, Can., president; Dr. John Gerin, Auburn, N. Y., secretary. Next meeting, Buffalo, N. Y., September 13, 14 and 15, 1898.

THE OHIO ELECTRIC LIGHT ASSOCIATION.—President H. K. Wood, Piqua; vice-president, Emil C. Schmidt, Sandusky; secretary and treasurer, Samuel Scovil, Cleveland. Last meeting, Sandusky, Ohio, August 18 and 19, 1898.

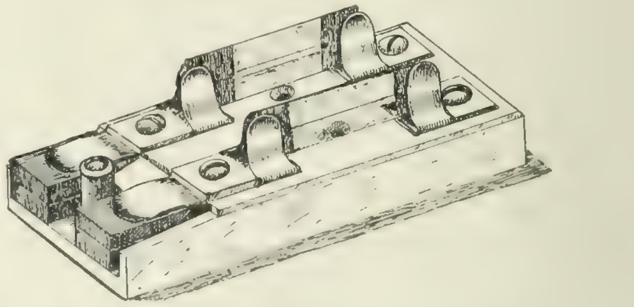
ASSOCIATION OF FIRE AND POLICE TELEGRAPH SUPERINTENDENTS AND MUNICIPAL ELECTRICIANS.—President, Will Y. Ellett, Elmira, N. Y. Last meeting Hotel Langewell, Elmira, N. Y., August 9 and 10, 1898.

INDEPENDENT TELEPHONE ASSOCIATION OF THE UNITED STATES.—President, Judge James M. Thomas, Chillicothe, Ohio; secretary, W. J. Vesey, Fort Wayne, Ind. Next meeting, June, 1899. Place to be named hereafter.

A New Combined Fuse Block and Lightning Arrester.

The telephone department of the Electric Appliance Company of Chicago has just put upon the market a combined fuse block and lightning arrester, intended to give absolute protection against burn-outs from crosses caused by trolley and electric light lines breaking and falling across the telephone wires.

The lightning arrester part of the instrument is constructed with two carbon blocks with perforated mica separating them. One block rests on the ground plate and the other is connected directly on the line, the idea being to produce an arrester on the air gap principle.



A Combined Fuse and Lightning Arrester.

The perforations in the mica separator produce this result when the carbon blocks are placed in their proper position on the arrester.

The effect of a lightning discharge across the carbon blocks is to produce a small amount of carbon dust, which can easily be removed by pulling out the carbon blocks, blowing out the dust and replacing them, when the arrester is in working order again.

The fuse end of the arrester should always be connected to the wires running to the instrument to be protected, and the carbon arrester end directly to the line wires.

The fuse portion of the arrester can be furnished with either the Postal or Western Union type terminals, an ordinary [illegible]-inch copper or foil terminal fuse being used. The base is made of porcelain, and is 4½ inches long by 1 and 1½ inches wide.

Improved Inclosed Arc Lamp.

The simplest means to accomplish an end is always the most satisfactory. This self-evident truth applies with particular force in mechanics, and its importance is fully appreciated by designers and constructors of electrical apparatus of all kinds. In arc lamp construction simplicity is one of the principal desiderata, and in late years considerable advance has been made in this direction. The inclosed arc lamp is one of the results of the effort to obtain the best results with the greatest economy.

Among the most recent designs of inclosed arcs may be mentioned those of the Sterling Arc Lamp Company, [illegible] West Twenty-sixth Street, New York City. This company is making direct current inclosed arc lamps for [illegible] alternating inclosed [illegible] and inclosed arcs for [illegible]. In all [illegible] the mechanism is practically [illegible].

[illegible] For instance, the [illegible] carbon [illegible] will be thoroughly [illegible]. The [illegible] is supported [illegible] shown in Fig.

[illegible] carbon. The outer

globe is simply set in the holder and held in position by means of a cross bar and cap, sliding between the two frame rods and suitably held down upon top of the inclosing globe, so that the latter is firmly and securely [illegible] in position, but can be easily removed by raising this cap bar. The upper sliding bar carbon holder is so constructed as to always maintain perfect alignment.

The regulating mechanism is of a new clutch chain feed type. One end of the chain is attached to the cross bar of the upper carbon holder. The chain passes over a toothed clutch pulley, and is kept taut by means of a [illegible] weight to the other end, and moving up and down in one of the hollow frame rods. The chain is not used for carrying the current, a separate conductor being provided for the purpose. The clutch pulley controls the movement of the feed chain and its attached upper carbon. The control magnet operates on a pivoted clutch, or brake bar, causing the chain pulley to be gripped by the clutch member, turned the necessary distance and carrying the carbon correspondingly. The clutch pulley is practically the complete regulating mechanism in all of the Sterling lamps, although its details are slightly modified to meet the conditions in each peculiar class of service. The actuating control magnets also vary in the different lamps, being single, series-connected solenoids in some, and double shunt and series differentially acting coils in others.

In the direct-current, constant potential lamp (Fig. 1) the clutch mechanism consists of a chain brake around the feed-chain pulley, and is attached to the operating bar, so that movement is imported to both ends of the chain when the bar is actuated. This clutch or brake chain operates as a hand brake, with both ends movable. The resistance is placed at the top of the lamp, and is held in place by radial arms, each arm carrying two porcelain insulators through which the resistance coils are carried in two concentric circles—once around and back. These lamps burn singly on 110-120 volt circuits, using about 4½ to 5 amperes at 80 volts.

The alternating lamp (Fig. 2) burns singly on 100-120 volt circuits at a frequency of 60 or 125 cycles, taking about 6 amperes at about 70 volts. It burns from 80 to 100 hours with one trimming. The regulating reactive coil, shown on the top, is so arranged that by changing the connections on the coil the lamp may be adjusted to any frequency and voltage. The clutch mechanism is the same as that used on the constant current series lamp. The regulating coils are double, series connected with the reactive coil, their double laminated iron cores being attached to the bar. This lamp is said to burn steadily and without noise.

The constant current series lamp (Fig. 3), as regards its mechanism, is substantially the same as the other lamps above described, the clutch wheel, however, being slightly modified. The freed chain wheel is clutched by a novel form of clutch device, which acts in a manner similar to the double acting chain brake above described. The regulating mechanism of the lamp is differential, the double series and shunt coils acting on solid cores connected to the clutch bar.

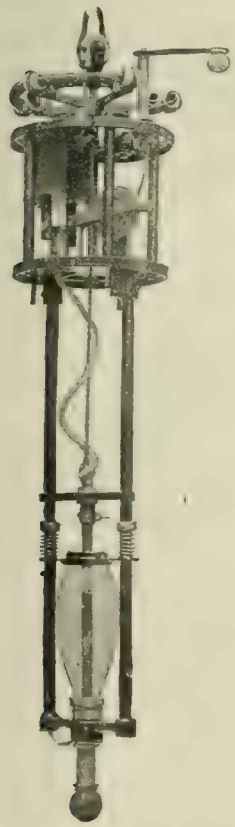


Fig. 1.

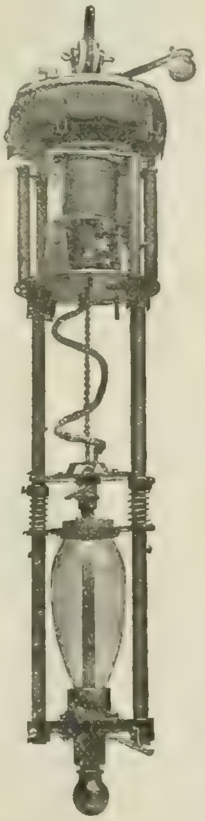


Fig. 2.

The lamp switch or line cut-out is a new feature. It is in a separate case, which is hung from the supporting hook, and permits complete disconnection of the lamp from the line. The line terminals from the switch to the lamps project through the bottom of the switch base in the form of two heavy insulated brass hooks. On the top of the lamp hood are two corresponding hooks. By engaging the two sets of hooks the lamp becomes connected with the line terminals. A centrally placed pin on the top of the lamp hood enters an aperture in a stud projecting downward from the switch box, and serves to hold the hooks firmly together and prevent any swinging of the lamp. The standard lamps of this type are made to take from 4 to 6 8-10 amperes of current at 65 to 70 volts.

The Sterling Company also makes inclosed arc lamps for power and railway circuits, 220 and 500 volts, and an open series arc lamp. The power and railway circuit lamps [illegible]

[illegible]

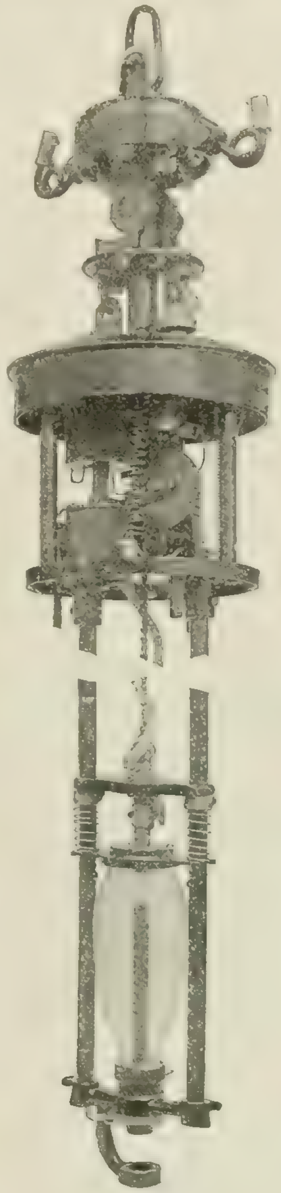


Fig. 3.

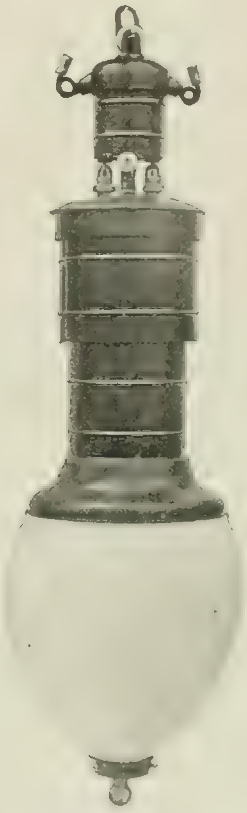


Fig. 4.

a plain, constant current, series lamp. The connecting hooks and the central steadying pin are clearly shown in this illustration.

The Measurement of Insulation Resistance.

There is no measurement of more importance to the present day electrical engineer than that of insulation resistance. Good insulation means the developed energy properly utilized; bad insulation means wasted energy, danger to life, fire risks, and a general uncertainty as to whether a plant is working well or ill.

It is not sufficient to make an occasional measurement of insulation or to depend upon the acceptance test indefinitely. Insulation should be regularly, continuously and systematically tested and proper records kept, since experience shows that from these records may be predicted the behavior of the insulation a week, two weeks, or a month ahead. Just as in a magazine a slow but continuous rise of temperature means danger and suggests taking steps to lower the temperature, so an insulation resistance of a cable, e. g., falling slowly day after day, means eventual breakdown and suggests proper provision being made long enough ahead to prevent accident or loss of light or power.

When the insulations are relatively low, say not over 4 or 5 megohms total, no method can be more simple or convenient than the use of a very sensitive milli-voltmeter. Such an instrument can be made sensitive enough to give one scale division with 100 volts through one megohm. The insulation may be read direct; its value will be, in each case, megs /N where N is the number of divisions of scale deflection. If a 500-volt power circuit is substituted for the 100-volt portable battery then the insulation is expressed by 5 megs /N.

Cable insulations run from 5000 to 20,000 megohms to the mile; perhaps 15,000 is a fair average. To measure such high values as these the voltmeter is valueless and we must use what is known as the "direct deflection" method. This method consists essentially in comparing the current produced by a known voltage acting through a known high resistance with the current produced by the same or other known voltage acting through the unknown insulation resistance.

If these currents be reduced to currents at the same voltage then the two resistances will be to one another inversely as the number of scale divisions deflection produced.

In practice either a Kelvin or a specially sensitive suspended coil (D'Arsonval) galvanometer is used in this method; deflections are observed either by the lamp and scale or telescope and scale method. For laboratory work the separate instruments, switches, etc., may be arranged upon the table.

Messrs. Willyoung & Co., Philadelphia, have arranged a very convenient portable set for the practice of this method and have been finding quite a demand for it of late among telephone and electric light companies. In laboratories it has also been found very useful, since all the necessary apparatus is compactly put up in permanent relation to itself and ready at all times for instant use.

Fig. 1 gives the typical plan of the set, while Fig. 2 is the detail of connections as actually run in the set. Referring to Fig. 1, C and B are the real main circuit terminals, A being simply a post from which is run a lead to the galvanometer short-circuit key. In series with the galvanometer is 100,000 ohms inductive resistance; this is used to "choke" the earth currents which would otherwise keep the galvanometer in continual motion. It also serves to make the effective galvanometer resistance R + 100,000, where R is the actual galvanometer resistance. This is of advantage in case of break in the galvanometer suspension, as the change in the galvanometer resistance caused by putting in a new suspension can be but inappreciable with respect to this large total, and

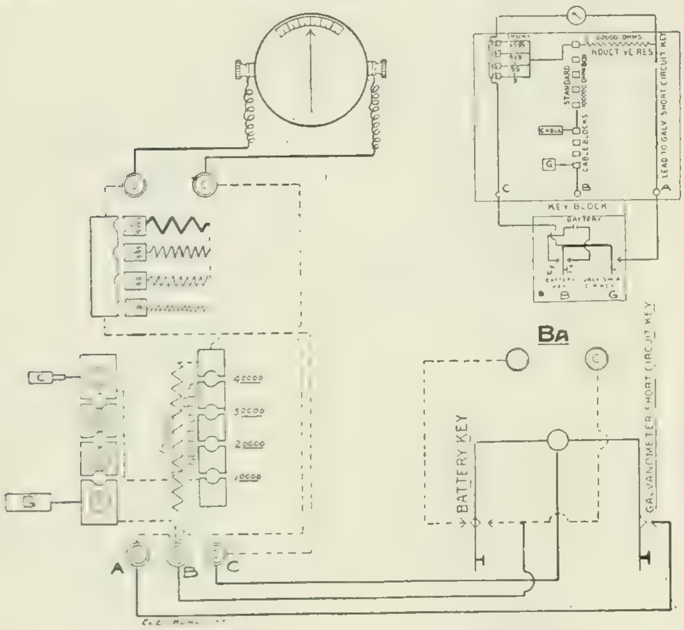


Fig. 1

Fig. 2.

[illegible]

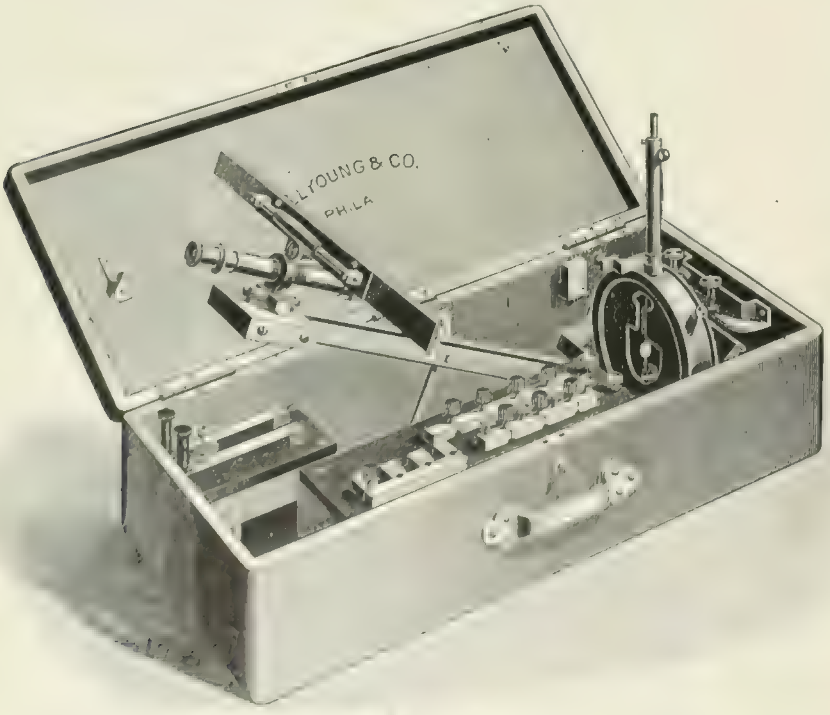


Fig. 3.

spectively, 1-10, 1-100, 1-1000 and 1-10,000 of the whole current to flow through the galvanometer.

In series with the galvanometer is the standard 100,000-ohm box, divided in four coils of 10,000, 20,000, 30,000, 40,000 ohms, respectively. Further on are the "cable blocks," to which the cable or unknown insulation is attached.

Fig. 3 shows the set ready for use. The galvanometer is a Rowland-D'Arsonval, mounted on gimbal bearings, and with telescope and scale attached. When not in use the galvanometer tips down flat against the telescope arm, which itself drops down into the bottom of the box. The standard 100,000 ohms, shunts and inductive resistance are contained in the interior box at the right. With 100 volts of battery ten scale divisions are obtainable through 5000 megohms of resistance.

The instrument as a whole folds up into a polished oak case, 22¾ inches by 10 inches by 7 inches deep, and weighing about 20 pounds. The entire time required to set up this instrument and have it ready for use with leveling, telescope adjustment and all effected is not over one minute.

Direct Dynamos—II.

(Concluded.)

All Crocker-Wheeler multipolar frames are of similar type and one distinctive of this company. (See Fig. 3.) They show finely rounded lines, and are of girder construction. The yoke is a cast iron ring with short internal

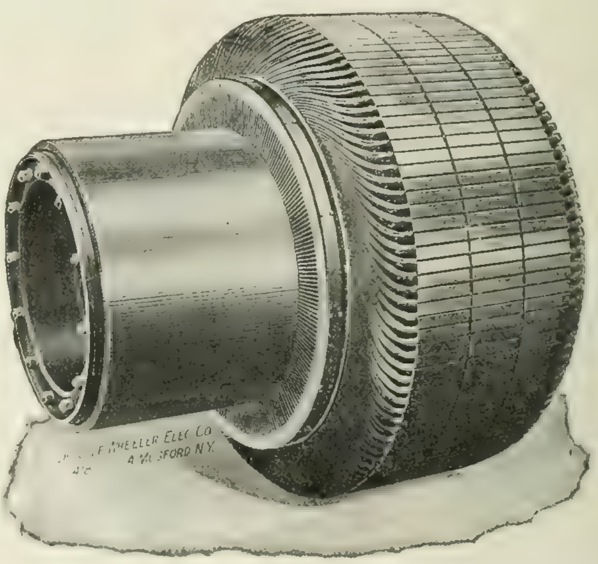


Fig. 4.

flanges on each side, which, besides strengthening the ring against breaking, afford considerable protection from mechanical injury to the field coils located between them. This yoke is divided into halves horizontally. Fig. 3 is a side elevation and section of a size [illegible] machine, and shows its construction clearly.

The pole pieces are [illegible] of cast [illegible], cast welded into the yoke, securing a perfect magnetic joint. They are provided with removable cast iron shoes [illegible] after the field coils have been put on. These

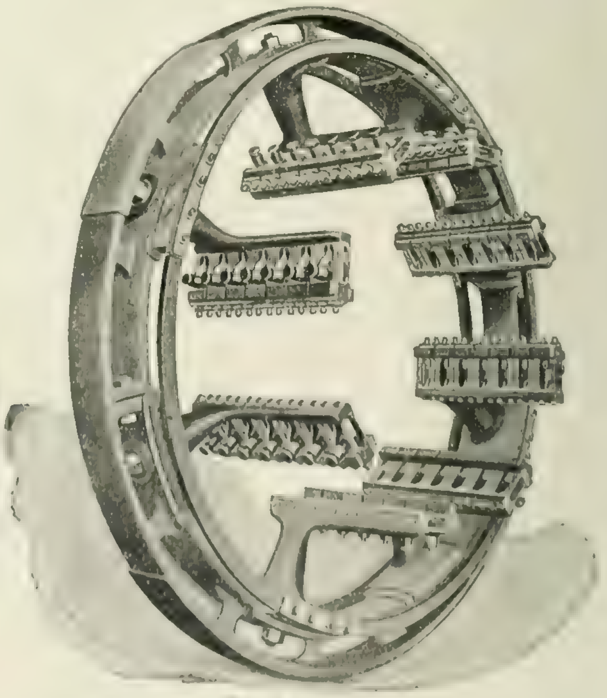


Fig. 5.

shoes increase the surface of the poles exposed to the armature and therefore reduce the density of the magnetic flux where it enters the armature, and permit a long air-gap or large clearance between armature and field to be used. A long air gap, in addition to its electrical advantages, obviates the necessity for an extremely accurate centring of the armature in the magnetic field, which would otherwise be of great importance and is difficult to secure. As the air gap is long, any slight inaccuracy in centring is but a small percentage of the total length and therefore has but a small effect on the magnetic balance of the machine. A dynamo with short air gap, whose armature is out of centre, will have its efficiency and capacity greatly reduced by the flow of current inside the armature from one portion of the winding to another. Its shaft will also be subjected to a magnetic pull at right angles to its axis, which will tend to make the bearings heat, heavily loaded as they already are with the weight of the armature and fly wheel.

Each pole is excited by a separate field coil, because this method gives greater economy of field current and copper than any other form. The pole pieces are made round, because they are more efficient than those that are square, rectangular, or of any other shape, since they require less copper and need less current to energize them. The pole pieces do not need to be laminated, because they have been designed with such a relation of length of air gap to width of slot opening that eddy currents are almost entirely avoided. Pole pieces, when laminated, must be made rectangular in shape, and they then lose much of their advantage of freedom from eddy currents, owing to their inefficient form.

All Crocker-Wheeler dynamo armatures have toothed cores. The slots have parallel sides with rounded bottom and very narrow opening at the top, which compels the winding to be threaded through from the ends. The cores are built up of sheet iron punchings .022 of an inch in thickness, except the end discs and those on each side of the air spaces, which are three-sixty-fourths of an inch thick. Owing to the large diameter of the armatures, the discs cannot be made in complete circles. They are punched out in sections and put together with joints staggered. At one or more points in the core ventilating ducts one-half of an inch wide are formed by the omission of a sufficient number of discs and the insertion of distance pieces, which allow free circulation of air. The laminæ are insulated from each other by a layer of oxide formed during the annealing process and in addition by a sheet of paper after every fourth disc.

The cores are mounted on cast iron spiders, as shown in Fig. 3, which are keyed to the engine shaft. The spider carries a sleeve extension at one end for the support of the commutator. The armature and commutator are therefore a unit, and may be removed from the shaft without disturbance of the connections between them.

The armatures, as in all large multipolar machines, have drum windings and these are usually connected for multiple circuits, though occasionally, in special cases, they are connected for two circuits. The conductors consist of solid copper wires of large size, triple cotton covered, and shellacked. This covering serves to insulate the wires from one another, but is not relied upon to insulate them from the core. In the slots are placed tubes, one above the other, made of micanite cloth and pressboard rolled up on a form and glued together. These tubes insulate the wires in the slots from the core. The conductors are threaded through the tubes from the ends, as can be seen in Fig. 3.

This "cable" winding is an improvement over the bar windings originally used and patented by us and now used by other makers, since it has no joints except at the commutator tails. It has the advantages over bar windings of being free from joints and of employing standard wire or copper rod, which is always readily obtainable, whereas the special conducting bars for bar windings require riveting together and can only be obtained from the makers of the machine. This is a point of great importance should a breakdown occur at a place remote from the manufacturer.

The commutator, the most costly part of an armature, has received the closest and most careful study in its design. The bars are made of the best hard drawn copper, with copper tails, riveted as well as sweated into one end. These tails are made sufficiently long to keep the soldered joints with the armature conductors cool, even though the commutator bars should become overheated from any cause, and are arranged so as to permit free circulation of air between them.

The larger sizes of commutators have their bars held down by sectional collars, each section of which covers but four or five bars. The object of this is to make it possible to bring equal pressure to bear on all the bars by individual adjustment of the parts of the collars, which are drawn toward the centre by wedges operated by screws at the ends of the commutator. It is obvious that repairs are facilitated, since one or more bars can be taken out without disturbing the others by removing the sections of the collars which hold their ends.

The spider which supports the commutator on the sleeve extension of the armature spider has wide spaces between its spokes, permitting the air to pass freely through the armature from end to end.

The commutator surfaces are ample, and are designed with reference to the energy dissipated in the act of commutation and to the heat caused by the mechanical friction of the brushes. A finished armature, ready for mounting on engine shaft, is well shown in Fig. 4.

The form of brush rigging adopted is shown in Figs. 5 and 8. A circular iron casting made in two parts is supported by brackets fastened to the yoke of the machine (see Fig. 3), and is, therefore, independent of the outboard bearing. To this ring, but insulated from it, are fastened the various sets of brushholders by means of cast iron brackets seen in Fig. 5. The brushholders are of what is called the parallel movement type, the brush being

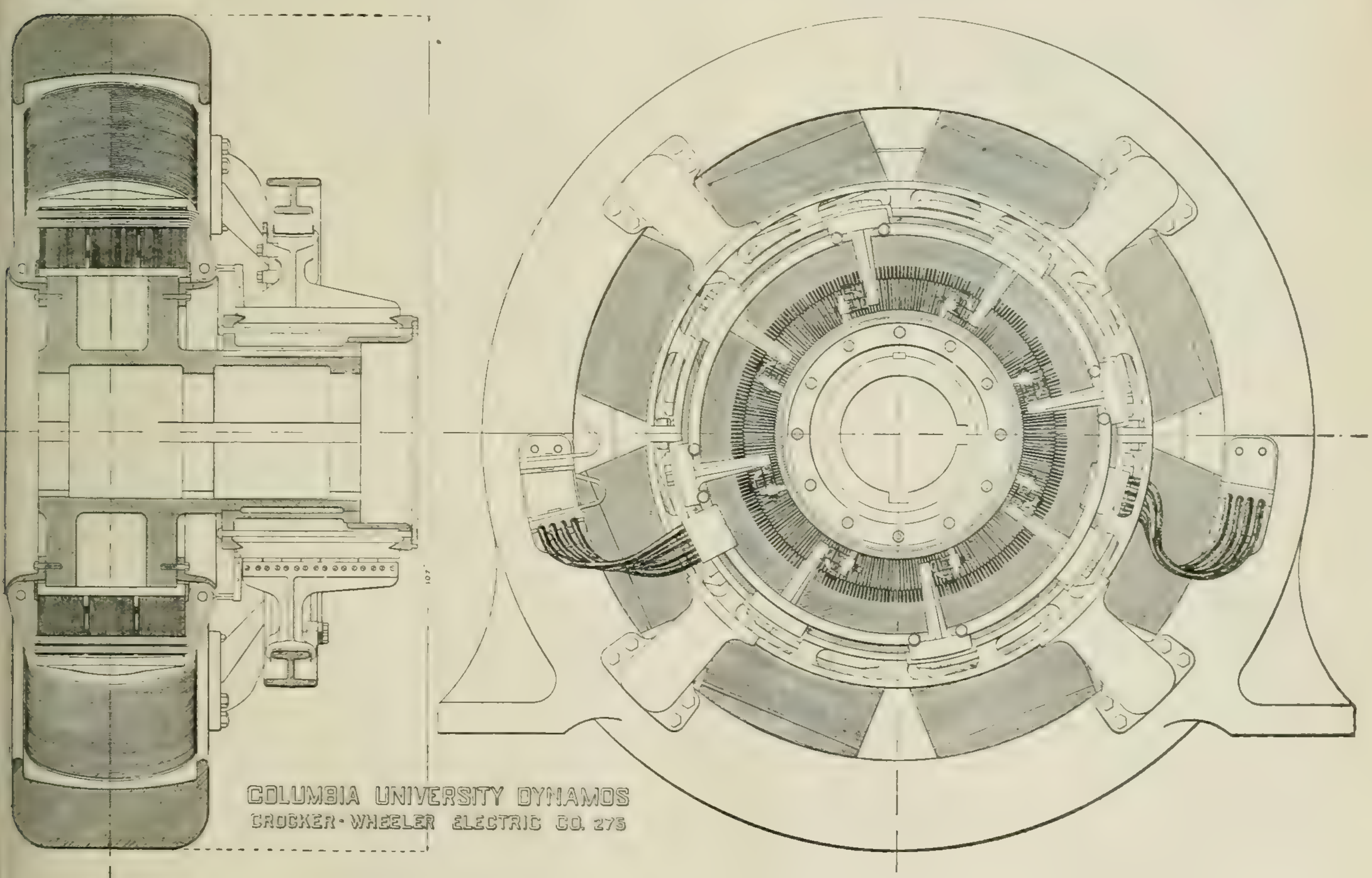


Fig. 3.

clamped firmly in a brass box which moves radially to and from the commutator. The brush is therefore always perpendicular to the surface of the commutator. No spring or sliding contact carries any current. An illustrated description of this holder may be found in The Electrical World of July 23, pages 89 and 90. All "positive" sets of brushes are connected together by a flat copper conducting ring mounted on one side of the "rocker ring," and all the "negative" brushes are connected by a similar ring on the other side. The exposed portions of these copper rings are insulated by a wrapping of cord covered with insulating paint. The brushes are shifted simultaneously by rotating the rocker ring by means of a screw operated by a hand wheel. When so desired, a special brush lifter can be added for lifting all the brushes from the commutator at the same moment by throwing a lever.

The standard brushes are of carbon, though in special cases they are fibre graphite and carbon in which are imbedded layers of copper gauze. The brush areas have been arranged with reference to the conditions of commutation—namely, the self-induction of the armature coils, the speeds of the machines, and the carrying capacity of the carbon. The cross section per ampere, therefore, varies somewhat with the different machines; it does not exceed, however, 40 amperes per square inch for standard carbon brushes, and averages about 30 amperes per square inch. For carbon gauze brushes it is twice as much and for graphite maybe half as much.

It is recommended in all cases where the armature is mounted upon its shaft by being slipped upon it as a sleeve, that the shaft be sent to the works to insure that the forcing on is done in the best possible manner, except for sizes of machines which have split hubs. If this mounting is done at the place of installation it is less convenient on account of the absence of proper tools and handling machinery, and risk of damaging either the shaft or the windings of armature is incurred. The fit between an armature and its shaft must be so exact that a discrepancy of a thousandth of an inch is enough [illegible] and entails great delay and possible [illegible] it can be removed and have its bore scraped to a fit. In the factory the whole resources of a machine shop are available for these delicate operations, and they can be performed with greater success and dispatch than [illegible] of a large office building or other place [illegible].

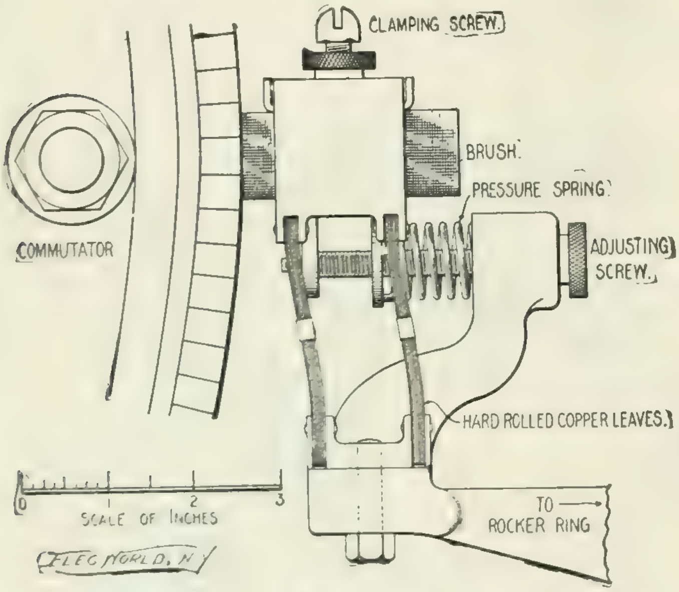


Fig. 8.

The Crocker-Wheeler machines are tested for proper insulation resistance [illegible] The insulation standard for [illegible] measured with field circuits and armature circuits connected and brushes [illegible]

[illegible]

It frequently happens that our insulation falls below this figure, but this is [illegible]

[illegible]

bottom of the feet and the top of the base upon which they rest to receive other insulating or metallic adjusting pads.

Electrical insulation of the frame undoubtedly safeguards the insulation between the frame and the windings, but in well-constructed machines this latter exceeds in so great a degree the maximum strain ever put upon it, that further protection is unnecessary. This is especially true in view of the fact that the armature, which is the most delicate element of the machine, and the one which, on account of its rapid motion, is most likely to suffer a deterioration of its insulation from the collection of dust, the accidental striking of foreign objects, and from other causes, cannot be insulated from the ground owing to the rigid manner in which it is necessary to attach it to the prime mover. Even when insulation is inserted between the frame and the base erection it quickly becomes dirty, and largely loses its insulating properties.

A partially insulated frame strains the insulation of the windings as much as a wholly grounded one, and has serious disadvantages, as the fact that, should any of the connections of the electrical circuits accidentally come in contact with the frame, the regular ground detector test for faults would not discover it, and trouble would be latent, awaiting an accidental connection between the frame and the ground to bring it out; also, all insulating materials are liable to shrink, and on this account are bad for mechanical uses. A shrinking of the insulation pad will not only permit the bore of the fields to settle eccentric to the armature, but will so relieve the tension of the holding down bolts as to render it possible for the machine to slide sidewise if there is sufficient jar to start it.

For the above reasons metallic adjustment pads are recommended with these machines, except where otherwise specified, since their use is now permitted by the underwriters' regulations of all but a few places.

The frame is lifted from the base by set screws, and when the proper distance is determined the pads are put in, the adjustment made by thin sheets of iron, the screws relieved, and the holding down bolts tightened.

Where insulation is demanded use the hardest kind of fibre to encounter as little shrinkage as possible, and make the adjustment in the same manner.

The Crocker-Wheeler Electric Company has adopted as its standard increase of temperature 45° C. over the temperature of the surrounding atmosphere, and, while this is 5° higher than is used by many builders of to-day, it is absolutely within the limits of safety after deducting an extremely large margin. While we believe in the standard of 45° C., we can meet a limit of 40° by slight modifications in windings, and many of our machines come within this lower limit normally. It is well known that a temperature of 100° C., corresponding to the boiling point of water, is absolutely safe for insulation; in fact, the limit is considerably higher than this.

As regards sparking, Crocker-Wheeler dynamos are built with special attention to perfect performance at the brushes. There is no sparking from no load to full load and no shifting of the brushes, and with very slight shifting there will be no sparking from no load to 25 per cent. overload. The brushes can be set for no sparking from ¼ load to 125 per cent. of load. An overload of 25 per cent. for one hour will not cause a rise of temperature of the core exceeding 55° C. A momentary overload of 50 per cent. can be carried without undue sparking or heating.

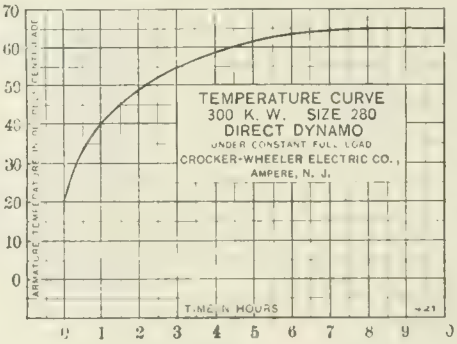


Fig. 9.

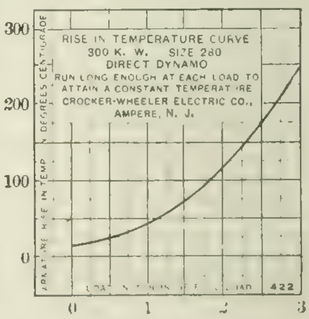


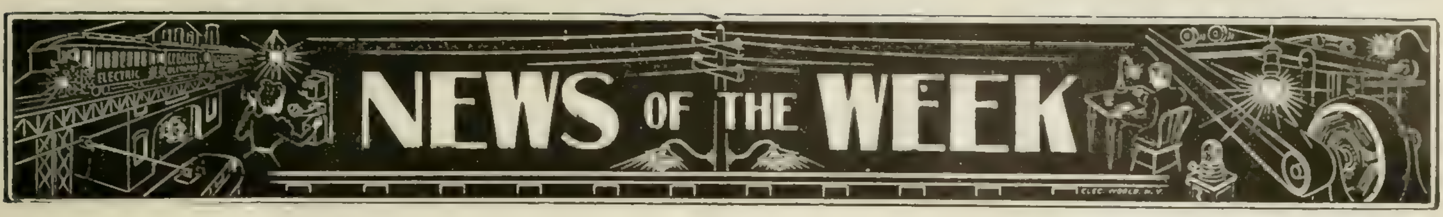
Fig. 10.

In Fig. 9 is shown the rate at which the temperature of the armature core of a large dynamo rises when the machine runs for ten hours under steady full load. The temperature of the air in this case, which is the temperature at which the dynamo starts, is taken as 20° C. It will be noticed that the machine attains a constant temperature at the end of about the eighth hour of its run, and that it is within two degrees of its constant temperature at the end of the sixth hour.

The temperatures which the armature core of a direct dynamo will attain if run sufficiently long at each load to reach a constant temperature, are graphically shown in Fig. 10. A range of load from 0 to 300 per cent. of full load is given.

At about [illegible] C. the cotton insulation of the armature wires will begin to char, hence a 300-per cent. overload, if long continued, will burn out the machine. Greater percentages of overload can be withstood, if they are for shorter periods of time. In these curves the heat generated in the armature by the current and the hysteresis and foucault current losses is divided by the specific heat of the mass of iron, with proper allowance for dissipation by convection and conduction.

[illegible] designed as dynamos, these machines operate perfectly as slow speed motors, and are often used when large slow machines are required. The shunt winding is employed most frequently for motors because it gives practically constant speed at all loads. The compound winding is used on motors which have to do "lumpy" work, the series coils serving to strengthen the field at moments of greatest load, thus preventing sparking which might otherwise result, and reducing the momentary excessive draft of current from the mains. They have the disadvantage of not being so constant in speed as the shunt motors. Owing to the drop in voltage in the series coil and to the stronger field employed, a given armature will run about [illegible] per cent. more slowly in a compound field than in a plain shunt field.



NEWS OF THE WEEK

Financial Intelligence.

THE METROPOLITAN STREET RAILWAY COMPANY, of New York City.—At a meeting of the stockholders held last week the proposed increase in the capital stock from $30,000,000 to $45,000,000 was unanimously ratified. It is stated that $10,000,000 of the additional stock will be used to liquidate outstanding obligations, the rest to be held in the treasury as a fund for improving the property.

GENERAL ELECTRIC.—A special meeting of the stockholders of the General Electric Company was held at Schenectady on August 10, for the purpose of considering the proposition to reduce the capital from $31,000,000 to about $21,000,000. The question of injunction, it is stated, was brought up, and Chairman Coffin read an opinion of counsel to the effect that Mr. Livermore's bill of complaint now pending would not cause any restraint to issue. Should its plea be granted the stockholders would return to original ratings. An adjournment was taken until Wednesday, August 17, when it is thought a decision will be reached.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
9 Murray St., NEW YORK, August 15, 1898.

MR. WILLIAM MAVER, JR., will shortly bring out a book entitled "Electrical Underground Conduits and Cables." Mr. Maver has been actively connected with underground work since its inception in this country, and is a recognized authority on this subject. His forthcoming book, therefore, will likely meet with a good demand, and will fill a want which at present exists in the literature of this art.

THE METROPOLITAN STREET RAILWAY COMPANY of this city has obtained permission from the State Railroad Commission to increase its capital stock from $30,000,000 to $45,000,000. The State board on August 11 granted the Metropolitan Company eighteen applications for permission to change the motive power on the Broadway, Lexington and Columbus Avenues roads, which are now operated by cable power. The underground conduit system will be introduced on these lines. President Vreeland states that on the completion of the work of introducing the underground conduit system on the Sixth and Eighth Avenues roads, the Broadway and Columbus Avenue lines will receive attention. According to a statement by Mr. Vreeland it is the purpose of the company, after all of the improvements on its lines have been completed, to run a large number of cars quickly and directly into the business section from every point up town. The cars from Second, Lexington, Madison, Sixth, Eighth, Columbus and Amsterdam Avenues will all turn into Broadway at convenient points. At certain hours a large proportion of the cars on the uptown lines will be run direct to the shopping district. Cars from Amsterdam, Columbus, Eighth, Madison and Lexington Avenues will be run through Fifty-ninth Street down Sixth Avenue and back again. During the evening, when people want to go to the theatres, all of the uptown lines will converge into Broadway. By the time the company gets its system in good working order it will have expended fully $15,000,000 for improvements. Among the roads to be equipped with the underground trolley system are the Twenty-eighth and Twenty-ninth Street cross-town lines, the Thirty-fourth Street cross-town, the Metropolitan cross-town, the Centre cross-town, the Chambers, the Bleecker Street and Fulton Ferry, Forty-second and Grand Street ferry, Fulton Street, Ninth Avenue, Broadway and Seventh Avenue lines, the Belt line, the Avenue C line and the remaining parts of the Second, Sixth and Eighth Avenue lines, all of which are operated by the Metropolitan Company.

BUFFALO AND NIAGARA FALLS NOTES.

BUFFALO, N. Y., August 13, 1898.

IT IS NOW EXPECTED that the new lighting station in Buffalo will be ready for operation by October 1. Engineer Stott, of the company, is in Schenectady assisting in getting the large amount of new apparatus in readiness.

IT IS ANNOUNCED that the new Lockport trolley line will be in operation next Monday, and as a car has already been run over the line the road is a fact now. It is nearly 30 miles long. The cars are built with motors capable of developing a speed of a mile a minute.

THE NIAGARA FALLS COMPANY is preparing to extend its operations to Depew, the new manufacturing centre, 10 miles east of Buffalo, at an early date, and is already at work obtaining right of way. One would suppose that the line of the Depew Terminal Railway would be taken, but the road objects, for the reason that a line carrying a current of such high voltage would interfere with the telegraph wires on the line of the road. It is expected that a line will be taken adjoining the lands of the road and left without fencing, though some of the authorities believe that at least the poles should be fenced, to prevent intrusion and possible accident. Depew will take about 20,000 horse-power eventually, without doubt, though it is not understood that actual contracts have yet been made.

APPLICATION has been made to the Niagara Power Company for power from the tunnel with which to operate the Buffalo Valley trolley line as soon as it is ready, which, however, will not be this year. This road would take its current from the Depew line instead of from Buffalo, since it is no further to Depew than it is to Buffalo, and a transformer station could be established at Elma, which is about a third of the distance from the Buffalo end of the Buffalo Valley road. Then by establishing a second station at Wales, about two-thirds of the distance out, the entire road could be operated. The terminus of the road at Java is 27 miles from Buffalo and something like 45 miles from the tunnel, but distance is now a mere matter of cost of the transmission line, the experiments made in Buffalo fully demonstrating this. It is also the intention of running the Buffalo & Depew trolley line with Niagara power when it is built, so that with the new Lockport trolley line already a fact and the systems of Buffalo, Niagara Falls, the Gorge road, the Victoria Park road across from the falls, and doubtless with all the roads inside and running into Tonawanda soon in the same combination, so far as the derivation of motive power is concerned, there is already a vast amount of work already done or soon to be done by the Niagara Company. Besides it must be understood that but a small part of the power actually needed, and which will soon be obtained from the same source, has yet been arranged for or asked for. Buffalo is expected to take 30,000 horse-power in the near future.

ST. LOUIS NOTES.

ST. LOUIS, MO., August 13 1898.

THE STRIKE among the linemen is still on, and the men claim that it will last. Neither side seems inclined to give in.

AN INJUNCTION has been granted to prevent the St. Louis, Belleville & Suburban Electric Railway Company from laying its rails on the Belleville turnpike.

THE ST. LOUIS, BELLEVILLE & SUBURBAN ELECTRIC RAILWAY COMPANY has filed its acceptance of the franchise granted it by the Belleville City Council to operate its cars over the portions of the tracks of the Belleville City Electric Railway.

NEW CARS.—A half a dozen representatives of street car manufacturers are registered at the various hotels. They are here to bid on 75 to 100 new cars for the Scullin Street railway system. The contracts will be placed in a few days, and the new cars will represent an outlay of not less than $200,000.

PACIFIC COAST NOTES.

SAN FRANCISCO, Cal., August 7, 1898.

THE TELEPHONE LINE BETWEEN HEPPNER AND BURNS, Ore., has been completed, and is now in operation. The latter place now enjoys telephonic communication with Canyon City via the new line.

THE STOCKTON GAS & ELECTRIC COMPANY has its new gas well down over 700 feet, and on its completion this winter will bore others, until it obtains a sufficient output of gas to supply all the fuel needed at its works. The company now has six wells in use.

THE TACOMA CITY COUNCIL recently rejected the offer made by C. B. Hurley in settlement of the litigation pending against the Tacoma Light & Water Company, growing out of the sale of the electric lighting plant to the city. The offer consisted of $100,000 and payment of the attorneys' fees in the case.

THE FIRE ALARM WIRES OF LOS ANGELES are being placed in the underground conduits of the Sunset Telephone & Telegraph Company, which company offered the city the free use of its ducts. City Electrician Francis, who superintends the work, will have the overhead wires removed as soon as the underground system is completed.

THE WHITE PASS & YUKON RAILROAD COMPANY, which recently completed a section of the first railroad in Alaska, has its terminus at Skaguay. The company recently placed contracts for 135 miles of telegraph wire and the supplies needed for equipping its offices at stations along the road. A telephone system will also be installed for the use of the company.

MR. W. H. HAMMOND has returned from England, where he obtained capital for the development of a water power electric proposition in Tuolumne County, Cal. He is associated with A. G. Wishon in a company which intends to install a plant on the Kaweah River, 29 miles east of Visalia. The transmission line is to be extended to Porterville, Tulare and Lindsay, if a sufficient amount of power be contracted for by residents of those towns. At Porterville the rate demanded is $50 per horse-power per year.

THE CITY ELECTRIC LIGHTING AND WATER WORKS PLANT for the town of Healdsburg, Sonoma County, Cal., has been laid out by engineers Barnes and Dodge, and representatives of electrical manufacturing companies are now figuring on the specifications. Two hundred horse-power will be transmitted 8 miles at 10,000 volts from a water power electric station to a sub-station in the town, where the voltage will be lowered to 2200 volts for distribution. Alternating arc lamps will be used for street lighting. The working head of water is about [illegible] feet. A triplex pump is to be driven by an induction motor.

[illegible] THE STREETS of San Francisco [illegible] San Francisco Gas & Electric Company, has been stopped by the veto of Mayor James D. Phelan on the resolution of the Board of Supervisors. One of his reasons for taking such action is said to be that there is a case pending which might affect the validity of the contract if awarded. The Mutual Electric Light Company some time ago brought suit to restrain the Supervisors from letting the contract until they had accorded the Mutual Company equal privileges with the other company in regard to the erection of poles and overhead wires where necessary.

THE ALASKA TELEGRAPH & TELEPHONE COMPANY, which was [illegible] California in July, [illegible] by San Francisco capitalists, has, after overcoming much opposition, secured a franchise. The Canadian Government grants the company the right to construct and operate telegraph and telephone lines in Canadian territory over the Chilkoot Pass, running along the lakes and up the Lewis and the Yukon Rivers to Dawson City. The line will start from Juneau and extend to Dyea, thence in a northeasterly direction over the Chilkoot Pass. After following the line of the rivers to Dawson, it will be continued as far as Circle City, which will be the terminus. The total length of the line and branches is estimated at 1000 miles. Construction will be commenced very soon, and the line rapidly pushed to completion. The Canadian Government is to have free use of the line. Theodore Reichert, formerly Surveyor General of California, is president, and J. F. Fassett secretary.

MILWAUKEE NOTES.

MILWAUKEE, Wis., August 11, 1898.

A LOCAL TELEPHONE COMPANY is being organized at New Richmond [illegible]

THE WISCONSIN TELEPHONE COMPANY will replace the system now in use at Washburn by the Guard system.

A BELOIT COMPANY has submitted a proposition to the city of Boscobel to erect an electric lighting and water system to cost $35,000.

THE MILWAUKEE, RACINE & KENOSHA ELECTRIC RAILWAY COMPANY is again asking Kenosha for a street railway franchise.

CONTRACTS for the construction of the Milwaukee Electric Railway & Light Company's power house at Oneida and Rivers Streets have been let.

THE CENTRAL OPERATING & CONSTRUCTION COMPANY of Fond du Lac has been incorporated with a capital stock of $25,000. The company will operate passenger and freight boats on Lake Winnebago, and will build or occupy a system of water works, electric lighting plant, gas lighting plant and street railway in the city of Fond du Lac. C. S. Smith, Menzo Smith and Maurice McKenna are the incorporators.

NEW ENGLAND NOTES.

Branch Office of THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., August 12, 1898.

[illegible] the station of the Boston Electric Light [illegible] the suspension of the lighting [illegible] The damage was slight, but the in[illegible] resumed after a few hours' delay.

MR. C. O. BAKER, manager of the Chicago office of the Anchor Electric [illegible] Boston for business and pleasure. He picked up some orders for Anchor goods in the towns through which he passed, and he found the Anchor Company business very active in the sections visited on his eastward journey.

THE ANNUAL REPORT of the Wire Department of Boston for the year 1897, just issued, is a very creditable piece of work. Mr. Thomas W. Flood, Commissioner of Wires, makes a most exhaustive report of the work of his de[illegible] and shows what has been done in the way of removing overhead wires [illegible] and placing them underground. A summary of the work dur[illegible] [illegible] and wooden ducts. Many very excellent half-tone illustra[illegible] [illegible] and after the removal of wires. The most interesting illustra[illegible]

CANADIAN NOTES.

[illegible]

throughout the city of Quebec. It is expected that the company will have the work in full operation on or before January 1 next.

THE MONTREAL PARK & ISLAND RAILWAY COMPANY has been refused the right to appeal to the Privy Council from the judgment of the Court of Appeal for the Province of Quebec. The company entered into a contract with the town of St. Louis du Mile End some years ago, by which it was to supply the town with a first-class electric car service on the principal streets, with transfers to the Montreal Street Railway. The company failed to carry out its contract, and the corporation took out an action against it and prevailed.

THE OTTAWA CITY COUNCIL has passed the Metropolitan Electric Company's by-law which lets in a new electric corporation to operate in Ottawa. The by-law provides among other things that the company is not to charge for incandescent lighting more than 1 cent per ampere hour, with a discount of 40 per cent. and a further discount of 12 per cent. for cash with fifteen days, off the lowest meter price. At the expiration of ten years the city has a right to acquire the property of the company at its actual cash value. The company has made arrangements for obtaining its water power at the Chaudiere Falls, and has already secured over 2000 horse-power to begin with and an option for 5000 more if needed.

MEXICAN NOTES.

MONTEREY, Mexico, August 3, 1898.

A NEW TELEPHONE LINE has been established between the office of the Governor of the Federal District and Cuajimolpa.

THE CONTRACT has been let for the lighting of the new theatre on Zaragoza Street, city of Mexico. There will be a total of 450 incandescent electric lights.

SENOR E. DYSTERUD, superintendent of the Monterey electric light plant, has returned from a business visit to New York and other Northern and Eastern cities. It is reported that he purchased some new machinery for the plant, and that it will soon arrive and be immediately installed.

IT HAS BEEN decided to operate the tramway which has just been constructed between Torreon and Lerdo with electricity. An iron bridge is being erected across the Nazas River, and as soon as this structure is completed the electric plant will be installed. The road runs through the rich Tlahualila farming region.

FRENCH NOTES.

(From Our Own Correspondent.)

PARIS, July 23, 1898.

NEW TELEPHONE LINE BETWEEN BRUSSELS AND PARIS.—With a view to secure eventually telephonic communication between Paris, Holland and Germany, the French and Belgian telegraph authorities are at work continually on a fourth line between Paris and Brussels, which is to have the remarkably large cross section of 40,000 circular mils metallic circuit. This line, with its very low resistance, will be especially well adapted to telephone service. The weight of copper which will go to equip it will reach the respectable figure of 94 tons.

PARIS ACADEMY OF SCIENCES.—Meeting of June 27, 1898: M. L. Bonetti read a paper on an improvement in X-ray tubes. By changing the condition of the rarefied gas in the bulb he has succeeded in getting a reduced resistance, and in this way he was able to utilize a tube which had become too high and was consequently useless. The method consists in keeping a platinum wire which is inclosed in the tube in a state of incandescence for an indefinite period of time. M. Bonetti uses an electric current for this purpose, so that what he has is practically an incandescent lamp with a platinum filament.

ELECTRIC TRACTION ON CANALS.—A powerful French company has recently sought to obtain from the French, Dutch and Belgian governments the right to establish electric traction on the waterways of these three countries. The intention is to construct a network of electric towage systems, stretching from the Rhine to Marseilles, through Eastern France, making use of the chief waterways of Belgium—the Meuse, the canal which connects the Meuse with the Scheldt, the Scheldt, the Terneuzen Canal, etc. Many of the canals of Northern France would also be connected with the Belgian canals and the upper Meuse by this system. It is rumored that this company has made proposals to the Brussels Maritime Company, both for the use of and for the construction of the Willeboeck Canal. The speed of boats hauled by electric traction would be one-third greater than with horses. In addition to [illegible] this system in use there would be greater certainty of travel, [illegible] allow coal dealers, for instance, to make contracts ahead of time.

THE ELECTRIC LIGHTING PLANT AT FOUSSERET (HAUTE GARONNE).—Many of the large towns are blocked in their attempts to in[illegible] the electric light on account of the existence of contracts with gas [illegible] with the smaller towns it is a different matter, and they have [illegible] coming into line in the march of progress, being un[illegible] which can keep them from utilizing to the fullest [illegible] in which electric energy can be placed at their disposal. [illegible] Fousseret, the county town in the department [illegible] Haute Garonne. This place has a population of about [illegible] and is [illegible] distant from the [illegible] a tributary of the Garonne. The [illegible] cubic feet, a fall of [illegible] feet [illegible] turbine of a new design, called the [illegible] and a minimum effi[illegible] guaranteed. The turbine drives two shunt wound [illegible] and [illegible] volts. The [illegible] distributed on the three-wire system. At present [illegible] incandescent lamps and four [illegible] incandescent lamps in [illegible] so that the [illegible] MM. Mon[illegible]

Tannoy et Compagnie, awarded the contract for building the plant to the Schabauer Construction Company, of Castres, whose engineers were warmly congratulated at the opening of the works by the municipality and the inhabitants. The Schabauer Company is not by any means new at this kind of work. They have, in fact, put up a number of plants in the South of France.

CENTENNIAL OF THE CONSERVATORY OF ARTS AND TRADES.

As the result of a decree dated the 12th Germinal, year 7 of the Republic (1797 of ordinary chronology), the Conservatory of Arts and Trades first took shape within the old walls of the Priory of St. Martin of the Fields at Paris. There is now nothing remaining of the abbey except the refectory, which has become a library, and the old chapel, which has been turned into a machine room. On Friday, June 24, the hundredth anniversary of the founding of this institution was celebrated by the opening of the exposition. The inauguration was conducted by the President of the Republic and the Minister of Commerce. Colonel Laussedat is the director of the conservatory. The chief electrical firms represented among the exhibitors were those of Digon, Ducretet, Dejardin, Gaeffe, Richard, etc. The new Dussaud micro-phonograph, built by the Telephone Company, and the silicon electric faggots of M. Le Roy attracted some attention. The firm of Richard showed some portable magnetic voltmeters and some recording voltmeters actuated thermically, which, being without self-induction, can be used on either alternating or direct currents. Also two recording voltmeters (one of 300,000 watts capacity, the other of 300,000) which complete the record which they furnish by giving the exact time of production of the energy. Also an energy meter combined with a recorder, which performs a similar duty. The Schneider Company, of Creusot, has on exhibition a three-phase alternator of 70 kilowatts capacity and 3000 volts, driven by a Thury direct-current motor. M. Ducretet performed some experiments in wireless telegraphy before a large audience, and M. Radigues gave some new experiments with Röntgen rays. The gardens, galleries and halls of the conservatory were brilliantly lighted at night by large numbers of acetylene lamps, furnished by the Metallic Carbide Company, and by arc lamps of all kinds furnished by the Clemeurcon Company.

General News.

NEW INCORPORATION.

ELECTRIC TERMINAL COMPANY, Cleveland; capital, $300,000; to erect buildings for the use of telephone and electric street railway companies. Incorporators: H. A. Everett, C. W. Wason, E. W. Moore,, B. Mahler, W. F. Carr.

THE TELEGRAPH AND TELEPHONE.

ALEXANDRIA, MINN.—The Village Council has granted the Alexandria Telephone Company the right to put in local telephone service.

LINCOLN, NEB.—The Nebraska Telephone Company is busy at work on extensions of its lines and the line between Seward and David City will be completed in a month, ready for public use.

MONROE, N. C.—Application has been made to incorporate the Monroe Telephone Exchange. The incorporators are John M. Blair, W. S. Lee, R. A. Morrow, C. W. Bruner, W. B. Houston and J. D. McRae.

DENVER, COL.—The Colorado Telephone Company has established a new line from Leadville to Granite, a distance of 18 miles. The line runs through Twin Lakes. Granite is south of Leadville on the Arkansas River.

ST. PAUL, MINN.—The Northwestern Bell Telephone Company has filed with the Secretary of State an amendment to the articles of incorporation providing for an increase in the capital stock of the company to $4,000,000.

SALINA, KAN.—The Missouri & Kansas Telephone Company has completed its line from Salina to Junction City. From there it is building a metallic circuit to Kansas City, and will be in connection with that place in about three weeks.

KALAMAZOO, MICH.—The Kalamazoo Mutual Telephone Company has asked the Council for a franchise to allow it to put its telephone wires in conduits under ground. The proposition comes from the company, as it claims such a system will be much cheaper to operate.

BOSTON, MASS.—Official statement of the Southern New England Telephone Company at New Haven shows the condition of the company June 30 as follows: Capital stock paid in, $2,511,000; debts, $573,986; credits, $188,774; real estate, $160,298; personal property, exclusive of patents, $2,680,944.

MONTREAL, QUE.—The directors of the Bell Telephone Company have decided to increase the capital of the company from $3,168,000 to $3,900,000. Each stockholder of record on July 29, 1898, is entitled to take at par shares of the new stock in the proportion of one share for every four shares now held.

JAMESTOWN, N. Y.—The Ripley Telephone Company, Ripley, N. Y., has been incorporated. The capital stock is $12,000. The directors are S. Fred Nixon, Vernon A. Kent, Otis L. Ingalls, Clayton J. Bannister, of Westfield; Fred N. Randall and J. Watson Burrows, of Ripley, and George H. Frost, of Buffalo.

CHICAGO, ILL.—There has been considerable increase in the business of the Chicago Telephone Company, as is indicated by the return to the city comptroller of 3 per cent. of the corporation's gross receipts from city lines during the first half of 1898. The gain for the first six months of the current year, as compared with the corresponding period in 1897, was equal to about 9 per cent.

DECATUR, ALA.—The American Bell Telephone Company now has a gang of about 200 men at work here pushing its line from this city to Birmingham and Montgomery. A large gang of workmen is erecting two towers 120 and 140 feet in height, which will be used to throw the wires across the Tennessee River, this plan being adopted instead of using the Southern Railway bridge, as was at first proposed.

PITTSFIELD, ILL.—At a meeting of the stockholders of the Pike County telephone lines it was decided to build a line to Pearl at once. An extension to Time and Montezuma was discussed and probably will be made at an early date. A plan to build to Versailles to connect with the lines of the Western Illinois Company has been taken under consideration, and will doubtless result in securing connection with Mt. Sterling before the summer is over.

MONONGAHELA, PA.—Rival telephone companies are about to clash in the Monongahela Valley. The Bell Company has had a monopoly in this territory, but the Maryland, Pennsylvania & West Virginia Company is now making strong competition. The latter has established exchanges at Uniontown and Connellsville, and is putting in an exchange at Masontown. The new company has purchased private lines to Farmington and Masontown from Uniontown, and is hustling to secure right of way to Brownsville and on down the Monongahela.

GOSHEN, IND.—The Goshen Telephone Company, with a capital stock of $30,000, has been incorporated. The system is to be a full metallic one, with 200 'phones and a capacity for 400. The incorporation papers include toll-lines in La Grange, Noble, Kosciusko, Elkhart and St. Joseph counties. The cost of the local plant will be about $20,000 when completed, and it is expected to be equipped with everything that is necessary to make it complete. The list of directors are James A. Arthur, George D. Lint, Wilson Roose, Ed. L. Barber and James S. Brailey.

SIOUX CITY, IA.—The Iowa Telephone Company will have connection in two weeks with Mapleton, Castana, Ute, Turin, Smithland and Rodney. Probably in two weeks the Sioux City exchange will be connected with two branches in Nebraska, which are connected with the Omaha system. The Nebraska Company is building in to meet the Iowa Company, and the Iowa Company is putting in two circuits between Sioux City and Dakota City. The Iowa Company is also building a line south from Cherokee along the branch of the Illinois Central to Onawa.

WASHINGTON, D. C.—The signal corps of the army in Porto Rico has constructed about 250 miles of telegraph and telephone lines, and more than half of the island is thus equipped. From Ponce four different lines radiate, and all are working in good order. The central office is in Ponce. One line runs to the east through Guayama to Arroyo to General Brooke's headquarters; a second line runs from Ponce to Coamo to General Wilson's headquarters; a third through Adjuntas and Utuado to the advanced lines of General Stone, and the fourth from Ponce to Yauco. The lines are being extended as the army advances.

WORCESTER, MASS.—The project of establishing a new telephone company in Worcester has been renewed, and the projectors have held several meetings of late and propose to immediately apply for a charter. The plan is to call it the People's Telephone Company, incorporate it under the laws of Massachusetts, with a paid-in capital of $150,000 and furnish telephone service at a much less price than is charged by the Bell Telephone Company. The men interested are I. L. Currier, Henry W. Aiken, C. H. Sanborn, Dr. Herbert L. Wheeler and Aldermen James H. Mellen. They state that they will give the best of local service at from $18 to $35 a year, according to the class and purpose of the instruments. A first-class house telephone they will rent for $25.

BOSTON, MASS.—In a circular to the stockholders of the New England Telephone & Telegraph Company, dated August 6, the board of directors orders that 5707 shares of the capital stock of the company now remaining unsold in the treasury be offered to stockholders for cash, at par, in proportion to their respective holdings. Each stockholder of record at the close of business Saturday, August 20, 1898, will be entitled to take, at $100 per share, shares of the stock to be sold in the proportion of one share for every twenty shares then held. This right to subscribe will expire at 1 o'clock in the afternoon of Saturday, September 24, 1898. Payment for the number of shares so subscribed for, at the rate of $100 for each share, must be made to the treasurer at his office on Wednesday, November 16, 1898.

ELECTRIC LIGHT AND POWER.

CRESCO, IA.—Cresco voted for an electric light plant.

GRAFTON, W. VA.—The election for the purpose of voting bonds for electric light purposes was carried by a large majority in favor of the proposition.

HEALDSBURG, CAL.—The plans and specifications for the city water works and electric lighting plant have been completed by Engineers Barnes and Dodge, and are now being printed to place before bidders.

GALLATIN, TENN.—The Board of Aldermen has decided that the town should put in an electric plant at its own expense. The following committee was appointed to procure estimates for plans suited for the purpose: W. G. Schamberger, R. M. Jones and John Fry.

PHILADELPHIA, PA.—The Pennsylvania Manufacturing, Light & Power Company, which recently purchased the Hestonville Railway Company's power house at Twenty-fifth and Callowhill Streets, is making arrangements for enlarging the station and converting it into one of the largest power plants in the country.

JERSEY CITY, N. J.—The Hudson County Electric Light Company, which has been operated for several years by the General Electric Company, has passed into the hands of a local syndicate represented by Edward F. C. Young, Bernard M. Shanley and Miles Tierney, who are connected with the North Jersey and Consolidated Traction Companies and the North Hudson County Railway Company. The company will be reorganized and new officers chosen.

CHICAGO, ILL.—Arrangements are being made by the Commonwealth Electric Company for an issue of $2,000,000 of 5 per cent. forty-five-year bonds. The total authorized issue will be $2,500,000, and the mortgage covering them will bear date of June 1, 1898. It will run to the Northern Trust Company as Trustee. The Commonwealth Company was organized some time ago to take all the [illegible] lighting and power business in the territory west of Ashland Avenue, south of Thirty-ninth Street and north of North Avenue. The consolidation of these companies was, it is stated, the work of interests closely identified with the Chicago Edison Company, and as a result the relations between those corporations will be harmonious.

CHICAGO, ILL.—It is stated that the Chicago Edison Company has completed the absorption of every company now furnishing electric light within the city limits. The names of the companies thus taken in are the Hyde Park Thomson-Houston, Hyde Park Electric Light & Power Company, People's Light & Power Company, People's Electric Light & Motor Power Company, Mutual Electric Light & Power Company, Englewood Electric Light Company, West Chicago Light & Power Company, Western Light & Power Company of Lakeview, Edgewater Electric Light & Power Company, Chicago Sectional Ground Company and the Commonwealth Company. The only company not included in the deal is the Cosmopolitan Company, and while it has a franchise and some wires laid it has not a plant, and is not prepared to engage in business.

THE ELECTRIC RAILWAY.

COLUMBUS, OHIO.—The Cincinnati, Hamilton, Middletown & Dayton Electric Street Railway Company has filed a certificate of a change of name to the Mill Creek Valley Railway.

SCHENECTADY, N. Y.—The General Electric Company has secured control of the Schenectady Illuminating Company and Schenectady Street Railway Company for a consideration of $750,000.

FAIRMOUNT, MINN.—M. T. Haines of this place is working up a scheme to build an electric railroad from Fairmount to Armstrong, and has already interested several of our local capitalists in the enterprise.

PETERSBURG, VA.—At a meeting of the Common Council an ordinance was passed granting a franchise to the Piedmont Traction Company, of Charlottesville, to build an electric street railroad in the city. The company will begin the construction of the road at once.

FRANKLIN, R. I.—The initiative has been taken by the Milford & Franklin Street Railway Company in securing the right of way for an electric road between here and Milford, Woonsocket, the Uxbridges and Wrentham. There is little doubt that the franchise will be granted.

ELIZABETH, N. J.—One of the largest bids for a trolley franchise was made on August 4 to the Union County Board of Freeholders by ex-Congressman John Kean. The bid was for $250,000, provided the franchise for the Westfield Avenue road to Plainfield was made for seventy-five years. Mr. Kean made the proposition in the name of the Elizabeth Street Railway Company, which he owns.

RICHMOND, VA.—The motormen and conductors of the Main Street line of the Richmond Railway & Electric Company tied up the line for an hour on the morning of August 7. The company proposed a cut in the wages of the motormen and conductors of nearly 50 per cent. and the men refused to go to work. After holding out an hour the company agreed to pay the regular wages for the day. It is thought that the end of the trouble is not yet.

QUINCY, ILL.—The entire electric street railway system was sold on August 5 to a Maine syndicate represented by W. B. McKinley, of Chicago. The same syndicate controls the street car systems and the electric light plants in Joliet, Bay City, Champaign, Springfield, Ohio; Trenton, Mo., and other cities. The consideration paid here was about $220,000. The syndicate will at [illegible] extensions and rolling stock. Capitalists in the same syndicate expect to close deals for the gas works and Thomson-Houston elec- [illegible] a few weeks. If all the plans are completed an invest- [illegible] likely.

BROOKLYN, N. Y.—In the County Clerk's office have been filed the formal papers in the merging of the Nassau Electric Railroad Company, the Coney Island, Fort Hamilton and Brooklyn Railroad Company with the Kings County Electric Railroad Company and the Union Railroad Company. The consent was also filed of the State Railroad Commission to the increase [illegible] Company from $[illegible] to $[illegible], which [illegible] 4 per cent. preferred stock and $8,5[illegible] [illegible]. The [illegible] of the Nassau Company are $[illegible] in [illegible] a floating debt of $[illegible] and $[illegible] permanent [illegible].

[illegible]—The employees of the Syracuse Rapid Transit Railway Company, including motormen, conductors, trackmen, engineers and firemen, [illegible] at a meeting in which the men [illegible] to make a deposit of [illegible]. The demands of the employees were refused by [illegible] ordered the interurban [illegible]. The Rapid Transit Company [illegible] from the men.

Trade and Industrial Notes.

[illegible]

[illegible]

[illegible]

slight pressure on the keys and has many other valuable features, not the least of which is the fact that it is sold at a low price.

THE OPEN HEARTH STEEL PLANT of the Sargent Company, of Chicago, has been running for the past few months at its fullest capacity on several large contracts, among which may be mentioned the castings for 10-inch gun carriages for the United States Government. The Sargent Company states that it has been very successful in this class of work, readily meeting the physical tests prescribed by the Government, as well as the short delivery, which is demanded in most cases.

DISSOLUTION OF PARTNERSHIP.—The co-partnership heretofore existing between Edgar H. Freeman, Walter H. Tobey and another, engaged in the business of electrical contracting and the sale of electrical supplies at No. 32 North Water Street, Rochester, N. Y., under the firm name and style of "Standard Electric Construction Company," was dissolved by mutual consent on June 23, 1898. The business will be continued under the same firm name and style by Edgar H. Freeman and Burton A. Vandy, who assume all the obligations of the old concern.

STANDARD INTEGRATING WATTMETERS.—The Government of Victoria, Australia, has placed an order with the General Electric Company for six 100-volt Thomson integrating wattmeters of varying capacities. These will be deposited in the electrical bureau of the home office of Victoria, and will be used as the official standards by which all electricity meters used in the colony will be tested. In future no meters measuring electrical energy will be allowed to go into service in Victoria unless they agree with those just ordered and receive the final sanction of the Victoria Government.

AMONG THE EXHIBITS at the coming convention of the American Street Railway Association, Boston, will be the following apparatus of the Walker Company: A section of the Walker underground conduit system, with car in operation; a 15-L railway motor in operation, a 15-L motor open to show construction, a 33-S motor mounted, a 33-S motor open, a set of 33-S armatures in various stages of construction, a set of 33-S motor parts, a Walker standard trolley, Walker standard railway switchboard panels, with wattmeter, type "S" controllers in operation, and solenoid partitions open and in operation.

THE PARTRIDGE CARBON COMPANY, of Sandusky, Ohio, manufacturer of carbon self-lubricating generator and motor brushes, will be represented at the Boston convention of the American Street Railway Association by Mr. J. S. Speer, secretary of the company. Mr. Speer will be on the ground with samples of the self-lubricating brush, and will be prepared to explain and show its valuable qualities as well as the qualities of the company's electric light carbons for arc lamps of every description. The excellent quality of the Partridge carbons has succeeded in building up for this company an enviable business, which is increasing with tremendous strides.

THE SAMSON BATTERY IN THE WEST.—The Central Electric Company, of Chicago, which is acting as the Western distributer for the various types of Samson batteries, reports a large and continuously increasing use of this product. The Samson battery has attained an enviable reputation as the proper battery for use in heavy service, quite recently introduced by the new Samson semi-dry battery, which has extra heavy zincs and large carbons contained in a porcelain jar and sealed. Its ampere output is very large, and as it is portable it is adapted for use under conditions where open batteries could not be used. The Central Electric Company is carrying large stocks of all Samson types, and is prepared to make immediate shipment on all orders.

MR. H. M. FISK, Wheaton, Ill., manufactures a telephone switchboard which possesses some desirable features. Each drop is complete in itself, and there are no joints to solder. It is easily operated; a simple pressure of the plug to one side as the plug is inserted places the operator in communication with the calling subscriber, and by pressing the connecting plug to the other side connects the subscriber with the operator's generator. The coils are wound suitable to any system of wiring. The board has been thoroughly tested at Wheaton for the past year, and has therefore passed beyond the experimental stage of its development. It is reported to have been found rapid, efficient and in every way satisfactory. The workmanship is the best, and the board is recommended by Mr. Fisk as being a near approach to perfection.

ANOTHER ADDITION TO THE GENERAL ELECTRIC WORKS.—Work on the machine shop of the General Electric Company at Schenectady was begun last week, when ground was broken for what will be a most important addition to the manufacturing facilities of that company. The contracts were let last week to A. & R. Roberts, of the Pencoyd Iron Works, Philadelphia, for the steel construction and to J. J. Turner, of Amsterdam, N. Y., for the masonry, etc. The cost of the new building is estimated at $175,000. The new machine shop will face on the central avenue, opposite building No. 1[illegible]. It will be 653 feet long and 166 feet wide, and will be divided into three aisles, the central one having a width of 65 feet, the side aisles being each about 50 feet wide. The total floor space of this building will be not less than 144,250 square feet. It will contain the machinery necessary to handle the very large apparatus which the requirements of modern practice have rendered necessary. The need of such an addition to the manufacturing facilities of the company can be appreciated after a visit to the factory at Schenectady at the present time. The many orders both for large machinery and for large quantities of apparatus are severely taxing the facilities, and such has been the rush of orders that the traveler on the New York Central Railroad as he passes the town at night, sees at least half of the buildings lighted up and filled with employees busily engaged in pushing forward to completion the orders in hand. The working at night [illegible] has been carried on since the beginning of the year and according to the superintendent there are few signs of the practice being abandoned for the present. It is expected that the new machine shop will be completed before the end of the year. The machinery will be driven by the current transmitted from Mechanicville, 1[illegible] miles distant. In addition to the new machine shop the company is making several important [illegible] to other buildings. The new foundry, which was recently [illegible] in [illegible] the [illegible] work, the support for the great [illegible] having been erected last week. It is claimed that this building [illegible] will contain the largest foundry under one roof in the world.

CONCENTRATION OF POWER BY ELECTRIC TRANSMISSION. One of the most forcible of the advantages of electrical transmission of power is that this method often makes it possible to combine two or more steam plants into one, greatly diminishing the cost of labor and supplies. Such an advantage appeals especially to the mill owner, who may operate shafting in several buildings or departments by separate sources of power. A conspicuous example of this wasteful arrangement is in the works of one of the largest locomotive shops of the country, where part of the plant is operated by water power, part by steam power, and part by compressed air, the latter necessitating an extra engine and compressor. The polyphase system of electric transmission as developed by the Westinghouse Company has made it possible to centralize the power in such shops. When Lieut. L. O. Garrett took charge of the affairs of the Atlas Tack Company, of Taunton, Mass., as manager, he instituted a thorough investigation as to the power required for the various classes of tack making machinery under normal conditions. The mills of this company at Taunton are three in number, located from 800 to 1200 feet apart, and were until recently operated by three separate steam plants, with the accompanying wastefulness incident to small units. It was found that, owing to variations in the amount of power required from day to day for the different classes of work, the duty of the three steam plants could be easily performed by a single steam plant of two-thirds their united capacity. So large a saving in coal and labor as was expected from this arrangement induced Lieutenant Garrett to engage the services of Mr. T. W. Sprague, of Boston, Mass., to investigate jointly with him the various systems of transmission. The parties interested inspected personally a number of the principal polyphase plants among the New England mills, and finally selected the Westinghouse three-phase system, 3600 alternations, as best adapted to the work of the Atlas Tack Company. This system, in connection with the Tesla "Type C" motors, made by the Westinghouse Electric & Manufacturing Company, has, it is stated, attained marked success in every instance in which a plant has adopted it, and the alternate-current motor, though developed later than the direct-current motor, has been favorably received in all such installations. The Atlas Tack Company is to use a 150-kw Westinghouse generator, which will operate nine Telsa induction motors of the above type, ranging from 3 to 50 horse-power, in the various mills. The gas lighting system of the mills will be replaced by about 1000 incandescent lights.

TRADE AND MISCELLANEOUS PUBLICATIONS.

A CATALOGUE OF THE MACHINE TOOLS manufactured by the Springfield Machine Tool Company, the Whitney Manufacturing Company and the Builders' Iron Foundry, for which Messrs. Patterson, Gottfried & Hunter, 146-150 Centre Street, New York, are agents, has been issued by the last-named house.

"HOW TO SELECT A DYNAMO" is the title of Circular No. 1079, issued by the Walker Company, under date of August 3. The principal features of Walker dynamos are described, illustrations being plentifully used to aid to a better understanding of the points that it is desired to bring out most prominently.

ASBESTOS MATERIALS for pipe covering, roofing, etc., are illustrated and described in a little pamphlet issued by the H. F. Watson Company, Erie, Pa., for which concern Mr. James J. Moran, 98 Maiden lane, New York, is agent. The asbestos materials include pipe and boiler coverings, ammonia and brine pipe covering, asbestos cement filling, retort cement, furnace cement, flexible roofing cement, millboard, sheathing, gaskets, rod packing, etc., etc.

THE DECENNIAL number of the Pratt Institute catalogue (1897-98) describes the aim and scope of this worthy Brooklyn institution. The courses of instruction include fine arts, domestic art, domestice science and science and technology. The Pratt Institute began its work in 1887 with twelve students, and in the succeeding ten years gave training to 25,528 students, and granted diplomas and certificates to 948 students. The two-year courses in drawing and machine design and applied electricity are filling a want that has for a long time been felt in the field of technical education. The aim of the institute is to make its work thoroughly practical.

THE D. VAN NOSTRAND COMPANY, New York City, announce the early publication of the first distinctively American pocketbook of rules, formulæ and tables for electrical engineers, to be edited by Mr. Horatio A. Foster, in collaboration with many specialists. The book has been written with the idea of filling a "long-felt want" for an American pocketbook; the data have been selected with very considerable care, and each chapter has been edited and revised by a specialist in that particular subject. The book is not intended for a text book, nor is it meant to be an encyclopedia, but simply a collection of rules, tables and formulæ which will be found handy for reference by the practicing engineer. Its title will be "Electrical Engineers' Pocketbook."

A COMBINED CATALOGUE has been issued by Messrs. Smith & Hemenway, the Utica Drop Forge & Tool Company, the Swedish Razor Company and the Ericsson Telephone Company, all of No. 20 Warren Street, New York City. Among the goods dealt in by the first-named firm are nippers and side-cutting pliers; the Utica Drop Forge & Tool Company also carries a line of pliers of all kinds, and the Ericsson Telephone Company, as is well known, is manufacturer and importer of Ericsson Swedish telephones. In the section of the catalogue devoted to the goods of the last-named concern wall sets, desk sets and interior sets are illustrated and their particular features briefly pointed out. The Ericsson Swedish long-distance transmitter, induction coils, double-pole receiver and the coal-grain microphone are similarly treated.

CHLORIDE ACCUMULATORS IN ELECTRIC RAILWAY SERVICE.—The Electric Storage Battery Company, of Philadelphia, has brought out a bulletin describing and illustrating the installation of chloride accumulators for the Buffalo Street Railway Company. The popularity of this rather new use of storage batteries is shown by the following list of railways now using or constructing chloride accumulators for this purpose: The Union Traction Company, Philadelphia; the Easton (Pa.) Edison Company, the Woonsocket (R. I.) Electric Machine & Power Company, the Central Railway of Baltimore, the Barre & Montpelier (Vt.) Railway Company, the Electric Railway, Light & Power Company, Anaconda, Mont.; the United Traction Company, of Pittsburg, Pa.; the Union Street Railway Company, Framingham, Mass.; the Potomac Electric Light & Power Company, Washington, D. C., and the Consolidated Traction Company, of Pittsburg, Pa. (two stations).

THE BINGHAMTON RAILROAD COMPANY, Binghamton, N. Y., has recently issued its annual Binghamton souvenir for 1898. The book this year surpasses every one of its predecessors in size and artistic excellence, and is a very handsome piece of work. It is profusely illustrated with very clear half-tone views of the city and its features. On the front page are given bird's-eye views of the city as it appeared in 1856 and in 1898. The book is devoted to a description and illustrations of Binghamton and its interests, "and incidentally to boom street railroad traffic." The illustrations show Binghamton to be an interesting and busy town, and to have an air of general prosperity. An excellent description of the Binghamton Railroad Company's system is given. It shows what a powerful influence for the general public good can be exerted by a well-managed railroad company. Mr. G. T. Rogers is the president of the Binghamton Railroad Company. He is one of the most energetic and progressive of street railway men.

APPRECIATION OF THE "IMPERIAL LAMP GAZETTE."—The London "Electrical Engineer" has the following kind words to say of THE ELECTRICAL WORLD and the "Imperial Lamp Gazette": THE ELECTRICAL WORLD is publishing, with the first issue of every month, in its advertising columns, three pages of most interesting and valuable information in connection with incandescent lamps for the Bryan-Marsh Company, of New York City. This latter company has adopted this novel and attractive manner of not only advertising its own excellent product, but in connection therewith gives a current discussion of timely topics on the incandescent lamp, the manufacture of which is in itself an enormous industry. It is called the "Imperial Lamp Gazette," and will certainly be looked forward to by every one interested in the incandescent lamp from any standpoint with the greatest interest. Thus in fact a journal within a journal is obtained, over which the advertiser has complete control. This is a great advantage, and the lamp company is able, by giving useful information, to insure that its three-page advertisements are read, as they certainly are not when they consist of catalogue matter only.

UNITED STATES PATENTS ISSUED AUGUST 9, 1898.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

608,614. PLATE FOR SECONDARY GALVANIC BATTERIES AND COMPOSITION FOR PRODUCING SAME; C. Marschner, of Berlin, Germany. App. filed Sept. 30, 1896. A filling composition for the plates of secondary batteries, consisting of an active material, such as lead oxide, and a binding medium composed of a solution of a fossil gum.

608,637. SUPPORTING CLIP FOR OVERHEAD ELECTRIC CONDUCTORS; W. A. Bartley, of Boston, Mass. App. filed May 23, 1898. A clip for overhead electric conductors, comprising two interlocking members provided respectively with fingers to engage opposite sides of the conductor, body portions diagonally opposite said fingers, a sliding clamp adapted to be forced into engagement with the outer surface of said body portions, and means for retaining said clamp after it has been forced into operative position.

608,685. LIGHTNING ARRESTER; J. F. Kelly, of Pittsfield, Mass. App. filed Dec. 16, 1895. A lightning arrester, consisting of a non-conducting containing vessel, in combination with a column of conducting or semi-conducting bodies, in bad contact with one another, within said vessel and suitable terminals in contact with the ends of the column, respectively.

608,711. ELECTRIC MOTOR; W. H. Powell, of Erie, Pa. App. filed Nov. 4, 1897. A compound wound electric motor, having each of its poles divided into three or more parts, the end parts carrying shunt windings and the middle parts the series windings.

608,714. STORAGE BATTERY; J. D. Rively, of Pittsburg, Pa. App. filed June 9, 1897. A storage battery, consisting of a series of perforated boxes, and of layers of fibre, oxide of lead and plates of conducting material, said plates terminating in positive and negative poles.

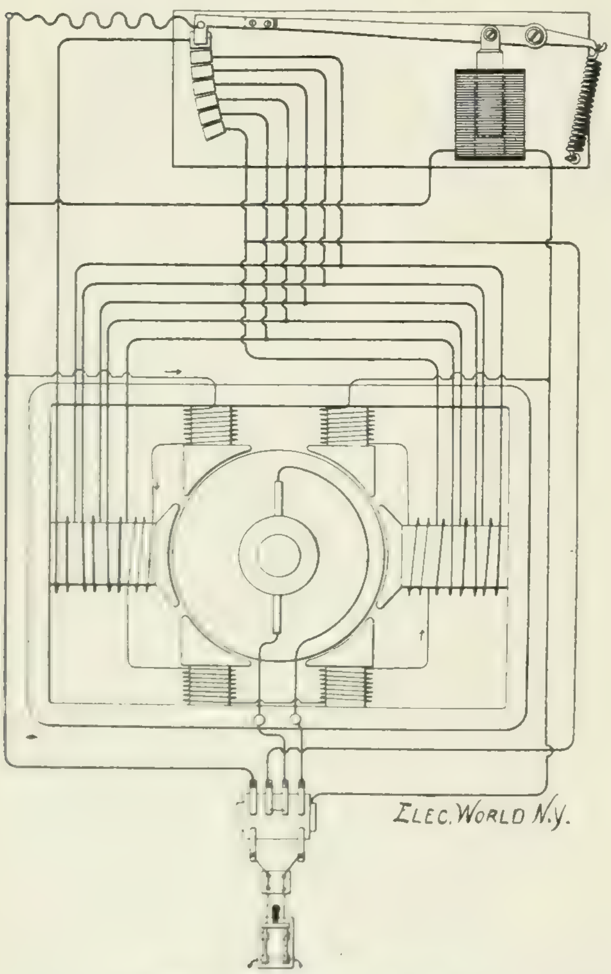
608,721. AUTOMATIC ELECTRIC REGULATOR; R. Skeen, of St. Louis, Mo. App. filed Oct. 23, 1897. An automatic electric regulator, comprising a series of contact points, and actuating means to energize them successively, in combination with a series of lamps or other devices on an electric circuit, of an interposed safety cut-out, consisting of a pivoted bar, one end normally communicating with one or more of said contacts, and the other end adapted to be operated in the extreme position of said actuating means, and insulation interposed between the contact points of said means and pivoted bar.

[illegible]. ELECTRIC ARC LAMP; [illegible] Spencer, of Philadelphia, Pa. App. filed Sept. [illegible]. An alternating current arc lamp, provided with a regulating coil and a cut-out actuated when the arc is sprung to cut down the current strength, whereby a starting current of abnormal strength is admitted to the electrodes

608,736. BOND FOR RAILS; G. A. Weber, of New York, N. Y. App. filed Feb. 7, 1898. The combination with the meeting ends of adjacent rails, fish plates therefor, a bond on both sides of the web of each rail and extending along the same across the joint formed by the said rail ends, and an elastic packing intermediate each bond and adjacent fish plate.

608,755. APPARATUS FOR STORING AND USING SOLAR HEAT; H. Cottle, of Boston, Mass., and J. J. Pratt, of Revere, Mass. App. filed Dec. 11, 1897. An apparatus comprising a body of heat retaining material occupying an excavation or recess in the ground, means for heating the body of material, and means for converting the energy of heat from said material into energy of electricity.

608,842. ELECTRIC METER AND MOTOR; H. P. Davis, of Pittsburg, F. Conrad, of Wilkensburg, Pa. App. filed June 18, 1898. The combination in an electric meter, of a main actuating means for propelling the [illegible] independent [illegible].



No. [illegible],711.—Electric Motor.

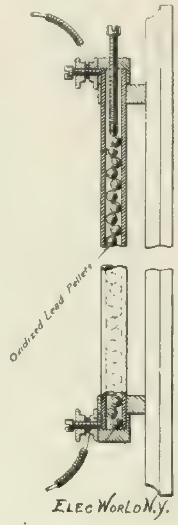
[illegible]. TELEGRAPH REPEATER; H. F. [illegible], of Cincinnati, Ohio. App. filed [illegible]. A relay having two opposing electromagnets [illegible] located between said electromagnets [illegible] and a movable contact [illegible] permanently connected to the [illegible] the other [illegible] connected with the other [illegible].

[illegible]. SWITCH FOR VARYING ELECTRICAL RESISTANCE; [illegible]. In a switch [illegible] a series of conduct[illegible].

[illegible]. INSULATION OF ELECTRIC WIRES; [illegible] currents of high potential, consisting of a surrounding insulating sleeve and [illegible].

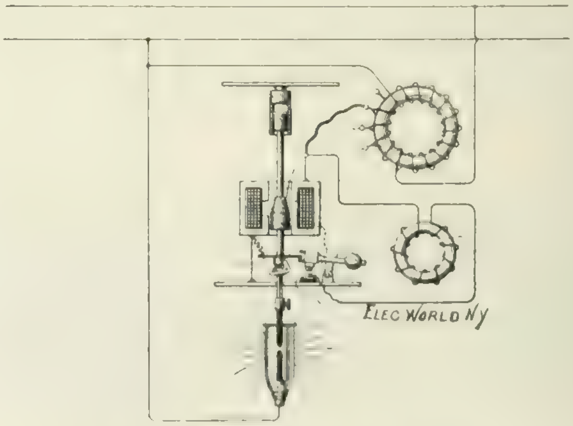
608,911. ELECTRIC CABLE; H. A. Reed, of Newark, N. J. App. filed Oct. 24, 1896. A sheathing or armor for electric cables, consisting of spirally laid wires of copper or other non-magnetic metal.

608,928. APPARATUS FOR HEATING AIR FOR THERAPEUTIC OR OTHER PURPOSES; W. Taylor, of Edinburgh, Scotland. App. filed Dec. 21, 1897. The herein described portable apparatus for producing a heated current of air or gas for therapeutic or other purposes, comprising a casing, a directing tube mounted upon and carried by the said casing, a tube of non-conducting material concentrically within said directing tube, an exposed resistance coil mounted upon the said concentric tube and forming part of an electric circuit, and means within the casing for forcing a continuous current of air or gas through the directing and concentric tubes, whereby air or gas passing through the concentric tube and between the outer walls of said tube, and the inner walls of the directing tube is heated thereby.



No. 608,685.—Lightning Arrester

608,932. TELEGRAPHY; G. V. Trott, of Chicago, Ill. App. filed Aug. 13, 1897. The combination with a centrally pivoted switch arm, of contact plates, carried thereby upon each side of its pivot, two circuits, contact-forming terminals thereof which are adapted to be closed by the contact plates carried by the switch when the switch occupies one position, whereby two independent circuits are completed, and a second set of contacts adapted when the switch occupies another position to engage the contact plates carried by the switch, whereby the independent circuits are opened and formed into one complete circuit, the conductors of each circuit being thereby included in series.



No. 608,723.—Electric Arc Lamp.

[illegible]. ELECTRICAL COOKING APPARATUS; E. B. Cary, of Baltimore, Md. App. filed March 14, 1898. In an electrical cooking apparatus, the combination of two boxes, each one having therein heating wires and a corrugated tray situated over the wires, and strap hinges, one member of the same being adjustably attached to a box, whereby the boxes may be separated and held in a separated position.

[illegible]. STEAM WHISTLE; E. A. Davey, of Detroit, Mich. App. filed June [illegible]. In a whistle valve, a main steam valve, comprising a freely sliding piston, heads thereon of different area, seats around each head, seats in the casing against which the seats on the piston respectively bear, the steam passage to the whistle leading to and controlled by the smaller head and an auxiliary valve controlled passage leading to the larger head, having an exhaust thereon.

The Electrical World.

Vol. XXXII. NEW YORK, AUGUST 27, 1898. No. 9.

PUBLISHED EVERY SATURDAY BY

The W. J. JOHNSTON COMPANY,

9 Murray Street, New York.

Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York.

New England Office, 620 Atlantic Ave., Boston.
Western Office, 936 Monadnock Block, Chicago.
Philadelphia Office, 929 Chestnut Street.

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9 Murray Street, New York.

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AMERICAN ELECTRICAL EXHIBITS AT PARIS.

Now that the war is practically over, and it is evident that the country is about to enjoy a period of vast expansion of trade, it seems eminently proper that the attention of the electrical industry should be directed to the necessity for making an exhibit that will do it credit at the international exposition of 1900. Looking at the matter from a purely business standpoint, the country has been well advertised by the achievements of its arms, and the reputation of American machinery and methods has been enormously enhanced by the admirable work of the navy. We are therefore in a position to command a respectful hearing for our claims to pre-eminence in the engineering arts, and the opportunity offered at Paris is too good to lose. It is evident that we may look for our market in any quarter of the globe with less fear of successful competition than ever before. Our pre-eminence in electrical manufactures is incontestable, but it is not well to let pass the chance to make it evident to all who will see. The industrial development of Asia has only begun, and there is in Europe a vast field for our enterprise. There seems, then, to be every reason why American manufacturers should combine to make the American section at the exposition worthy of their reputation and of their country. Motives of expedience, of profit and of patriotism should unite to inspire the manufacturers here to excel their best former efforts and show the world what we can do in the arts of peace as a fit sequence to the exhibition but lately given of what we can do in war.

THE GENERAL ELECTRIC'S REDUCTION.

After a short delay caused by opposition of a technical legal character on the part of dissenting preferred stockholders the reduction of the General Electric Company's share capital from $34,712,000 to $20,827,200 was duly ratified at the adjourned meeting held in Schenectady, N. Y., on August 17. This settles the question of the reduction, and the company's books have been promptly closed for the carrying out of the plan, the exchange of the old stock for the new being scheduled to take place in about a month.

It does not seem that the opposition met with the approval of even a majority of the preferred shareholders, but in view of the company's circumstances the outcome now determined upon seems to have been about as fair a solution of the trouble as could be devised. By wiping out the impairment of capital, which is what this reduction of 30 per cent. in the outstanding stock virtually amounts to, the company at last corrects the error made when it was originally formed. As frankly stated in the circular issued by the directors in July this consisted of an overvaluation of patents, franchises and good will.

Having gotten rid of this cause of many trials and tribulations the company is now in a position to give its stockholders the benefit of the more profitable business conditions which are apparently coming in the industrial world. The facts in this case should serve as a warning against unwarranted overcapitalization and lack of preparation for hard times, or the changed conditions which are liable to occur in fields like the electrical, in which the prosperity of companies is likely to be affected by the advances in the sciences on which they are based. While no definite figures regarding the General Electric's earnings and profits are given to the public there is no doubt that the management can redeem the pledge conveyed in its circular that from this time on it can pay full dividends on the reduced amounts of both classes of stock, which will be $2,551,200 of preferred and $18,276,000 of common. Under the circumstances the stockholders appear to have acted wisely in accepting the reduction.

FREQUENCY OF LIGHTNING DISTURBANCES IN ELECTRICAL APPARATUS.

There may be found on another page of this issue an article by Mr. C. P. Steinmetz, discussing the frequency of discharges set up in electrical transmission lines by lightning and other disturbances. In this connection it might be seen at first sight as though the frequency of the lightning discharge itself would be an important factor in that it would inductively impress itself upon the line and affect particularly such parts of the line as were approximately tuned by virtue of capacity and self-induction to resonance therewith. This, however, is probably not an important consideration due to the nature of the lightning discharge and its action upon the line. Mr. Steinmetz advances the idea that the lightning discharge proper may not be as a whole oscillatory. The stroke may start as a small discharge from rain or cloud particle to particle which occurs as soon as the difference in potential between the two drops of water rises to a sufficient value to strike across the intervening air gap, this almost infinitesimal equalization spreading from drop to drop, in general along the path of greatest charge of potential, increasing in intensity by accumulation of the charge of successive particles or decreasing and dying out when reaching parts of the cloud having lesser electrostatic charges. Thus the lightning stroke would be made up of an infinite series of successive discharges following each other as the disturbance spreads through space, and while each of these discharges might in itself be oscillatory the stroke as a whole would not have a definite period of oscillation. This theory is borne out more or less by the photographic reproductions of lightning discharges which show numerous forks and branches deviating from the main path throughout its length, these branches being as a rule inclined so as to follow more or less closely the general direction through space of the potential gradient. The theory is also borne out, as Mr. Steinmetz states, by the fact that it would not require such an extraordinarily high potential as would be required for a single stroke across a mile or so of space. This hypothesis would not apply, however, to a stroke to ground which might be considered the result of a gradual accumulation of small discharges until the aggregate accumulated sufficient volume to leap over the intervening space to the earth.

The principal effect of a lightning discharge in any case on an overhead transmission wire is a statically inductive one, instances of an actual stroke to the wires being rare. The accumulated charge in a cloud attracts and binds to the surface of all conductors near it and connected with the ground a charge of the opposite polarity. The transmission line below the cloud is sufficiently well connected with the ground (no matter how highly insulated) to gradually accumulate through leakage this static charge, its potential thus remaining the same as that of the ground below it, so long as the overhead charge remains unchanged. When, however, the charge of the cloud is neutralized by a lightning discharge to a neighboring cloud, the bound charge on the [illegible] is practically released and flows off, [illegible] a difference of potential of many thousands of volts between the line and the ground. This tends to discharge disruptively, and, owing to the influence of capacity and self-induction, to oscillate. The oscillations thus set up will be [illegible] by the conditions of the line so that the frequency can be correctly determined as Mr. Steinmetz derives it on another page by a quantitative discussion of the electrical properties thereof. As shown there the distribution of the line capacity renders the oscillations of an exceedingly complex wave form, with a fundamental not very much higher than frequencies in commercial use and a large number of harmonics.

Several valuable conclusions may be drawn from this, one being that ordinary choking coils, which might be effective against discharges of a greatly higher frequency, comparable with Hertz waves oscillations, for example, are absolutely ineffective with lightning discharges. One conclusion is that experimental operations with static machines and Leyden jars cannot represent the conditions of a long-distance transmission line and thus do not give reliable tests with lightning arresters, since such experimental tests give oscillations of one definite frequency and resonance phenomena for this frequency only.

SINGLE VERSUS MULTIPHASE SYSTEMS.

In the paper read by Mr. Ernst J. Berg before the recent meeting of the Ohio Electric Light Association, an abstract of which will be found in another column, the growing popularity of multiphase systems, especially of the two-phase, is strongly disapproved. Mr. Berg considers the use of the multiphase as only excusable where the distance of transmission is so great that the closest economy of copper with the highest permissible voltage is essential or where rotary transformers and direct-current distribution are used. Mr. Berg considers complete parallel operation an important requirement and does not, therefore, approve of the division of a lighting system between two phases. An advantage of the multiphase that Mr. Berg does not mention in his comparison is the improved economy of copper in the armatures of such machines and the more uniform reaction of such armatures.

On the question of frequency Mr. Berg also disapproves of recent tendencies and believes in the higher frequencies formerly considered best. This is also in spite of the fact that he brings out a new argument against such frequencies. This argument is the better action of dynamos in multiple with a lower periodicity. When two machines driven by engines, the angular velocity of which varies somewhat during each rotation, are run in multiple, if their frequency and the number of poles is high, a very small relative angular displacement will throw them considerably out of phase, while with a lower frequency and consequently a reduced number of poles the same angular displacement will make a correspondingly smaller phase displacement. On this account Mr. Berg states that it is often advisable to use lower frequencies rather than higher, but advises for lighting or alternating current distribution the use of sixty cycles at least, while for purely rotary converter purposes a lower frequency is permissible.

A New Cable Between the United States and France.

On August 17 the new cable of the French Telegraphic Cable Company was officially opened by the transmission of congratulatory messages between President McKinley and President Faure. The new cable runs from a landing on Cape Cod direct to Brest, being some 3400 land miles in length, the longest unbroken cable across the Atlantic. This is the second transatlantic cable of the French company, its older cable running via a landing on St. Clair Island, south of Newfoundland, where the messages are repeated. The new cable is single conductor, and for the present will be worked simplex, but will later be duplexed.

Resonance in Wireless Telegraphy.

Those interested in the subject of telegraphy by means of Hertzian waves will find considerable information of interest in the patent of Oliver Joseph Lodge, No. 609,154, issued August 16, 1898, and noted in the record of electrical patents on another page of this paper.

The Largest Induction Motor in the World.

The accompanying photographs represent a two-phase motor for 1000 brake horse-power which has just been turned out from the works of Messrs. Brown, Boveri & Co., of Baden, Switzerland. As this is probably considerably the largest induction motor in the world, some details may be of interest.

The motor is intended to work in the municipal pumping station of the city of Geneva. The existing pumps, of the piston type, are driven direct by turbines, but as no further water power was available for extensions it was decided to put down a centrifugal pump driven by a two-phase motor deriving its power from the electric power house of Chèvres, some miles farther down the river. The pump for the exceptionally high lift of 460 feet is from the works of Sulzer Brothers, of Winterthur, and will be coupled directly to the motor here shown.

The motor is wound with ten poles, so as to run at a speed of 544 revolutions per minute when fully loaded, the frequency of the supply being 46 cycles per second. It is supplied directly with the high-tension current at 2500 volts. The total weight of the motor is 27 tons. It will be seen that the front cover plate is made to slide out on the prolonged bed-plate, so as to facilitate the removal of the rotating part. The circuits of the latter are brought out through the hollow shaft to three contact rings, for the use of a separate starting resistance in the secondary.*

The Natural Period of a Transmission Line and the Frequency of Lightning Discharges Therefrom.

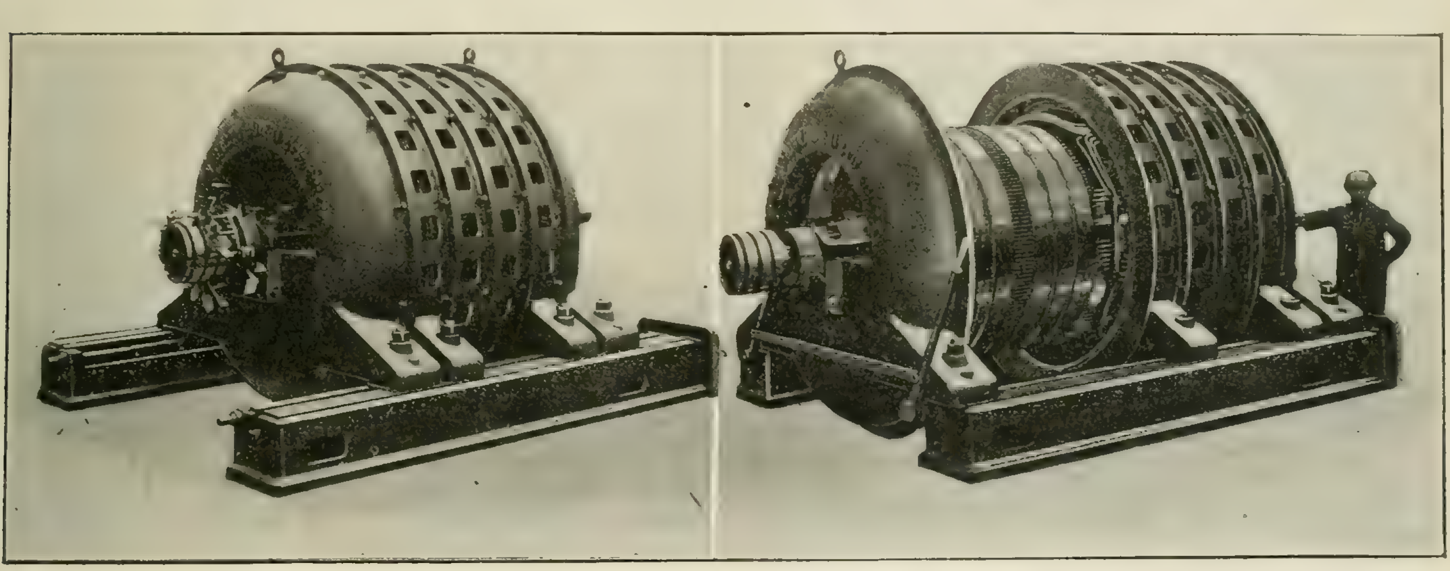
BY CHARLES PROTEUS STEINMETZ.

The discharge of a condenser through a circuit containing self-induction and resistance is oscillating (provided that the resistance does not exceed a certain critical value depending upon the capacity and the self-induction). That is, the discharge current alternates with constantly decreasing intensity. The frequency of this oscillating discharge depends upon the capacity, *C*, and the self-induction, *L*, of the circuit, and to a much lesser extent upon the resistance, so that if the resistance of the circuit is not excessive the frequency of oscillation can with fair, or even close, approximation be derived by neglecting the resistance, by the formula

$$N = \frac{1}{2 \pi \sqrt{C L}}$$

An electric transmission line represents a capacity as well as a self-induction, and thus when charged to a certain potential, for instance, by atmospheric electricity, as by induction from a thunder cloud passing over or near the line, the transmission line discharges by an oscillating current.

Such a transmission line differs, however, from an ordinary condenser, in that with the former the capacity and the self-induction are distributed along the circuit.



A 1000-HP INDUCTION MOTOR.

The power house at Chèvres is also undergoing complete reconstruction, six new generators of 1200 horse-power each being now in course of construction in Messrs. Brown, Boveri & Co.'s works, as well as a new switchboard for all the generators and circuits, this switchboard being no less than 85 feet in length.

Convention of the Association of Fire and Police Telegraph Superintendents and Municipal Electricians.

This association held its last meeting in Elmira, N. Y., on August 9, 10 and 11. About sixty delegates were in attendance. They were welcomed to the city and entertained pleasantly. Several valuable papers were read and the following officers were elected for the coming year: President, J. W. Aydon, Wilmington, Del.; vice-president, C. T. MacDonald, Ottawa, Can.; treasurer, Adam Boesch, Newark, N. J.; secretary, H. T. Blackwell, Jr., New York; financial secretary, Burt McAllister, Bradford, Pa. The next meeting will be held in Wilmington, Del.

A New Source of Carbon for Calcium Carbide.

In a large lumber yard near Ottawa, Canada, there has been installed a retort for producing carbon from sawdust. It is almost needless to remark that this material is cheap, in fact so cheap that it is a matter of considerable expense in many large lumber yards to dispose of it by burning or otherwise. It is claimed that the charcoal obtained is purer than coke, and is therefore better suited to making calcium carbide.

The object of the following is to determine the frequency of the oscillating discharge of such a transmission line, which is the frequency of the discharge of atmospheric electricity, or of the oscillation set up when suddenly changing the condition of the circuit, as, for instance, opening the circuit.

For this purpose sufficiently close approximation is derived by neglecting the resistance of the line, which, at the relatively high frequency of oscillating discharges, is small compared with the reactance. This assumption means that the dying out of the discharge current by the resistance of the circuit is neglected, and the current assumed as alternating current of approximately the same frequency and the same intensity as the initial waves of the oscillating discharge current.

Hereby the problem is essentially simplified by the possibility of using the symbolic method of investigation.

Let c = total length of a transmission line;
r = resistance per unit length;
x = reactance per unit length $= 2 \pi N L$.
where L = coefficient of self-induction or inductance per unit length;
g = conductance from line to return (leakage and discharge into the air) per unit length;
b = capacity susceptance per unit length $= 2 \pi N C$
where C = capacity per unit length.
l = the distance from the beginning of the line,*

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*See also THE ELECTRICAL WORLD January 15, 1898, p. 89.

* "Alternating Current Phenomena," by Charles Proteus Steinmetz, second edition, paragraph 110, pages 161 and 166, equations 14 and 11

The e. m. f. :

$$E = \frac{1}{g - jb}\left\{(A\varepsilon^{\alpha l} - B\varepsilon^{-\alpha l})\cos\beta l - j(A\varepsilon^{\alpha l} + B\varepsilon^{-\alpha l})\sin\beta l\right\}$$

the current :

$$I = \frac{1}{\alpha - j\beta}\left\{(A\varepsilon^{\alpha l} + B\varepsilon^{-\alpha l})\cos\beta l - j(A\varepsilon^{\alpha l} - B\varepsilon^{-\alpha l})\sin\beta l\right\} \quad (1)$$

where :

$$\alpha = \sqrt{\frac{1}{2}\left\{\sqrt{(g^2 + b^2)(r^2 + x^2)} + (g\,r - b\,x)\right\}}$$

$$\beta = \sqrt{\frac{1}{2}\left\{\sqrt{(g^2 + b^2)(r^2 + x^2)} - (g\,r - b\,x)\right\}} \quad (2)$$

ε = basis of natural logarithms, and A and B integration constants.

Neglecting the line resistance : $r = O$, and the conductance (leakage, etc) : $g = O$, gives :

$$\alpha = O$$

$$\beta = \sqrt{b\,x} \quad (3)$$

These values substituted in (1) give :

$$E = \frac{j}{b}\left\{(A - B)\cos\sqrt{b\,x}\,l - j(A + B)\sin\sqrt{b\,x}\,l\right\}$$

$$I = \frac{j}{\sqrt{b\,x}}\left\{(A + B)\cos\sqrt{b\,x}\,l - j(A - B)\sin\sqrt{b\,x}\,l\right\} \quad (4)$$

If the discharge takes place at the point : $l = O$, that is, the distance is counted from the discharge point to the end of the line : $l = c$, it is :

At : $l = O$: $E = O$
At : $l = c$: $I = O$

Substituting these values in (4) gives :
For : $l = O$:

$$A - B = O \qquad A = B$$

These values substituted in (4) :

$$E = \frac{2A}{b}\sin\sqrt{b\,x}\,l$$

$$I = \frac{2jA}{\sqrt{b\,x}}\cos\sqrt{b\,x}\,l \quad (5)$$

and at $l = O$:

$$I_0 = \frac{2jA}{\sqrt{b\,x}} \quad (6)$$

At $l = c$: $I = O$, thus, substituted in (5) :

$$\cos\sqrt{b\,x}\,c = O \quad (7)$$

hence

$$\sqrt{b\,x}\,c = \frac{(2k + 1)\pi}{2};\ k = O, 1, 2, \ldots \quad (8)$$

that is $\sqrt{b\,x}\,c$ = an odd multiple of $\frac{\pi}{2}$. And at $l = c$

$$E_c = \frac{2A}{b} \quad (9)$$

Substituting in (8)

$$b = 2\pi N C$$

$$x = 2\pi N L$$

gives :

$$2\pi N\sqrt{C L}\,c = \frac{(2k + 1)\pi}{2}$$

$$N = \frac{2k + 1}{4c\sqrt{C L}} \text{ the frequency of the oscillating discharge, where } k = O, 1, 2 \ldots \quad (10)$$

That is, the oscillating discharge of a transmission line of distributed capacity does not occur at one definite frequency (as that of a condenser) but the line can discharge at any one of an infinite number of frequencies, which are the odd multiples of the fundamental discharge frequency :

$$N_1 = \frac{1}{4c\sqrt{C L}} \quad (11)$$

Since :

$C_0 = c\,C$ = total capacity of transmission line,
$L_0 = c\,L$ = total self-inductance of transmission line, (12)

it is :

$$N = \frac{2k + 1}{4\sqrt{C_0 L_0}} \text{ the frequency of oscillation,} \quad (13)$$

or natural period of the line, and :

$$N_1 = \frac{1}{4\sqrt{C_0 L_0}} \text{ the fundamental,} \quad (14)$$

or lowest natural period of the line.

Substituting (10) gives :

$$b = 2\pi N C = \frac{(2k + 1)\pi}{2c}\sqrt{\frac{C_0}{L_0}} \quad (15)$$

$$\sqrt{b\,x} = \frac{(2k + 1)\pi}{2c} \quad (16)$$

thus, substituted in (5) :

$$E = \frac{4c}{(2k + 1)\pi}\sqrt{\frac{L_0}{C_0}}\,A\sin\frac{(2k + 1)\pi}{2}\,\frac{l}{c}$$

$$I = \frac{4jc}{(2k + 1)\pi}\,A\cos\frac{(2k + 1)\pi}{2}\,\frac{l}{c} \quad (17)$$

The oscillating discharge of a line can thus follow any of the forms given by substituting $k = 0, 1, 2, 3 \ldots$ into equation (17).

Reduced from symbolic representation to absolute values, by multiplying E with $\cos 2\pi N t$ and I with $\sin 2\pi N t$ and omitting j, and substituting N from equation (13), it is :

$$E = \frac{4c}{(2k + 1)\pi}\sqrt{\frac{L_0}{C_0}}\,A\sin\frac{(2k + 1)\pi}{2}\,\frac{l}{c}\cos\frac{(2k + 1)\pi}{2}\,\frac{t}{\sqrt{C_0 L_0}}$$

$$I = \frac{4c}{(2k + 1)\pi}\,A\cos\frac{(2k + 1)\pi}{2}\,\frac{l}{c}\sin\frac{(2k + 1)\pi}{2}\,\frac{t}{\sqrt{C_0 L_0}} \quad (18)$$

where A = integration constant, depending upon the initial distribution of voltage, before the discharge, and t = time after discharge.

The fundamental discharge wave is thus, for: $k = O$:

$$E_1 = \frac{4c}{\pi}\sqrt{\frac{L_0}{C_0}}\,A\sin\frac{\pi l}{2c}\cos\frac{\pi t}{2\sqrt{C_0 L_0}}$$

$$I_1 = \frac{4c}{\pi}\,A\cos\frac{\pi l}{2c}\sin\frac{\pi t}{2\sqrt{C_0 L_0}} \quad (19)$$

With this wave the current is a maximum at the beginning of the line: $l = O$, and gradually decreases to zero at the end of the line: $l = c$.

The voltage is zero at the beginning of the line, and rises to a maximum at the end of the line.

Thus the relative intensities of current and potential along the line are as represented by Fig. 1, where the current is shown in dotted lines, the potential in drawn lines.

The next higher discharge frequency, for: $k = 1$, gives:

$$E_3 = \frac{4c}{3\pi}\sqrt{\frac{L_0}{C_0}}\,A\sin\frac{3\pi l}{2c}\cos\frac{3\pi t}{\sqrt{C_0 L_0}}$$

$$I_3 = \frac{4c}{3\pi}\,A\cos\frac{3\pi l}{2c}\sin\frac{3\pi t}{2\sqrt{C_0 L_0}} \quad (20)$$

Here the current is again a maximum at the beginning of the line: $l = O$, and gradually decreases, but reaches zero at one third of the line $l = \frac{c}{3}$, then increases again, in opposite direction, reaches a second but opposite maximum at two thirds of the line $l = \frac{2c}{3}$, and decreases to zero at the end of the line. There is thus a nodal point of current at one third of the line.

The e. m. f. is zero at the beginning of the line: $l = O$, rises to a maximum at one third of the line, $l = \frac{c}{3}$, decreases to zero at two thirds of the line: $l = \frac{2c}{3}$, and rises again to a second but opposite maximum at the end of the line: $l = c$. The e. m. f. thus has a nodal point at two thirds of the line.

The discharge waves $k = 1$ are shown in Fig. 2, those with $k = 2$, with two nodal points, in Fig. 3.

Thus k is the number of nodal points or zero points of current and of e. m f. existing in the line.

In case of a lightning discharge the capacity C_0 is the capacity of the line against ground, and thus has no direct relation to the capacity of the line conductor against its return. The same applies to the inductance L_0.

If d = diameter of line conductor,
D = distance of conductor above ground,
and c = length of conductor,

the capacity is:

$$C_0 = \frac{1.11 \times 10^{-6}\, c}{2\, lg \frac{4D}{d}}\, mf$$

the self-inductance:

$$L_0 = 2 \times 10^{-6}\, c\, lg \frac{4D}{d}\, mh \qquad (21)$$

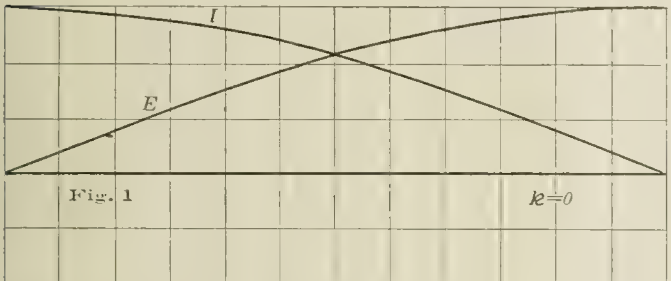

Fig. 1

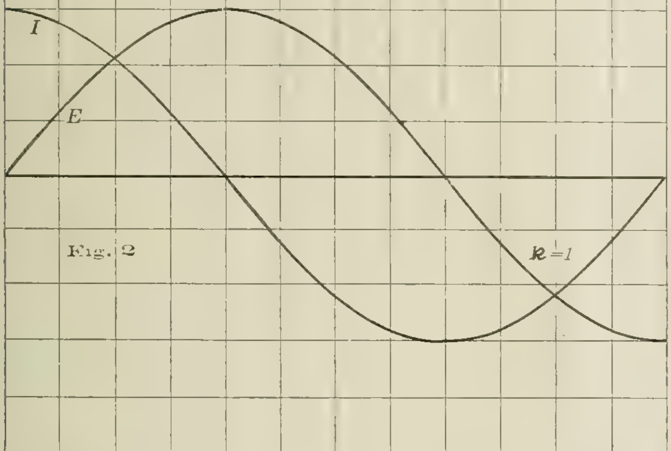

Fig. 2

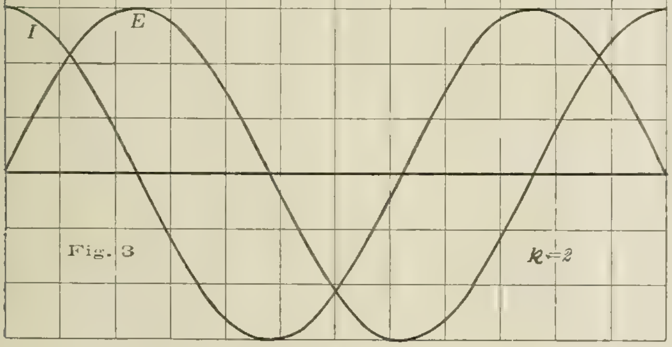

Fig. 3

The fundamental frequency of oscillation is thus, by substituting (21) in (14):

$$N_1 = \frac{1}{4\sqrt{C_0\, L_0}} = \frac{7.5 \times 10^9}{c} \qquad (22)$$

That is, the frequency of oscillation of a line discharging to ground is independent of the size of line wire and its distance from the ground, and merely depends upon the length c of the line, being inverse proportional thereto.

We thus get the numerical values:

Length of line		10	20	30	40	50	60	80	100 miles
	=	1.6	3.2	4.8	6.4	8	9.6	12.8	16 × 10⁶ cm.
hence frequency:	N_1 =	4680	2340	1560	1170	937 5	780	585	475 cycles.

As seen, these frequencies are comparatively low, and especially with very long lines almost approach alternator frequencies.

The higher harmonics of the oscillation are the odd multiples of these frequencies.

Obviously all these waves of different frequencies represented in equation (18) can occur simultaneously in the oscillating discharge of a transmission line, and in general the oscillating discharge of a transmission line as thus of the former:

$$\left(\text{by substituting: } a_k = \frac{A_k}{2k+1}\right)$$

$$\left.\begin{aligned} E &= \frac{4c}{\pi}\sqrt{\frac{L_0}{C_0}}\left\{a_1 \sin\frac{\pi l}{2c}\cos\frac{\pi t}{2\sqrt{C_0 L_0}} + a_3 \sin\frac{3\pi l}{2c}\cos\frac{3\pi t}{2\sqrt{C_0 L_0}} + \dots\right\} \\ I &= \frac{4c}{\pi}\left\{a_1 \cos\frac{\pi l}{2c}\sin\frac{\pi t}{2\sqrt{C_0 L_0}} + a_3\frac{3\pi l}{2c}\sin\frac{3\pi t}{2\sqrt{C_0 L_0}} + \dots\right\}\end{aligned}\right\} \qquad (23)$$

where $a_1\ a_3\ a_5, \dots$ are constants depending upon the initial distribution of potential in the transmission line, at the moment of discharge, or at $t = O$, and calculated therefrom.

As instance is calculated the discharge equation of a line charged to a uniform potential e over its entire length, and then discharging at $l = O$.

The harmonics shall be determined up to the 11th—that is, a_1, a_3, a_5, a_7, a_9, a_{11}.

Those six unknown quantities require six equations, which are given by assuming $E = e$ for $l = \frac{c}{6}, \frac{2c}{6}, \frac{3c}{6}, \frac{4c}{6}, \frac{5c}{6}, \frac{6c}{6}$

At $t = O$, $E = e$, equation (22) assumes the form

$$e = \frac{4c}{\pi}\sqrt{\frac{L_0}{C_0}}\left\{a_1 \sin\frac{\pi l}{2c} + a_3 \sin\frac{3\pi l}{2c} + \dots + a_{11}\sin\frac{11\pi l}{2c}\right\} \qquad (24)$$

Substituting herein for l the values: $\frac{c}{6}, \frac{2c}{6}, \dots \frac{6c}{6}$

gives six equations for the determination of $a_1, a_3 \dots a_{11}$. These equations solved give:

$$\left.\begin{aligned} E &= e\,(1.26 \sin\omega\cos\varphi + .40 \sin 3\omega\cos 3\varphi + .22 \sin 5\omega\cos 5\varphi + .12 \sin 7\omega\cos 7\varphi + .07 \sin 9\omega\cos 9\varphi + .02 \sin 11\omega\cos 11\varphi) \\ I &= e\sqrt{\frac{C_0}{L_0}}\,(1.26 \cos\omega\sin\varphi + .40 \cos 3\omega\sin 3\varphi + .22 \cos 5\omega\sin 5\varphi + .12 \cos 7\omega\sin 7\varphi + .07 \cos 9\omega\sin 9\varphi + .02 \cos 11\omega\sin 11\varphi)\end{aligned}\right\} \qquad (25)$$

where:

$$\left.\begin{aligned} \omega &= \frac{\pi l}{2c} \\ \varphi &= \frac{\pi t}{2\sqrt{C_0 L_0}}\end{aligned}\right\} \qquad (26)$$

Instance:

Length of line: c = 25 miles = 4×10^6 cm.

Size of wire: No. 000 B. & S. G., thus: d = 1 cm.

Height above ground: D = 18 feet = 550 cm.

Let e = 25,000 volts = potential of line in the moment of discharge.

It is then:

$$E = 31{,}500 \sin\omega\cos\varphi + 10{,}000 \sin 3\omega\cos 3\varphi + 5500 \sin 5\omega\cos 5\varphi + 3000 \sin 7\omega\cos 7\varphi + 1750 \sin 9\omega\cos 9\varphi + 500 \sin 11\omega\cos 11\varphi.$$

$$I = 61.7 \cos\omega\sin\varphi + 19.6 \cos 3\omega\sin 3\varphi + 10.8 \cos 5\omega\sin 5\varphi + 5.9 \cos 7\omega\sin 7\varphi + 3.4 \cos 9\omega\sin 9\varphi + 1.0 \cos 11\omega\sin 11\varphi.$$

$$\omega = .39\, l\, 10^{-6}$$

$$\varphi = 1.18\, t\, 10^{+4}$$

A simple harmonic oscillation as a line discharge would require a sinoidal distribution of potential on the transmission line at the instant of discharge, which is not probable, so that probably all lightning discharges of transmission lines or oscillations produced by sudden changes of circuit conditions are complex waves of many harmonics, which in their relative magnitude depend upon the initial charge and its distribution—that is, in the case of the lightning discharge, upon the atmospheric electrostatic field of force.

The fundamental frequency of the oscillating discharge of a transmission line is relatively low, and of not much higher magnitude than frequencies in commercial use in alternating current circuits.

Long-Distance Transmission of Power.*

BY ERNST J. BERG.

When in the early '90s multiphase systems were introduced on a commercial scale it looked as if the field for the simple single-phase system would be very limited, indeed as if the latter be altogether superseded by the new systems; yet upon investigating all properties of the latter it was soon apparent that, although the multiphase systems were superior for some conditions, such as for the operation of motors, they did not compare favorably with the simple alternating-current system for lighting. Mistakes are often made in choosing the best system when contemplating a new installation. The reason for this mistake lies probably in the fact that it is generally assumed that alternating-current motors must run on multiphase circuits, and, therefore, even if the motor load does not amount to anything when installing a new plant, such a system has been adopted.

At the present stage of the art, there can be no question but that every central station man sees the advantages of parallel operation. By this is meant not only parallel running of generators in the station, but also multiple connection of the distribution system, whether direct or alternating current. This feature is most important as well for economy as for satisfactory operation sake. From the nature of things it is evident that the system must be divided when laid out multiphase, therefore when alternating current is used single phase should be adopted. Against this argument it is often stated that in a territory where the load is scattered greatly a secondary network cannot well be laid out, but each customer, or each set of customers, has to be supplied from his own transformer, in which case the distribution is single phase, regardless of whether the system is single phase or multiphase. If a multiphase system is used single-phase mains are brought over to the individual customer or groups of customers. This arrangement may look feasible on paper, particularly so if no investigations are made to determine the regulation in these single-phase mains. By a few calculations, however, it is readily found that although apparently everything is nicely balanced, such system is very often much unbalanced and consequently perfectly unsuited for its purpose. But even were it possible to distribute from a multiphase system with scattered transformers on each main, it is not at all correct to install such a plant, because any well-managed power distribution must sometime increase in magnitude, and arrangements should be made so that it can be changed over to a perfect system when needs be, which is only possible where each circuit has the same phase; that is, this is only possible with the single-phase distribution from a single-phase generator.

Still, a further reason for not adopting multiphase system is that by this time motors can be operated perfectly satisfactorily from a single-phase system; that is, single-phase system such as the monocyclic system.

As referred to above there may, however, be conditions which would warrant a multiphase, or rather a three-phase, installation, and these are when the distances between generating station and consuming circuit are so great that power cannot be transmitted from one to the other, except at the highest possible commercial voltage, without too great an expenditure of line copper; under such conditions the three-phase system, which takes 75 per cent. of the single-phase or two-phase copper, and say about one-half as much copper as the monocyclic system, may be preferable. [illegible] however, where it is not necessary to run at the limit of permissible voltage, the apparent saving in copper in the three-phase system over the monocyclic system is of little consequence, since the monocyclic system can be operated with the [illegible] at a [illegible] higher voltage. Thus, excepting very long distance transmissions, the only field for multiphase system is in places where installation of rotary converters are warranted.

The next question of interest is the determination of proper frequency. [illegible] distributions are certainly [illegible] there [illegible] than [illegible] speed regulation of the [illegible]. The tendency seems now to be [illegible] units as far as possible. Without [illegible] this [illegible] correct in most cases, yet undoubtedly it is carried too far in many instances. With very large units such as 1000 horse-power and more, there is no doubt but what the direct connection is better, but we often face propositions where the customer wants to install a direct-connected slow-speed 75 to 100-kw machine. That is, in my opinion, to carry things a little too far, since the slow speed necessitates very large and inefficient alternators with very many poles and engines with exceedingly close speed regulation.

In order to obtain satisfactory parallel operation of alternators it is necessary that their speed be uniform, and since no steam engine of reciprocating type can be made which gives a perfectly uniform rate of rotation, it is necessary to devise in some cases generators suited to the engines. It is often possible to build a 25-cycle direct-connected alternator which will operate perfectly satisfactorily from a given steam engine, whereas, if a 60-cycle alternator were installed on the same engine, its behavior would be so bad as to make parallel running prohibitive.

The amount of permissible variation is inversely proportional to the frequency of the alternator connected to the engine, so that, for instance, if a 20-pole alternator were directly connected to a steam engine which gives a speed variation of say one-half per cent., and it was desired to get as satisfactory results with a 40-pole alternator—that is, with an alternator giving double the frequency—it would be necessary to have one-quarter per cent. speed variation.

If belted alternators are used it is hardly ever necessary to consider lower frequencies than 60 cycles, since the question of speed variation of the engine is, of course, not of such importance as with the direct-connected engine, yet it may be given as a rule that two-crank engines should be used wherever possible.

Since incandescent and arc lighting are unsatisfactory with frequencies below 40 cycles, it is evident that we always have to consider either 40, 60 or 125-cycle systems, these being the standard frequencies, and of these the 125 or 60-cycle system should preferably be used, and the 40-cycle only when forced by the speed regulation of the engine.

As between 125 and 60 cycles, it is hard to give any rule. Were it not for the closer speed regulation required for the 125-cycle alternators I believe I favor them, particularly so if the distance of transmission is not so long that the line inductance may be objectionable, and if the secondary network is not too extensive and too large conductors used. Yet if a considerable motor load is anticipated, 60 cycles may be better. In connection with this it may be well to bring out the fact that 125-cycle iron-clad alternators are very well suited for parallel operation. Thus, a good rule regarding frequencies is to use as high a frequency as possible, and where no limitations are imposed by the driving power use nothing lower than 60 cycles.

With rotary converter installations the question of frequency is different. There the intention is not to distribute from the multiphase alternating circuit, but only through a direct-current network. The frequency of such a system is preferably 25 cycles, since at this frequency the regulation of the engines need not be so extremely good, and the rotaries can be built with relatively low speed. The three-phase system is, of course, preferable to the two-phase system, since it requires less copper, fewer lines, less switching arrangements, etc.

Sometimes, however, it is desirable to distribute the greater part of the load by means of the rotary-converter direct-current network, but also to do some lighting in another territory. Under such conditions, it is rather attractive to install a 60-cycle three-phase plant and use 60-cycle rotary converters, in which case the lighting could be directly done from the 60-cycle mains.

Considering, however, the high speed which is necessary in connection with the 60-cycle rotary converter and also the extremely close speed regulation of the engine or turbine driving the alternator, it may not always be good policy to use this frequency, but would be advisable to install a frequency changer in connection with a three-phase 25-cycle alternating current generator.

Such a frequency changer can be used for transforming three-phase power to single-phase power, 25 cycles to 60 cycles, and any impressed voltage to another. For instance, with the frequency changer installed in Brooklyn power is transferred from 6600 volts, three-phase, at 25 cycles, to [illegible] volts, two-phase power, at 62 cycles. The frequency changer is to all appearance an induction motor driven by a synchronous motor. Its capacity is greater than the capacity of a corresponding motor generator set and its efficiency is higher.

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*[illegible]

The Chicago & Milwaukee Electric Railway.

On July 1 a part of the Chicago & Milwaukee Electric Railway was put in operation. Although this line is not yet complete, and is now being operated by means of a temporary electrical equipment in the power house, it is thought that the plans for the complete installation, which have been developed by Mr. Bion J. Arnold, the consulting engineer for the company, represent such a radical departure from ordinary electric railway engineering practice as to justify a brief description at this time.

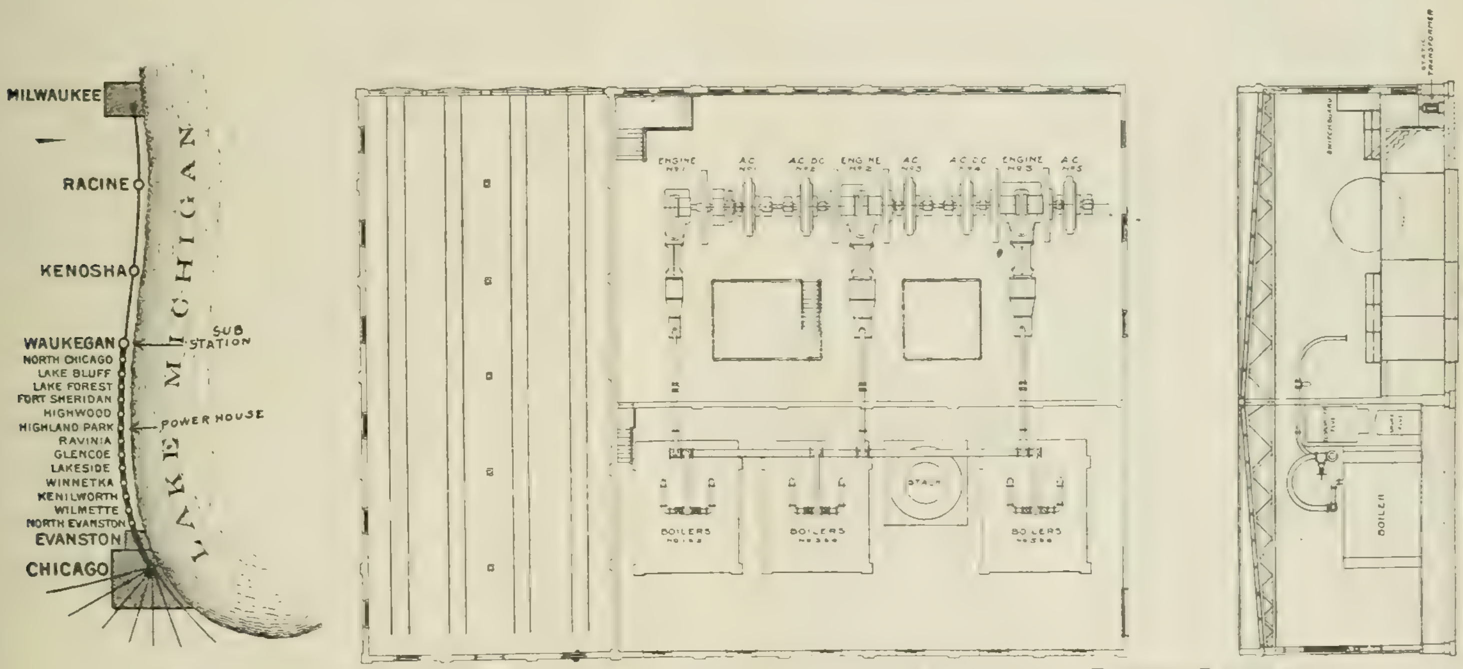
The line may be called an inter-suburban road. It runs through the chain of Chicago's most beautiful suburban districts lying along the shore of Lake Michigan, between Evanston and Waukegan. When the road is completed it will be hard to imagine a more delightful ride than it will offer. Beautiful suburban and country homes are scattered all along the way. The southern portion of the road is not yet completed, but north from Highland Park the line is now in operation. The route of the line is 30 miles in length and parallels for the entire distance the Chicago & Northwestern steam railroad. The name of the road would seem to indicate that it might eventually connect Chicago with Milwaukee.

The plan which was adopted for power generation and distribution consists of a combination direct-current and three-phase alternating-current system, with a generating station placed at the centre of the line. The sections of the road adjacent to the power station are supplied with direct current from the power house itself. Sections of the line at a distance from the power house get their supply of current from substations. The location of these sub-stations and their distance apart is governed by the conditions of traffic and somewhat by the nature of the grades along the line.

As shown upon the map, the power station is located at Highwood, and the sub-station for the operation of the northern portion of the road is situated near the southern limits of North Chicago. Connecting the power house with the sub-station is an 8-mile, 5500-volt, three-phase transmission line of three No. 8 wires. From the sub-station the 00 trolley wire is reinforced by a 0000 feeder extending 4 miles south and a 000 feeder extending 3½ miles north.

The line is at present operated on a single track road, except in Lake Forest, and a block signal system has been adopted to insure safety in operation. The fares charged are about one-half the rates charged upon the Northwestern Railroad for the same distances.

The plan of the power station is shown in the accompanying figure.



Map and Plan and Elevation of Power Station of the Chicago & Milwaukee Electric Railway.

The unique feature of the power station, however, is the electrical equipment. Two different types of generators are employed: Generator No. 1, which is installed next to the engine No. 1, is an alternating three-phase generator of General Electric make. It has a capacity of 250 kilowatts at 125 revolutions per minute. This generator has 24 poles, and, therefore, delivers a three-phase current of 25 cycles per second. This current is generated at a potential of 5500 volts, ready to be delivered directly to the transmission lines without the use of transformers. Generator No. 2 is a combination generator. It is also of 250 kilowatts capacity, and runs at 125 revolutions per minute. It can deliver its output, however, either as direct or as three-phase current. It has but one armature, but the windings of this armature are connected on one side to a commutator and on the other side to collector rings. The potential of the direct-current end is 600 volts, while the three-phase current is delivered at a voltage of 380. The generator can deliver an output up to its rated capacity of 250 kilowatts from either the commutator or the collector rings. It can thus be used to supply current directly to the trolley passing in front of the power station, or can be used to operate the motors in the sub-stations, or for both purposes, at the same time dividing the load in proportion to the demand.

When the three-phase current from this generator is transmitted to the sub-station it is necessary to raise its potential from 380 volts to 5500 volts. This is accomplished by means of transformers placed in the basement, as shown. The transformers are cooled by a blast fan operated by a 1-hp induction motor. Generator No. 3 is to be a duplicate of generator No. 1.

The engines and generators are connected by means of the "Arnold System," which is particularly adapted to a station of this character, containing as it does two different types of generators.

When the load is light the road may be operated from the alternating-current direct-current generator, and is always available from two engines. In case of a breakdown of one engine, this generator may be connected to the other engine. To secure this same reliability with the ordinary direct-connected independent-unit station, another engine and generator unit would have been necessary, as in such a plant an accident to an engine cripples the entire unit.

As the demand for the current varies the load may be transferred from one engine to another, or all engines may be operated in unison, which is important when working alternating generators in parallel. As each generator is mounted on independent bearings, it is possible, if occasion should arise, to operate generator No. 2 as a rotary converter, or even to connect generators Nos. 1 and 2, so that they could be used in the same manner.

These sub-stations are each to contain step-down transformers, a rotary converter and a storage battery. It will be noticed that the electrical equipment of the substations is not in duplicate. This has been considered unnecessary, as it is intended to mount the machinery needed for a sub-station, step-down transformers and one rotary converter, upon a truck fitted with motors. In case of breakdown at any sub-station, the battery can be relied on to supply current for several hours, during which time the portable reserve sub-station equipment can propel itself to the crippled station and be connected ready to operate until the repairs have been made.

Convention of the Ohio Electric Light Association.

The fourth annual meeting of the Ohio Electric Light Association was held at the West House, Sandusky, Ohio, on August 18 and 19, a large number of members being present.

President H. K. Wood, of Piqua, called the meeting to order at 10:30 A. M., August 8. The first business laid down on the programme was the reports of committees, officers, etc., after the reading and adoption of which the president read his address.

After referring to the growth of the association and the good accruing to its members through organization, he touched upon the question of municipal ownership.

"There have been guerrillas in the bush in the past," he said, "and in the active competition for business in the future and the strong agitation for 'municipal plunder' we may reasonably look for them again. We do not have to review ancient history to learn there are men, yes, corporations, who, regardless of the months and years of anxiety of the local manager and stockholder, and their efforts to secure a fair compensation for their labor and capital, will, by one 'fell swoop,' endeavor to destroy and make worthless your investment. We should be 'united, vigilant and in the watch-tower,' for I fear the already troubled waters may soon need unusual and united effort to quiet them."

Speaking of the return of business prosperity, and the consequent demand for more light and power he suggested that the members should prepare their stations to meet the demand. He advised selling "our goods" upon their merits and not being driven to give satisfaction to a customer by a Welsbach burner or some new device.

Adjournment was then taken until afternoon.

At the afternoon session, which was called to order at 3 o'clock, the first business was the reading of a paper entitled "Positive and Negative Economies in the Operation of Small Electric Light Plants," by E. P. Roberts, of Cleveland, Ohio.

The author made his paper particularly interesting and valuable to those present at the convention by discussing the question not from the standpoint of one designing a new plant, but from the standpoint of one owning and wishing to run most economically a plant now in existence. A great many of these, probably the majority, can reduce their operating expenses by 10 or 20 per cent. if their officers are better informed as to the conditions under which they are operating and how to improve these. Examples are given, from the author's experience, of details. For instance, considering belts and shafts: Are the belts tighter than advisable? If so, it may be because they are oily or dirty; possibly the belt centres are too close together and this distance cannot be increased; possibly larger pulleys can be placed; preferably larger in diameter, but if this is not feasible wider in face. Will this pay? Assume that a belt transmitting 100 horse-power costs $100 and is running too tight and is adding 3 per cent. (3 horse-power) to the friction more than it would do if running loose. Suppose that the change to larger belts costs $75 and the extra belt costs $25, making a total of $100. Probably the life of the belt would be increased 50 per cent., say nine years as against six, with a saving of 3 horse-power giving 1300 hp-hours per year. With a coal consumption of 4 pounds per hp-hour and coal costing $1.50 per ton, this gives a saving of $40 per year, and a reduction of the depreciation by $5, or a total of $45 saving, giving 45 per cent. on the investment, besides the improved reliability of service. How many managers would spend $100 to save a belt slipping? The station superintendent must get along with resin. This is certainly a negative economy. Other instances are given, taking up in detail the boilers, the engines, the shafts, electrical machinery, etc. The question of engine size was well discussed, the advice "Do not get your engine too small" being condemned and improved on as follows: "Do not get your engine cylinder too large and do not get the valve parts too small." This refers to an engine for a variable load, in which the average load may be considerably [illegible] [illegible] have around.

A paper entitled "Some Suggestions Relative to Determining the Cost of Electrical Supply" was then read by Mr. M. E. Turner, of Cleveland.

The discussion of this paper related chiefly to the principle and operation of the Wright demand system, Mr. Scovil outlining a similar method of charging adopted by his company. It was the cause of some complaint among customers, who thought that the company was discriminating, but he was not going to operate his business to help a lot of people advertise their wares on Saturday nights, and the sooner the members cut off such customers the better it would be for them. In this connection Mr. Roberts mentioned a case coming under his experience. A ruinous competition of rates existed between the gas company and the electric light company in a small town, which resulted in the absorption of the gas company by the electric company. In order to provide business for both branches, saloons and such places were urged to use electric light, while gas was recommended for churches and other places with a poor load factor.

The meeting then adjourned until Friday morning.

The first business transacted at Friday morning's session was the reading of a paper by Mr. Caryl D. Haskins, of Boston, entitled "The Meter's Relation to the Dividend," an abstract of which will appear in a later issue of The Electrical World.

Mr. J. H. Perkins, of St. Louis, followed the discussion of Mr. Haskins' paper with a paper entitled "Comparative Commercial Qualities of Old and Modern Transformers as Applied to an Exchange."

The paper takes up the requirements of a modern transformer, discusses the losses, the regulation and the relations of these. It is almost an axiom in transformer design that with a given type, cost and weight per kilowatt, whatever is gained in copper loss will be lost in iron loss, and vice versa. The regulation is more or less proportional to the copper loss, so that where individual transformers without a secondary network are required the copper loss should be kept down. Under the same circumstances, however, the low-load factor renders the iron loss, which is a constant, a serious impediment to high efficiency. The best solution is the use of a secondary network wherever this is possible with a reduction of the iron loss, even at the expense of copper loss and regulation; since the copper loss is only serious at times of high load and the regulation can be corrected for in that case. Aging of iron is discussed and the paper states that the more able companies have solved the problem and are ready to make specific guarantees with a limit of from one to five years. Some recently developed grades of iron show absolutely no detectable change. The use of oil is commended. The saving on several installations, in which small old type transformers have been replaced by large modern ones, is described, curves being shown, showing in every case a very satisfactory rate of interest on the investment in new apparatus, besides the improvement in the reliability and satisfaction of the service.

After passing a vote of thanks to Messrs. Haskins and Perkins for their papers the meeting adjourned until afternoon.

At the afternoon session Mr. E. J. Berg, of Schenectady, N. Y., read a paper on "Long Distance Transmission of Power," an abstract of which may be found in another column.

After a vote of thanks to Mr. Berg for this paper the Question Box was opened. Question 1 was "What are the advantages of inclosed arc lamps for outside lighting?" Mr. Scovil, of Cleveland, stated that the inclosed arc lamp had obvious advantages over the open arc in the matter of saving of labor and carbons; they gave, besides, a steadier light. He had been informed that the Boston Electric Light Company effected a saving of $10 per year per lamp by the use of inclosed arcs.

Mr. Espy, of Kenton, gave an account of some experiments he had made by making the globe of an ordinary open arc lamp air tight. Lamps thus altered burned four or five nights on one trimming, and worked well both indoors and outdoors. The outdoor lamps, however, gave some trouble in wet weather by reason of the globes breaking. This damaging effect he supposed was due to the unequal temperatures within and without. No trouble was experienced in running the lamps with ordinary ½-inch x 12-inch carbons. As regards the candle power of altered lamps he could give no definite information. His customers, however, thought it had [illegible] when the lamps were altered than before. The lamps were certainly giving better satisfaction, he said.

A member suggested that the life of the carbons was gained at the expense of the coal pile, by an increase of voltage at the arc.

Mr. Espy, however, thought that such was not the case, as the lamps took the usual amount of current and at the ordinary voltage—there was no increase of voltage.

Question 2 was "Can the candle power of arc lamps be accurately determined by the use of a portable photometer?" The consideration of this question was very brief. Mr. E. P. Roberts stated that the candle power of arc lamps could be so measured, but it would be too inconvenient a method to use in practice.

Question 3, "In what way can competition of the gasoline incandescent burner be most successfully met?" being one of particular importance to the Ohio electric light men, elicited some discussion, in which considerable information on the subject of gasoline plants was developed. Mr. Espy explained that the gasoline incandescent system comes in direct competition with electricity in small towns. He understood that an 8 or 10-light plant could be installed in dry goods stores, etc., at a cost of $50 or $60. They are maintained very cheaply, and in some Ohio towns excellent results had been attained. In this system of lighting the Welsbach mantle is used, the gas being generated on the premises. The best field for this system of lighting was in small towns which could not afford an electric or gas plant.

Mr. Berg stated that he had been testing a Welsbach light in his house and found by photometric measurements that its candle power runs down rapidly. After six months' use of his light on a daily average of four hours, he did not get half as much light from it as from an incandescent lamp burned under similar conditions.

Mr. Roberts stated that while Welsbach burners had been very much improved in the past two years they deteriorated in use, particularly under the effect of frequent lighting and extinguishing of the gas. They gave longer life when burned more continuously. He thought that members need not worry over the Welsbach burner. The best way to handle the subject was to let it alone. Experience has proved that people soon get tired of replacing broken down mantles. These people soon came back again to electricity.

Mr. Scovil gave some figures showing the cost of Welsbach lamps to the city of Cleveland. Some of the ordinary gas burners had been changed to Welsbach burners, and the city was paying $31 per lamp per year as against $16 for the old style. One Welsbach replaced two ordinary burners, but he thought the distribution of light was not so good.

Question 4, "Is it advisable for a plant to change from 15,000 volts alternating single-phase to 7200 volts, two-phase, if no question of motor business is concerned?" was passed over, since the subject was discussed quite fully in Mr. Berg's paper.

Question 5, "What are the types and makes of engines in use in the smaller plants of the association; the time of their installation and their condition at the present time?" did not extract much information from the members. Mr. Roberts, however, stated that in his experience he found that in the smaller plants in Ohio the average engine used was the high or medium-speed automatic non-condensing type, single valve, working on a pressure of from 80 to 90 pounds. Their life, of course, depends upon how they are maintained. He had found many cases of mismanagement.

President Wood then announced that the next year's meeting of the association would be held in Cleveland at a time to be set by the executive committee.

In bringing the convention to a close President Wood made a few appropriate remarks upon his retirement, thanking the members for their earnest support and attention to business. The meeting he thought was the best the association had yet held. At 5 P. M. the convention adjourned.

The following named gentlemen were chosen at the morning session of the executive committee as officers for the ensuing year: President, Emil C. Schmidt, Sandusky; vice-president, B. P. Holmes, Youngstown; secretary and treasurer, Samuel Scovil, Cleveland.

On Saturday, through the courtesy of the Sandusky Lighting Company, which was represented by Mr. Emil C. Schmidt, superintendent, the members and their friends enjoyed an excursion to Put-in-Bay, where dinner was served at the Hotel Victory. An orchestra was provided by the Warren Electric Manufacturing Company, and the music was an added pleasure to the enjoyment of the trip.

The day was a delightful one, and the ride was keenly enjoyed by all who had the good fortune to avail of the Sandusky Company's hospitality.

The Parallel Running of Alternators.[*]

The conditions of parallel running of alternators are, briefly, to have uniform speed of the driving power, and to adjust the speeds of the alternators which are to run in multiple so that they run at the same rate. Alternators capable of absorbing approximately the full capacity of their driving powers and operated from independent prime movers are most readily run in multiple. Thus, for instance, two alternators, each of which is belted to a steam engine of its own size, present an easy problem and can most readily be run in parallel, at least if the engines are of the cross-compound type and the belts reasonably good. Such alternators can be thrown in parallel, even should the speed not be exactly the same, but with the phasing lamps flickering at the rate of, say, one pulsation in two seconds.

Direct-connected alternators, operated on engines of sufficiently close speed control, as well in regard to variation in speed between no load and full load as change of rate of rotation during one revolution, can also be thrown in multiple at the same rate of pulsation of the phase lamps.

Alternators driven from the same countershafting offer a somewhat more difficult problem, and in such case it is necessary that their speeds should be closer when thrown in multiple, therefore great care has to be taken that the pulleys are of exactly the same size and the belts running smoothly. A flickering of phase lamps corresponding to a period of, say, five seconds at least should be obtained before attempting parallel running.

Alternators driven from independent countershafts, which are supplied with much more available power than the alternators can absorb, offer an exceedingly difficult problem in parallel operation. For instance, assume that two alternators are of 50-kw capacity and operated by engines of 500 or 600 horse-power, these offer an exceedingly difficult problem, since with them the synchronizing action of the alternators may not suffice. The pulleys must under such conditions be adjusted exceedingly close. This is particularly the case if the two countershafts are not interconnected by a large belt; thus, briefly, the ease with which alternators can be thrown in multiple depends not so much on the alternators themselves, but upon the condition of the driving power.

The best condition is belted alternators operated from independent driving power of approximately the same size as the alternators themselves, or direct-connected generators on close regulating engines.

The next condition is alternators operated from different countershafts, which, however, supply chiefly the loads of the alternators themselves. Next alternators operated from the same countershaft, then alternators operated from different but inter-connected countershafts, where the capacity of the alternators is small compared with that of the countershafts themselves; and, finally, the worst case is when alternators are operated from different countershafts which are not joined together by belting, and the size of the alternators is small compared with the output from the countershafts.

Some Suggestions Relative to Determining the Cost of Electric Supply.[†]

BY M. E. TURNER.

At the National Electric Light Association Convention in '97, Mr. Arthur Wright, of Brighton, England, read a paper in which was developed a method of charging a consumer for electrical current based on the cost of the consumer to the supply company.

The foundation of this system is the proportioning of all expenses into, First: Those which are fixed, or those which remain about constant, only changing as the number of consumers increases, or as the territory is extended, or as the capacity of the station is increased, or as the investment is increased. These are termed standing charges.

Second: Those expenses which increase or decrease with the output of the station; that is, the number of kw-hours or hp-hours manufactured.

To illustrate this method I have taken a station operating an Edison system with underground distribution, and have divided the total expenses into four general headings, viz.: Manufacture, distribution, general expense and fixed charges.

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[*] An abstract of the discussion following the reading of Ernst J. Berg's paper at the Convention of the Ohio Electric Light Association.

[†] A paper read at the Convention of the Ohio Electric Light Association, Sandusky, Ohio, August, 1898. Abstracted.

Manufacture includes all expenses incidental to the work in the station, such as fuel, water, oil waste and packing, removal or disposition of ashes, labor, repair and maintenance of engines, boilers, auxiliary engines and piping, electrical machinery, tools, building and incidental expenses.

Distribution includes all expenses of repair and maintenance of underground conductors, tools, meters, inside wiring, etc., and overhead lines.

General expense includes all expenses, such as salaries of officers and superintendents, rents, taxes, insurance, legal and sundry expenses, casualties, etc.

Fixed charges include the interest on all outstanding capital and a depreciation item which is an amount to be charged off against the life of the property.

In the following determinations the depreciation is taken at 5 per cent. of the cost of the plant.

It is now necessary to arrange these various items into either standing or running accounts. Let us start with manufacture. Fuel you will find is proportional or nearly so to the kw-hours manufactured. To show this take the fuel account of your own station for six summer or light months, and for six winter or heavy months, also the kw-hours manufactured for the first period, then for the second period. Dividing the cost of fuel by the kw-hours you will find that the kilowatts you manufactured cost as much for fuel during a summer as a winter month.

Next, oil, waste and packing. These items are found to vary more with the number of hours the machinery is run than with the work done or the output manufactured. It takes almost as much of these items to run engines light as heavy, yet about half the expenses of these items are due to extra engines run at maximum or to the length of time run. So one-half has been proportioned to standing and one-half to running. The removal of ashes being proportional to the coal burned will be readily seen to be a running cost.

By the same course of reasoning, labor in the station would be placed under the head of standing charges, but as a considerable part of the labor is used in handling coal and ashes, and a part in the handling of oil, it has been considered best to place a portion of it under running charges, and in this example I have placed one-half to running and one-half to standing.

Next, take the repair and maintenance of boilers. As these repairs or expense come irregularly, the formula cannot be applied. By watching closely the repairs it will be seen that quite as much expense is caused by the length of time of use as by the output or power delivered. This is also true with the repair of engines, steam piping, pumps, electrical machinery and the building.

It has been thought best to divide these accounts as follows:

Fuel, water and ashes, all to running.

Labor, oil, waste and packing, one-half to running, one-half to standing.

Renewal and repair of engines, one-third to standing, two-thirds to running.

Renewal and repair of boilers, electrical machinery and piping, one-half to standing, one-half to running.

Incidental expenses, renewal and repair of building, tools and instruments, all to standing.

Under distributing expenses, take the repair and maintenance of underground conductors or overhead lines. A careful examination of the causes of the expenses of this work will show that they are neither caused by nor proportional to the output or power transmitted, but are caused by the breaking down of the insulation due to the pressure carried or by the weather, or by poor workmanship or faulty material or by such other cause. But none or almost none are due to the output transmitted. This is also true with the meter accounts, the tool and instrument accounts and the inside wiring account, so that all of these expenses are standing expenses.

All of the general expenses belongs to the standing charges. Whether the plant operates under heavy or light load, the organization of the company must be maintained, insurance carried, taxes paid, and damages settled. The output might be doubled without increasing these expenses, or might be cut in half without decreasing them. This principle applies unquestionably to the interest and depreciation charges, which are also standing charges.

The next step is the reducing of all standing charges. The total standing expense or charge is proportional to the kw capacity installed, and will increase as the size and the capacity of the plant is increased. For as the engines, boilers, generators and piping are increased, so will the standing charges of these accounts increase, and as the number of miles of underground or overhead lines are increased, so are the expenses of repair and maintenance increased. Now, these standing expenses, being proportional to the capacity, should be divided by the kilowatts installed at the end of the period at which the capital is taken. This gives us the annual standing charge per kilowatt of capacity installed, which divided by 305 days gives the cost per day. (Three hundred and five days are taken, they being working days, Sundays and holidays being excluded.)

In order to apply these principles and to show what a large proportion of the total cost the standing charges are, let us take the example referred to before. We will assume that the capital cost of plant, station and lines is $500 per kilowatt of station capacity installed. We will assume that the sum of all the running charges is 1 cent per kw-hour. This sum is derived from the items previously mentioned.

This gives a total standing cost of $82 per annum for each kw-capacity we have installed, or in other words, a cost to us of $82 per year for each kw-capacity we keep at a customer's disposal, whether we generate for this customer current from this apparatus for one hour or for twenty-four hours per day. Next, dividing $82 by 305 days, gives us 26.9 cents per day. Now, if the consumer uses a maximum of one kw-capacity, his cost to us per day would be 26.9 cents, plus the running cost per kw-hour multiplied by the number of kw-hours he uses. For instance, for one hour's use it would be 26.9 plus 1 cent or 27.9 cents, for two hours' use it would be 26.9 plus 2 cents or 28.9 cents or 14.95 cents per kw-hour.

A Great Advance in Fire Alarm Telegraph Protection.*

I desire to present to the convention a brief description of a most important and recent advance in methods of fire alarm protection, which will make the outbreak of a fire and the sounding of the alarm through the municipal system practically simultaneous.

I refer particularly to a combination of the well-known Gamewell auxiliary fire alarm system and the cable of the Montauk Multiphase Cable Company, which combination makes the Gamewell auxiliary system automatic as well as manual.

The auxiliary system was a great step forward, in that it brought the nearest public fire alarm box into the interiors of buildings, and placed it at any desired number of points, by providing a series of small auxiliary boxes, from any one of which the street box could be instantly operated. But the system, being purely manual, was not effective when the protected premises were vacant; and it was to cover this point that a method of rendering the auxiliary system automatic as well as manual was perfected. It has never been a matter of electrical or mechanical difficulty to connect ordinary thermostats into an auxiliary system, so that an excess of heat would automatically operate the street box, but the danger of unnecessary alarms has prohibited this.

The recent invention of the Montauk "multiphase cable" referred to above is adapted for use in connection with the auxiliary system, so that it becomes automatic as well as manual, without the sacrifice of any of the peculiar features of safety from false alarms, which is the foundation of the willingness of fire departments to allow its use in connection with street boxes.

Such an automatic auxiliary equipment would consist of the desired number of auxiliary boxes, distributed throughout a building at convenient locations, connected through the usual apparatus with the nearest street fire alarm box, with the interior wiring of the equipment of this "multiphase" cable.

As fires do not start upon the ceilings of rooms (where ordinary thermostats are placed), the automatic wires which would be run around baseboards, back of benches, through closets, under staircases, etc., could be more readily made to cover every danger point where a fire would be likely to start. These danger points can be scientifically located for each class of risk by reference to insurance tables giving the accumulated experience of all of the insurance companies for a period of years, as well as by individual judgment in each case.

Since it takes actual flame, or a temperature of 360° without flame, to cause this wire to send in an alarm, this prevents false alarms from the overheating of a building, which might not necessarily be dangerous.

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*Abstract of paper by J. W. Aydon, superintendent fire and police telegraph, Wilmington, Del., at the third annual convention of Fire and Police Telegraph Superintendents and Municipal Electricians, Elmira, N. Y., Aug. 18, 1898.

DIGEST OF CURRENT ELECTRICAL LITERATURE

AMERICAN AND FOREIGN

By Carl Hering.

Dynamos, Motors and Transformers.

TANDEM COUPLING OF MULTIPHASE MOTORS. Reithoffer. "Elek. Neuigkeits Anz.," August 1.—A description of the method used by the (foreign) Thomson-Houston Company. Two identical motors are coupled to the same shaft; the stationary part of one receives current from the line, say a three-phase current with a frequency of n; the stationary part of the second motor obtains its current from the armature of the first through sliding brushes; the armature of the second motor is short circuited through regulating resistances; the frequency of the multiphase currents generated in the first armature depends on the slippage; if m is the speed of the two motors, then $n-m$ will be the frequency of this current: the speed of the two coupled motors will then be approximately half of the full speed. It does not follow, however, that, because the slippage is about 50 per cent. the efficiency is below 50 per cent., as part of the energy generated in the first motor is used in the second. The general case is briefly discussed mathematically. By means of switches the two motors may be either connected in parallel, both being supplied from the outside circuit, or in cascade or tandem, and they may thus be made to have two speeds. The switching must be so arranged that the rotating field revolves in the direction of rotation when it is developed in the stationary part and in the opposite direction when it is generated in the moving part, in order to help the rotation of the motor.

SPARKLESS REVERSAL IN DYNAMOS. Allen. Lond. "Elec. Eng.," August 5.—The begnning of a reprint of the article noticed in the "Digest" May 7.

TRANSFORMER LITIGATION.—Lond. "Elec. Rev.," August 5.—A short article calling attention to the fact that the present owners of the nearly expired Zipernowski and Deri fundamental transformer patents are about to use them to obtain royalties from those using transformers in England.

ARMATURE MAGNETIZATION.—"Amer. Elec.," August.—A short editorial article discussing what is good practice in armature magnetization, a subject on which dynamo builders differ very widely. Armature densities vary from 40,000 to 90,000 lines per square inch, the English, as a rule, using high densities and the Americans lower; the density should depend on the conditions that are to be met in the design; if, for instance, a slow speed is desired a high density must be used, while if overload capacity is desired high density should be avoided; it does not follow that a high density in an armature means light weight of the machine, for generally little is gained in this direction by such practice; the diminished area of the air gap will increase the reluctance and leakage so as to require exciting coils of greater weight. For high densities it is very important to carefully select the iron for the armatures, as it is frequently so highly susceptible to hysteresis losses that it would heat dangerously from hysteresis alone. The concensus of modern opinion seems to be that density is something like speed: it may be increased above a certain limit to gain other advantages, but as a general rule it cannot be increased over 50,000 lines to the square inch without serious sacrifice.

SPEED-REDUCING RESISTANCE. Heldt. "Amer. Elec.," August.—An article of an elementary character explaining how the resistance in a motor circuit is calculated when it is desired to reduce the speed to a definite amount. The torque at a given speed is first determined by a simple calculation from the power and speed, after which the resistance is calculated, which will give the current required for that torque. It is illustrated by an example.

ARMATURE WINDINGS. Rice. "Amer. Elec.," August.—Diagrams and explanations of multipolar windings in which the coils consist of cables wound on forms.

WINDINGS OF MULTIPHASE ARMATURES. Stone. "Amer. Elec.," August.—A number of diagrams showing the most useful multiphase armature windings that are used in American practice.

INDUCTION MOTOR. Wiener. "Amer. Elec.," August.—The third installment of his serial; he describes the induction motor field winding with the aid of a large number of diagrams.

DESIGNING A DYNAMO.—"Amer. Elec.," August.—A short, elementary article explaining how to design a dynamo.

HOME-MADE TRANSFORMER.—"Amer. Elec.," August.—An illustrated article with working drawings, showing how to design a small transformer, which can be easily made by an experimenter for his own use, as it requires no machine work.

Lights and Lighting.

HEAT COMPENSATOR IN ARC LAMPS.—Lond. "Elec. Rev.," August 5.—An illustrated description of the Koerting and Mathiesen compensator, which was noticed in the "Digest" June 11.

INCANDESCENT LAMP RESISTANCE. Shedd. "Amer. Elec.," August.—A short, illustrated article of an elementary character pointing out the resistance properties of carbon which make it suitable for incandescent lamp filaments.

Power.

RAND CENTRAL ELECTRIC WORKS. Klug. "Elek. Zeit.," August 4.—A long, illustrated description of the electric power transmission plant of this company at Johannesburg, South Africa. Other descriptions of this plant have already been referred to, but this one seems to be more complete.

SOO POWER PLANT.—"Amer. Elec.," August.—An illustrated description of this plant at the Sault Rapids, below Lake Superior; 40,000 horse-power can be delivered at the turbine shafts; there will be a 375-kw slow-speed alternator coupled to each turbine shaft, delivering current at 200 volts, with a frequency of 60. The armatures are stationary and the fields rotate. (Other descriptions have already been referred to.) See THE ELECTRICAL WORLD, August 6, 1898.

WATER-POWER STATION. Hobart. "Amer. Elec.," August.—Some hints concerning the operation of a plant in which water power and steam power are used together to drive a generator.

COAL MINING PLANT. Gresley. "Eng. News," August 18.—A long abstract of a paper read before the (English) Inst. of Civ. Eng., describing the plant at Scott Haven, Pa.

PROPOSED METHOD OF LONG-DISTANCE TRANSMISSION. Asher. "Elec. Rev.," August 17.—A suggested system in which he intends to place a transformer having a ratio of one to one (that is, with identical coils), at the extreme distance to which the power can be transmitted, and then send the current from the secondaries to an equally great distance to another, and so on, believing that thereby great distances could be covered. For continuous currents he suggests the use of rotary transformers. (What he proposes to gain by inserting these transformers instead of leaving them out entirely is not described; the fallacy of the suggestion is self-evident. Were he to use them to recuperate the line loss at the expense of the current there might be some element of use in the system).

Traction.

HEAVY RAILWAY LINE.—Lond. "Elec.," August 5.—few notes about a plant at Thun, Switzerland, which is being built and which will be the first attempt in that country to use electricity on a large scale for heavy railways. A waterfall will be used having a head of 215 feet, and there will be four turbines of 900 horse-power each for the present, driving three-phase dynamos generating current at 4000 volts for the neighboring localities; this is raised to 16,000 for long-distance transmission; about half the power will be transmitted to Berne, 25 miles, being reduced to 3000 volts outside of the city; the other half is to work a 25-mile railway from Burgdorf to Thun; there will be eleven transformer stations along the line and 60-hp three-phase motors on each axle of a four-axle car carrying sixty passengers; owing to the heavy gradient the speed will be only 26 miles per hour.

ELECTRIC TRACTION AT THE PARIS EXPOSITION.—"Elek. Neuigkeits Anz.," August 1.—A brief description of this line, to which other references have already been given.

ELECTRIC RAILWAYS IN EUROPE. Lauriol. "L'Eclairage Elec.," July 30.—A brief abstract of his recent report (see "Digest" last week, under "Installations, etc.").

CONDUIT RAILWAY SYSTEMS.—"L'Elec.," August 6.—An editorial article enumerating the particular characteristics which distinguish the various systems and the reasons for their adoption. No conclusions are drawn.

ELECTRIC LAUNCH. Preller. Lond. "Engineering," August 5.—A brief, illustrated description of the 33-foot electric launch on the Walen Lake, in Switzerland. It carries twenty passengers, and contains forty-four accumulators, having a maximum capacity of 210 ampere hours, operating a 3-hp motor. The weight, cost and working expenses are given, the weight and cost of the battery motor being 0.6 tons and $520 per horse-power respectively; a mineral oil motor would weigh and cost 0.4 ton and $200 per horse-power, respectively.

AUTOMOBILES.—"L'Energie Elec.," August 1.—A long, illustrated description of the electric vehicles exhibited at the recent exhibition in Paris. There were altogether 250 vehicles exhibited, of which thirty were electric, and exhibited by ten exhibitors. With but few exceptions the illustrations give only external views, showing very little detail.

AUTOMOBILES.—Lond. "Elec. Rev.," August 5.—An abstract of Hospitalier's paper noticed in the "Digest" August 6.

FREIGHT TRAFFIC ON SUBURBAN TROLLEYS. Bonner. "Elec. Eng.," August 18.—A plea for the introduction of a system of freight traffic on suburban trolleys. He shows the relatively great cost of moving freight by horses over ordinary roads, giving a table of actual observations of the cost of moving 1 ton 1 mile over different pavements, including rails; the average cost of transportation by animal power, based on many statistics, is about 25 cents per ton mile. He recommends a system in which the freight is loaded on what he calls rail wagons, which are drawn by horses and are then run on a low truck on the trolley tracks, on which they are then drawn by an electric locomotive. See The Electrical World, July 16, 1898, p. 66.

POWER CONSUMPTION IN ELECTRIC RAILROADING. Dodd. "Elec. Eng.," August 18.—A reprint of the article noticed in the "Digest" February 19. He calls attention to the fact that so much more power seems to be required on trolley cars than on the horse cars formerly used, and makes an analysis of the losses occurring in street railway operation to show that the power used is no greater than might be expected.

TROLLEY LIGHTERS. Hibbard. "Sc. Am.," August 6.—He proposes the use of a system of lighters for the Chicago River, which are to be operated by a propeller driven with currents from trolley wires. He proposes four lines of double trolley wires, two along the centre and one along each dock; the motors could also be used to furnish power to unload the boats.

CAST-WELDED JOINTS.—"El'ty," August 17.—A reprint without the illustrations of the article noticed in the "Digest" last week.

ACCUMULATION TRACTION. Bayly. "Elec. Rev.," August 17.—An illustrated description of the Madeleine line in Paris. (Other descriptions have already been referred to.)

ACCUMULATORS FOR ELECTRIC CARRIAGES. Niblett. "Elec. Rev.," August 17.—An article describing recent improvements in accumulators for such vehicles.

ELECTRIC VEHICLES.—"Elec. Eng.," August 18.—Brief, illustrated descriptions of the "American" vehicles made by a company in Indianapolis.

Installations, Systems and Appliances.

INSTALLATIONS IN THE FRENCH ALPS.—"L'Eclairage Elec.," July 30.—Tables of statistics. There are sixty electric lighting installations, representing 4600 horse-power, of which 3300 are furnished by water power; forty-four use the continuous and twenty-one the alternating current, with two using tri-phase currents and the rest combinations of these. For the transmission of energy there are fifteen installations, representing 5500 horse-power, practically all of it being water power; seven use the continuous current and six the simple alternating current, one the biphase and one the tri-phase current.

ACCUMULATORS FOR LIGHTING AND TRACTION. Davenport. Lond. "Elec. Rev.," August 5.—Some brief comments on the recent paper by Rider (see "Digest" July 30; also below). It is claimed that the misuse is intentionally or unintentionally omitted in the paper; these misuses account for most of the prejudices which still exist against accumulators, and to these he calls attention; many of the bad effects caused by systematic overcharging might be obviated by the use of automatic switches. To get the best results care needs to be taken with the batteries equally as with a steam plant, and he believes many of the failures of batteries have been due to the culpable negligence of the engineers under whose supervision they were.

FRANKFORT.—Lond. "Elec. Eng.," August 5.—A short description of the central station.

OFFICE BUILDING PLANT.—"Amer. Elec.," August.—An illustrated description of the plant in the Cushman building, New York, in which steam is obtained from the central steam station in that city and used in steam engines to generate electrical energy which is used for lighting and elevator service, the exhaust steam being used for heating. See The Electrical World, July 30, 1898.

DETROIT MUNICIPAL PLANT.—"Elec. Eng.," August 18.—A discussion of the 1898 report of this municipal lighting plant, about which there has been much discussion; there is also an editorial [illegible] in the same issue. See The Electrical World, August [illegible], 1898.

MADRID.—"Sc. Am. Sup.," August 6.—An illustrated description [illegible] the [illegible] of an alternating current plant erected by an English firm.

ACCUMULATORS IN LIGHTING AND TRACTION. Rider. "El'ty," August 17.—A reprint of the paper noticed in the "Digest" July 30.

ALTERNATING CURRENT CONNECTIONS.—"Amer. Elec.," August.—[illegible] diagrams showing the [illegible]

Wires, Wiring and Conduits.

APPARATUS FOR DISTRIBUTING SYSTEMS.—Lond. "Elec. Rev.," August 5.—A brief illustrated description of a new system of [illegible] apparatus in which the main principle is its insulations, both between the circuits and between them and the ground; it is specially adapted to the 200 volts supply systems.

FUSES.—Lond. "Elec. Eng.," August 5.—An answer to a request to give the essentials of a good fuse to protect street mains from short circuits on consumers' premises; several sketches are given; also rough curves, showing the relation between the fusing current and the diameter, the fusing current and the length, and the difference between open and closed fuses.

HIGH-VOLTAGE TRANSMISSION LINE. Dailey. "Amer. Elec.," August.—Some practical hints concerning the erection of such lines.

INTERIOR WIRING. Knox. "Amer. Elec.," August.—A short article illustrating the methods of controlling lights and branches.

Electro-Physics and Magnetism.

CURRENT AT RUPTURE. Arons. "Wied. Ann.," December; abstracted in "L'Eclairage Elec.," July 30.—Instead of assuming, as is generally done in finding the equation of the current at rupture, that the E. M. F. is annulled or the resistance becomes suddenly infinite, it is more logical to suppose that this variation has a certain duration. On this basis he deduces some equations and applies them to two cases; in the first this duration is greater than the time constant of the circuit, and he then finds that the current decreases from its initial value to zero, and the E. M. F. increases from zero to a certain value (not clearly explained in the abstract, but presumably the product of the initial voltage and the time constant, divided by the difference between the duration and the time constant) and remains finite, its limit being larger the less the duration differs from the time constant. In the second case the duration is less than the time constant, and the current will then decrease from the initial value to zero, but the E. M. F. will increase indefinitely; in practice it will increase until it becomes sufficient to pierce the insulation. The effect of the duration is shown in a table of calculated values for a special case, the table being reproduced in the abstract.

MUTUAL EFFECT OF TWO SPARKS. Karoly. "Wied. Ann.," 62, p. 612; abstracted briefly in "L'Eclairage Elec.," July 30, and "Science Abstracts," July.—An illustrated description of a lecture experiment.

AIR UNDER POWERFUL ELECTRIC STRESS. Trowbridge. "Phil. Mag.," August.—A short article on the behavior of air and rarefied gases under powerful electric stress. He lately increased the number of his condensers to 120, thus obtaining an E. M. F. of 3,000,000 volts. The initial resistance of air under these circumstances is greatly reduced, and the curve representing the relation between spark length and voltage departs from a straight line beyond 1,200,000 volts, approaching the axis expressing the voltage; thus the extreme length of spark in air with 3,000,000 volts is 6.5 feet, whereas it should be 10 feet if the proportionality between spark length and voltage had been maintained. This departure from proportionality is due to the increased conducting power of air; a powerful brush discharge passes to the floor and walls; portions of the discharge are shunted through the surrounding air; with still higher voltages it is probable that the resistance of air would be of the order of metals. The initial resistance also of highly rarefied media diminishes in a similar way; thus a Crookes tube which resisted the passage of an 8-inch spark is brilliantly lighted by 3,000,000 volts; one discharge lasting a millionth of a second is sufficient to obtain a photograph of the bones of the hand. The electrostatic field in the neighborhood of the apparatus is extremely powerful; long sparks can be drawn from neighboring metallic masses. The behavior of air and rarefied gases with powerful electric stress is analogous to that of elastic bodies under mechanical stresses; the initial resistance of air steadily diminishes with powerful electric stresses, and under disruptive discharges sinks to 2 or 3 ohms; this leads to a rapid change of potential producing the electromagnetic impulses, which, we have reason to believe, are the source of the X-rays.

CONTACT RESISTANCE. Branly. Lond. "Elec.," August 5; abstracted from "Comptes Rendus," July 25.—A brief abstract of an Academy paper describing experiments with similar metals as distinguished from his former experiments with dissimilar metals. In the case of aluminum, iron and bismuth the resistance was low, if the discs forming the piles are placed on one another gently, but if dropped on each other with a slight shock and then subjected to the same pressure as before the value of the resistance increased enormously. No attempt is made to account for the phenomenon.

HALL EFFECT IN LIQUIDS. Everdingen. "Proc. Acad.," Amsterdam; abstracted briefly in Lond. "Elec.," August 5.—An important contribution to the discussion; he determined the theoretical value of the effect in a given electrolyte; the results in concrete cases do not agree with the experimental values obtained by [illegible]

GAMMA FUNCTION APPLIED TO AN ELECTROSTATIC PROBLEM. Jude. "Phil. Mag.," August.—Maxwell gives an equation for the distribution of electricity on a pair of freely charged spheres in contact, but, except when the spheres are equal, the result cannot be calculated by ordinary algebra; in the present short article, which is of a mathematical character, he shows that the results may be obtained by means of the gamma function.

ATMOSPHERIC ELECTRICITY. Chauveau. "L'Elec.," August 6.—An abstract of a French Physical Society paper on the diurnal variations of the atmospheric electricity; he gives the results of observations extending over several years at the meteorological bureau and on the Eiffel Tower.

ELECTRICITY AND LIFE. Solvay. "Bul. Acad. Roy. Belgique," No. 5; abstracted briefly in Lond. "Elec." August 5.—An announcement that two important organic syntheses have been obtained electrically; one is a sugar, which was made from the mixture of one volume of dry and pure carbonic acid and two volumes of hydrogen, contained in an ordinary Berthelot ozone tube, by the action of a brush discharge kept up for five hours; the process may be compared with that of the formation of sugar in plants under the influence of sunlight. The other product is urea, which is made from one volume of carbonic acid and two volumes of dry ammonia.

LUMINOUS EFFICIENCIES OF THE RARE OXIDES. Chatelièr and Bondouard. "L'Eclairage Elec.," July 30.—An abstract of a French Academy paper discussing the numerous theories to explain for the great efficiency. They claim that each of the theories is in contradiction with direct observation, and that the ordinary laws of radiation suffice for accounting for the high luminous efficiency of the rarefied oxides at incandescence. In conclusion they say that the theory may be stated as follows: The hood is composed of a material of which the emissive power at the existing temperature is different for the different radiations. The good efficiency is due to the very great emissive power, in the neighborhood of unity for the blue, green and yellow rays and less for the red and much less for the infra red rays; the proportion of energy radiated as visible rays is therefore very great; however, the absolute value of the energy thus radiated in the luminous form is less than that which would be emitted by a black body at the same temperature.

EVIDENCE THAT ROENTGEN RAYS ARE ORDINARY LIGHT. Stoney. "Phil. Mag.," August.—A short article supplying an omission in his paper in the June number of that magazine and giving the following summary of the results arrived at in that paper: "Röntgen rays consist of two distinct undulations, which present themselves in succession. They are an irregular progression of independent pulses in the first part of their course—from the target upon which the cathode rays impinge up to the object which is being skiographed. Beyond that object, between it and the fluorescent screen, they are a different undulation. For, as proved in the June number of the magazine, the radiation from the target is the same *physical* (and not merely kinematical) event as the simultaneous advance over the same ground of trains of waves, some of long, others of short wave lengths. Since the resolution into these trains of waves is physical the trains advance independently of one another; so that if, by any contrivance, some of them can be stopped, the rest will be unaffected and will proceed. Now the flesh of the human hand is a contrivance of this kind; it is opaque to the wave lengths of all visible light and of much ultra-violet light, but allows waves that are below a certain limit of shortness to pass through it. Accordingly, the trains of sufficiently short wave lengths are the only physical constituents of the first undulation which can get past this obstacle; and are what produce, by their co-existence in the space beyond, that second part of the Röntgen undulation which lies between the object and the fluorescent screen."

DISTRIBUTION OF CHARGES IN GEISSLER TUBES. Riecke. "Wied. Ann.," 63, p. 220; abstracted briefly in "L'Eclairage Elec.," July 30.—He deduces formulas for calculating the voltages and charges along the length of a tube.

POTENTIAL GRADIENT IN GASES. Capstick. Lond. "Elec.," August 5; abstracted briefly from the "Proc. Roy. Soc.," No. 398.—When the pressure in the tube is a few millimeters there is a rapid flow of potential near each of the electrodes, with a more gentle fall in the space between. He made some experiments to find some connection between the cathode fall and other physical properties of the gas.

DISRUPTIVE DISCHARGE. Steinmetz. "Amer. Elec.," August.—A diagram giving the relation between the striking distance and the disruptive discharge for currents from an iron-clad alternator and a smooth-core alternator. The discharges were between the fine points of sewing needles; between balls, plates or rounded conductors the distance is very nearly the same for voltages above 100,000, but is very much less for low voltages; the discharge between needle points is said to be much more reliable for fairly low voltages than between balls, which is the reason why needles were used; temperature, moisture, etc., seem to have no noticeable effect on the striking distance between sharp points.

ROENTGEN LIGHT NOTES. Rollins. "Elec. Rev.," August 17.—In this continuation of his long serial he shows the fallacy of using the equivalent air spark as a measure of the degree of vacuum in a Röntgen tube; other data should accompany this statement; for instance, the striking distance will be different whether a static machine or induction coil is used, also with different types of induction coils; at the exhaustion required the resistance of the tube as measured by the equivalent spark in air is inversely proportional to the voltage; the lower the voltage the higher the vacuum must be to produce an equal radiation. He shows that covering the target with aluminum gives no better results than platinum. The diaphragm for sharpening the shadows cast he now makes of glass half an inch thick instead of metal, as usual. Instead of using the water to cool the target it is sufficient for moderate currents to use a copper stem attached to the target to carry off the heat.

Electro-Chemistry and Batteries.

DEPENDENCE OF THE E. M. F. ON THERMO-ELECTRIC DATA. Platner. "Elektrochem. Zeit.," Aug.—The first part of an article on the dependence of the E. M. F. of a galvanic cell on the thermo-electric data. The dependence of the one on the other may be calculated from Helmholtz's well-known formula; this contains a term which may be either negative or positive, and which depends on the increase of temperature; relatively little seems to be known about this term. He discusses the nature of this source of energy; it has been suggested that it was due to the Peltier effect, but he shows that this does not explain it, as in some cells the quantity is positive. Moreover, it is not quite correct, as assumed in the Helmholtz formula, that the thermic equivalent for the chemical process is independent of the temperature. All this shows that our knowledge of the conversion from chemical into electrical energy is still quite incomplete. He then begins the description of researches which he made to elucidate this point; to measure the temperature exactly the metal of the thermometer was used as one of the electrodes. The results so far seem to lead to the assumption that there is no real difference between galvanic cells and the so-called thermopiles, and that there is no necessity to assume two different kinds of processes of generation. He promises to give the results of his investigations in the next portion of the article.

ELECTROLYTIC THEORIES. Edser. Lond. "Elec. Eng.," August 5.—In this continuation of his serial he discusses electrolytic refining of metals, the Thompson law for calculating the E. M. F. of a cell and the distinction between reversible and irreversible cells.

CHLORINE AND CHLORATE. Hargreaves. "Zeit. f. Elektrochemie," August.—A reply to a recent article by Lunge; it is theoretical in character.

OZONE. Andreoli. Lond. "Elec. Rev.," August 5.—A brief reply to the article by Kershaw noticed in the "Digest" last week. He claims that the data concerning the yield of the Otto and the Yarnold ozonizers are questionable, and that the figures obtained were due to defective and inaccurate methods in the determination of the ozone produced; the results obtained by such an analysis depend greatly on the methods employed, and errors of 50 to 80 per cent. are easily made; he personally challenges the accuracy of the figures given. He claims that the calculations of Kershaw concerning the comparative action of the various bleaching agents have no value whatever, for the reason that ozone is not applied like the other bleaching material. In a previous paper he said that decoloration by ozone alone is a myth.

TREATMENT OF ARGENTIFEROUS LEAD. Hesse. Lond. "Engineering," Aug. 5.—A brief extract of an article from a German journal in which he states that experimental work with an 8-hp installation has been successful and the estimates show that the process can be worked to yield a large profit. The zinc-silver alloy used contains 10 to 12 per cent. of silver; the solution is a neutral or slightly basic zinc sulphate; the deposit of zinc was satisfactory when the electrolyte was free from impurities, but only then; purity of the electrolyte is the principal factor for obtaining proper deposit of zinc; the electrolyte was systematically aerated to precipitate metallic impurities as oxides; the silver passed into the anode slimes. He doubts whether the electrolytic separation of zinc is profitable except in the case of zinc and silver alloys.

UTILITY OF PRIMARY BATTERIES.—Lond. "Elec.," August 5.—A long editorial in defense of the primary battery. The electric light did not lead to the abolition of candles, and similarly the dynamo does not necessarily lead to the abolition of the primary battery, for which it is claimed that there is a legitimate place which is better filled by it than by any other generator. Considerable advance could be made if local action and polarization could be minimized or eliminated, or if it were possible to use cheaper materials; there is nothing inherently impossible or even improbable in a well-organized company being run successfully on the merits of a new primary battery; it is not claimed, however, that the battery to do this has yet been invented; it is thought, however, that the new one which is being at present brought out in England (the Rowbotham, see "Digest" last week) possesses in many respects the elements of commercial success. Local action is said to be prevented when the cell is not in use by the fact that the water is kept in circulation through the space containing the iron; when running, the current generated in the porous tubes forces the acid into the outer chamber, but when there is no current there is no pressure, and every trace of acid is then flushed out by the water. According to Prof. Thompson there is no polarization when in use and no local action when lying idle. It appears that the initial outlay is considerably below the cost of a small steam or gas driven plant, and according to the tests the cost of attendance will be much less than for the usual isolated plant; the estimated cost will be higher when only small quantities of the materials are used. The success of a new battery does not rest on whether a current can be generated for 12 cents or 37 cents per kilowatt hour, as there is a field at even the latter rate, but the success must depend entirely on whether it can be installed and used continually without inconvenience from frequent repairs, without bad odors or falling voltage.

TRANSITION CELL. Cohen. "Zeit. f. Phys. Chem.;" noticed briefly in the Lond. "Elec. Eng.," August 5.—He describes an electric cell in which the E. M. F. is produced by means of electrodes placed in saturated solutions of the two forms of a compound capable of undergoing a transition change; also an element in which the temperature coefficient changes abruptly at the transition temperature; no further information is given in the abstract. Another class of cells is of the following type: "Electrode reversible with respect to the anion-saturated solution in presence of stable solid phase—electrode reversible with respect to the cation."

ARRANGEMENT OF AN ELECTROPLATING PLANT. Ulke. "Eng. and Min. Jour.," August 6.—A short, illustrated description of the arrangement of a model electroplating and polishing plant of the usual capacity, showing also how the various connections should be made.

RECOVERY OF GOLD FROM CYANIDE SOLUTIONS. Cowper-Coles. "Eng. and Min. Jour.," August 6.—A long abstract of a paper noticed in the "Digest" June 25, in which he recommends the use of an aluminum cathode.

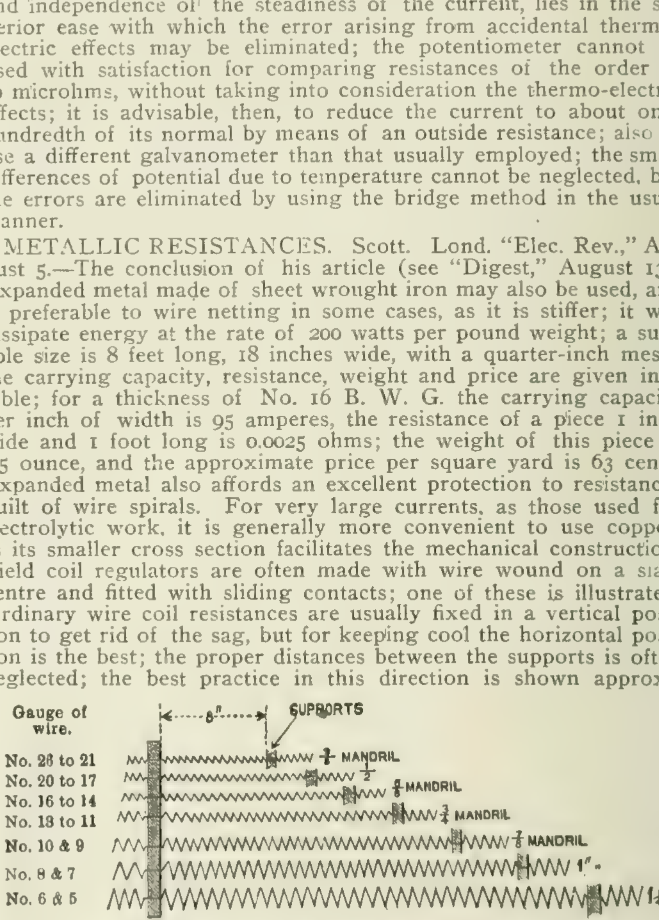
ZINC EXTRACTION PROCESS. Threlfall. "El'ty," August 17.—A reprint of the article noticed in the "Digest" August 13.

Units, Measurements and Instruments.

EFFICIENCY MEASUREMENTS OF DYNAMOS. Bunet. Lond. "Elec. Rev.," August 5; reprinted in "El'ty" (N. Y.) August 17.—A long abstract of an article from the "Rev. Phys. et Chemie." He describes various methods of measuring the efficiency and discusses their relative advantages and disadvantages; he divides them into two classes, one in which the energy consumed and delivered is measured, and the other in which either of these and the losses are measured; the methods themselves are well known. He discusses the question of the relative efficiencies of the same machine as a dynamo and as a wattmeter, concluding that if in each case it is run so that the induced E. M. F. is the same, with the same currents through the armature and magnets, then the speed and magnetic flux will also be the same; the resistance losses and those due to friction, hysteresis and eddy currents will also be the same; formulas for the efficiency of the dynamos and for the motor are then given and are very nearly equal; he assumes the lead of the brushes to be the same and that the armature reaction requires the same compensating ampere turns and excitation, claiming that this is borne out by his experience; editorially, preference is given to adjusting the exciting currents until the speed is the same, when the motor is supplied with current with a terminal voltage equal to the terminal voltage of the dynamo plus twice the calculated drop in volts in the armature. It is often held that the Swinburne method, in which the losses are measured, gives too high an efficiency, but Bunet gives figures of tests by the Swinburne and other methods which show that this is not so to any appreciable extent; these figures are reproduced in the abstract. The well-known Hopkinson method is next discussed; instead of the dynamometer for measuring the lost power, the method has been modified so that the energy required to make up the losses is supplied by a dynamo which is connected either in parallel or in series with the generator under test; in the former case it must supply current at the same voltage, and in the latter case it must carry the main current in its armature; Bunet recommends the former because it is easier to regulate the speed of the machines. The proper way of deducing the efficiency of each of the machines from the combined efficiency found from this test has given rise to much discussion; he states that if the square root of the combined efficiency is taken as the efficiency of each machine, an error of as much as 2 per cent. may be made; he makes recommendations concerning the best conditions; but it is thought that there is no appreciable error in assuming the hysteresis, eddy current and friction losses to be the same in both; he gives an equation for the efficiency when the current in the motor armature is greater than that in the generator armature; editorially, it is preferred to calculate the resistance losses, deduct them and allot half the remainder to each machine as the sum of the friction and core losses, after which the efficiency is calculated like for the Swinburne method. When the testing dynamo is connected in series with the machines under test the best conditions are those which make the mean of the voltage at the dynamo and motor armatures equal to the normal voltage; it is preferable to separately excite the magnets in this case, regulating the [illegible] of the dynamo and increasing the [illegible] so that the [illegible] at normal speed the currents in both armatures are then the same, as are also the friction and other losses. It is thought that the Swinburne and Hopkinson methods are far ahead of [illegible] in accuracy, and the choice between them is determined by which is the more convenient in a particular case; if only one machine is to be tested the Swinburne method is the best, the resistance should be measured hot; the Hopkinson method is preferable when two similar machines are available; [illegible] the test under good conditions with the auxiliary dynamo in series no [illegible] difference was found in the two methods that either may be used depending on the auxiliary dynamo at one's disposal.

COMPARISON OF LOW RESISTANCES. [illegible] Lond. "Elec. Rev.," August 5.—A communication on a comparison with the potentiometer, with special reference to the recent remarks of [illegible] (see "Digest," August 6). The potentiometer method is [illegible] of disadvantage in the time required [illegible] low resistances large testing currents are required, which are seldom found where they are wanted; for comparing unequal resistances he finds the Nalder instrument more convenient than Crompton's. The best method of comparing two unequal resistances by means of the Crompton potentiometer is to shunt the larger of the two with a finely subdivided ratio box or slide of relatively high resistance and to find by means of the ratio slide what fraction of the voltage on the larger resistance is equal to that on the smaller; the potentiometer is merely used as a test of equality and the accuracy of the measurement depends on the accuracy of the reading of the balance point on the slide; this method reduces the time of observation to a minimum and greatly diminishes the trouble arising from variations in the testing current; the advantage is that only one balance point has to be found for the comparison of two resistances; in the majority of cases, however, it is much simpler and better to discard the potentiometer with its two separate sources of steady currents and to use only the ratio slide by the bridge method, so as to be entirely independent of batteries and steady currents. For accurate work a great advantage of the bridge method as compared with the potentiometer method, in addition to its simplicity and independence of the steadiness of the current, lies in the superior ease with which the error arising from accidental thermoelectric effects may be eliminated; the potentiometer cannot be used with satisfaction for comparing resistances of the order of 10 microhms, without taking into consideration the thermo-electric effects; it is advisable, then, to reduce the current to about one-hundredth of its normal by means of an outside resistance; also use a different galvanometer than that usually employed; the small differences of potential due to temperature cannot be neglected, but the errors are eliminated by using the bridge method in the usual manner.

METALLIC RESISTANCES. Scott. Lond. "Elec. Rev.," August 5.—The conclusion of his article (see "Digest," August 13). Expanded metal made of sheet wrought iron may also be used, and is preferable to wire netting in some cases, as it is stiffer; it will dissipate energy at the rate of 200 watts per pound weight; a suitable size is 8 feet long, 18 inches wide, with a quarter-inch mesh; the carrying capacity, resistance, weight and price are given in a table; for a thickness of No. 16 B. W. G. the carrying capacity per inch of width is 95 amperes, the resistance of a piece 1 inch wide and 1 foot long is 0.0025 ohms; the weight of this piece is 3.5 ounce, and the approximate price per square yard is 63 cents. Expanded metal also affords an excellent protection to resistances built of wire spirals. For very large currents, as those used for electrolytic work, it is generally more convenient to use copper, as its smaller cross section facilitates the mechanical construction. Field coil regulators are often made with wire wound on a slate centre and fitted with sliding contacts; one of these is illustrated. Ordinary wire coil resistances are usually fixed in a vertical position to get rid of the sag, but for keeping cool the horizontal position is the best; the proper distances between the supports is often neglected; the best practice in this direction is shown approximately in the accompanying diagram, of which no further explanation is given (the gauge numbers evidently refer the B. W. G.). It is a mistake to skimp the ironwork in a resistance frame, as it is a great heat dissipator, iron, for instance, absorbing about 2000 foot pounds of heat units to raise one pound from zero to 100° C. A frame which can be built up without the necessity of making patterns is illustrated, it being made of T-iron bent in the form of a rectangle. Siemens & Co. inclose wire spirals in iron tubes filled in with fine sand; the General Electric Company's (American) and the Carpenter resistances are described.



CALCULATION OF THE JOINT RESISTANCE OF CONDUCTORS. Ross. "West. Elec.," August 13.—For calculating the joint resistance (in parallel) he gives the following rule: Add the reciprocals of the resistances and then take the reciprocal of the fraction thus obtained. (This is nothing more than the well-known rule to add their conductivities and then change the conductivity into resistance.)

Telegraphy, Telephony and Signals.

TELEGRAPHIC LIGHTNING ARRESTERS. Voisenat. "Ann. Télégraphiques," January-February; abstracted by Pierard in "L'Elec.," July 30.—After a discussion of the work of Lodge in this direction he gives the experiences which have been had with the various types of arresters. His conclusions are that telegraphic lines should be considered as being exposed to two kinds of currents very different from each other in their method of action—high-frequency currents and currents which vary relatively slowly; these two currents can succeed each other actively and even act simultaneously, thus producing very varied effects. The transmission of the high frequency currents is hindered by the impedance of the conductors, and the discharges, being oscillary in character, are probably dangerous only in a very limited district near the point struck; the currents, which vary slowly, are subject to Ohm's law; they have their effect on the whole length of lines and on the apparatus connected to them; it is thought that there is no other means of avoiding their evil effects except by some means of breaking the circuit. Fuse wires and discharge arresters are, therefore, two indispensable pieces of apparatus to protect the lines. Metallic circuits with quite symmetrical conductors, if there is absolutely no communication with the earth or a possibility of an accidental ground, have no need of protection against permanent currents, and fuses are therefore superfluous, but the discharge arresters are indispensable. According to the principles which he enunciates interior installations should be protected by a series of protectors on the lines themselves outside of the building, the only one inside being the fusible wire; vacuum protectors are of no particular use except on conductors having no connection with the earth. The exterior and interior connections are then briefly described, the latter depending upon whether the apparatus to be protected is of great value or not, and on the liability to lightning discharges; for the former it is sufficient to use a good discharge arrester, a useful precaution being to run the earth wire along the same path as the line wire, and in case of single-wire circuits to attach the ground wires to the arrester; when great protection is required it is well to use two or three successive arresters separated by one or two pairs of coils; on a metallic circuit each conductor should be thus protected; in a single-wire circuit it is preferable to have the interior wiring a metallic circuit, making the ground connections through the arrester. If the wires pass near a high-tension circuit the fusible cut-out should always be added.

WIRELESS TELEGRAPHY AND COLLISIONS AT SEA. Branly. "L'Elec.," August 6.—A short Academy paper. In applying the wireless system of telegraphy to ships at sea the difficulty arises that the transmitter should not operate the receiver on the same vessel; he has shown in a previous paper that the receiver may be protected by being completely enveloped in metal; a device might be arranged so that the receiver is automatically covered when the circuit of the transmitter is closed, and vice versa; not only the coherer, but the whole circuit, must be included. Such a system should also indicate the direction of the other vessel, and whether it is approaching or receding; the receiver might be placed in a metallic cage open only on one side and capable of being turned; the direction in which this opening points when the bell rings will indicate approximately the direction from which the electric waves come. Experiments analogous to those described in his paper read July 4, he thinks, would surely lead to the use of covers, which, by a comparison of the effects, will enable one to determine whether the distance was increasing or diminishing.

LONG-SPAN CABLE. Preller. Lond. "Engineering," August 5.—A brief description, with data, of a long span across the Walen Lake in Switzerland, which is the longest span in Europe. The span is 1.56 miles, one end being 1180 feet above the lake and the other end 426; the greatest dip is 590 feet. The original wire broke during a storm and a subsequent one broke from a deposit of snow; this was replaced by a cable of three zinc-coated, 3-mm steel wires, weighing 462 tons and having a breaking strain of 3330 pounds; the ends are suspended from a movable insulating drum held by a swivel, so that vertical and horizontal variations take place in the links, and not in the cable; the total cost, including re-erection, was $100, or $40 per km, while the average cost of an ordinary double 2-mm copper wire telephone line, including poles and re-erection, is about $90 per km, and $20 per km for every additional two wires. Since this was written the cable has broken again; during violent gusts of wind it is suddenly lifted, after which it falls, producing a wave-like motion, the vibrations being transmitted from the upper toward the lower end, like in the cracking of a whip, and they become so great that the cable is fractured at the lower end; the re-erection of the cable will necessitate its being suspended from supports placed at equal heights at both ends.

PROTECTION OF RAILWAY TRAFFIC.—Lond. "Elec. Rev.," August 5.—A brief description of the Chauvin and Baulan system, which was noticed in the "Digest" May 28.

TELEPHONE SYSTEM OF THE UNITED KINGDOM. Raphael. Lond. "Elec.," August 5.—The concluding article of his long series (see "Digest," June 11).

PHONOPORE PATENT EXPIRING.—Lond. "Elec.," August 5.—A note stating that the English patent 10,990 to Langdon Davies, 1884, for his phonopore, expires August 6.

FIRE ALARM SYSTEM.—"Elec. Eng.," August 18.—A brief description of the motor-generator system used on the Chicago fire alarm circuits.

AMERICAN TELEPHONE PRACTICE. Miller. "Amer. Elec.," August.—An illustrated description of self-restoring switch drops as used in this country.

PITTSBURG. Fairchild. "Elec. Eng.," August 18.—An illustrated description of the Bell plant in that city.

TELEGRAPHY AT THE OMAHA EXHIBITION.—"West Elec.," August 13.—Illustrated descriptions of some of the exhibits.

Miscellaneous.

LITHIN; A NEW INSULATING MATERIAL.—"Elektrochem. Zeit.," August.—The tabulated results of tests made by the Reichsanstalt of this new insulating material, which is intended to be used in place of hard rubber or fibre wherever these materials are no longer suitable. One of the chief properties is its independence of the effect of moisture, a plate, for instance, immersed seventy-two hours in water increased in weight only 0.41 per cent. Both insulation and breaking-down tests were made, the former before and after immersion in water. A plate about 1.25 mm thick was pierced with 9300 volts, while a plate about 1 cm thick withstood 26,000 volts for fifteen minutes without change.

ELECTRICITY AND FIRE DAMP. Couriot and Meunier. "L'Elec.," July 30 and August 6.—A reprint of the complete Academy paper, which was noticed in the "Digest" June 11.

CROMPTON & CO.'S WORKS.—Lond. "Elec.," "Elec Eng." and "Elec. Rev.," August 5.—A well-illustrated description of the new works of that company at Chelmsford.

ABSTRACTS.—The "Elec. Rev." frequently reprints abstracts from "Science Abstracts," the issue of August 17 containing a number of these.

Book Review.

LA TRACTION ELECTRIQUE SUR VOIES FERREES. By Andre Blondel and F. Paul-Dubois. Published by Librairie Polytechnique Baudry et Cie., Paris, France. Two volumes, 1700 pages, 1014 illustrations. Price, 50 francs.

The names of the authors of this work are a sufficient guarantee of its reliability, and its completeness is well indicated by the number of pages. The work is very thoroughly prepared, a short chapter given to the history, followed by descriptions of suitable roadways, rolling stock, motors, electric locomotives, etc. The second volume contains chapters on the action of direct current traction motors, regulation of the speed, the braking of electric vehicles, alternating current systems, etc. An almost invaluable part of the work is the complete classified bibliography, the work itself being rendered much more valuable by a most thorough alphabetical index with many cross references carefully worked out.

Exhibits at the Convention of the Ohio Electric Light Association.

THE BRADFORD BELTING COMPANY, Cincinnati, Ohio, was ably represented by Mr. George C. Kunz.

MR. H. E. ADAMS represented the Illinois Electric Company, Chicago. This is a comparatively new house, but its managers are experienced and know how to get business and conduct it.

MR. EMIL C. SCHMIDT, superintendent of the Sandusky Lighting Company and president-elect of the Ohio Electric Light Association, made for himself a reputation as being a master in the art of entertaining a crowd. His careful attention to the wants of the visitors, especially the ladies of the party, won to him many friends. Those who know Mr. Schmidt best predict some excellent executive work in the interest of the association during the coming year.

MR. W. D. PACKARD, of the New York & Ohio Company, Warren, Ohio, made his appearance at the convention on Friday. Mr. Packard has a host of friends in the electrical fraternity, and is a gentleman held in high regard by all who have the pleasure of his acquaintance. He reports that Packard lamps and transformers are growing in favor, and that his company's facilities are fully utilized in the production of these well-known goods. Besides Mr. Packard, the company was also represented by Mr. D. W. Low and Mr. Robert E. Gorton.

THE ELECTRIC APPLIANCE COMPANY, Chicago, had a live representative in the person of Mr. C. J. Wells. In addition to his social and business qualities Mr. Wells enjoys the distinction of being the only electrical man on the road that writes his name and address backwards and upside down, and not as ordinary beings subscribe themselves. However, when he talks Electric Appliance Company business it is not necessary to stand on one's head to understand him.

THE JANDUS ELECTRIC COMPANY, Cleveland, Ohio, had two of its inclosed arc lamps on exhibition in the hotel corridor. The steadiness of the light and the graceful outlines of the lamps themselves were prominent outwardly visible features, while the constructional details of the lamp, ordinarily invisible, were carefully explained by the company's representative. He was aided in this task by the exhibition of samples of the various parts which combine to make a completed lamp.

MR. CARYL D. HASKINS is a pet of the Ohio electric light men. He met with a very hearty reception on his arrival at the hotel on Friday morning, and it was evident by the questions plied to him by groups of members that the subject with which he is so familiar—meters—was a live one to them all. Mr. Haskins evidently reciprocates the feeling of regard, too, or he would not have come all the way from Boston to read a paper, and then rush back home as soon as the paper was read and discussed.

MR. JOSEPH M. HILL, of Chicago, the Western representative of the Bryan-Marsh Company, New York, was in attendance in the interest of Imperial incandescent lamps. Mr. Hill is known to every station man in the West, and he never fails to meet with a hearty reception at conventions. He is a very popular gentleman, and his personality is brimful of good humor. Mr. Hill did not have with him a lamp exhibit, but his vocal organs supplied this deficiency. His disquisitions on Imperial lamps are quite as effective in a business way as a display of the lamps themselves would be.

MESSRS. JAMES T. PARTRIDGE and J. S. Speer, of the Partridge Carbon

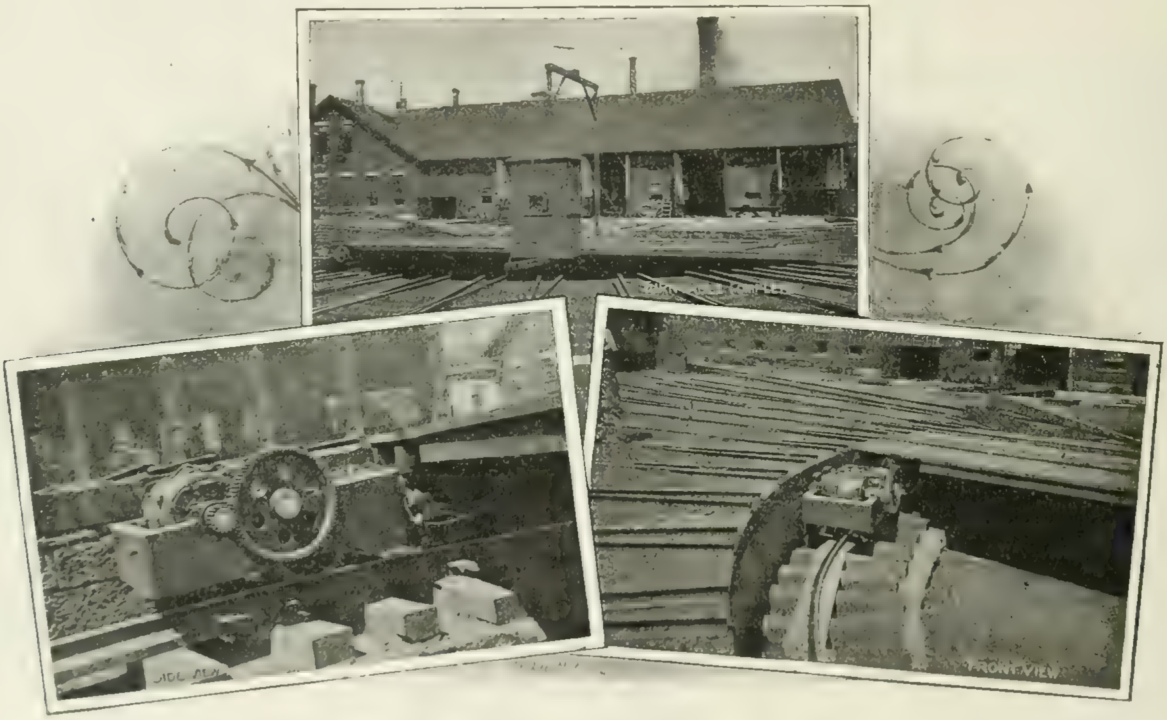
Company, Sandusky, Ohio, spent considerable time around the hotel conversing with the members and making new friends among them. The Partridge Company has succeeded in producing an electric light carbon for inclosed arc lamps which is claimed to be in all respects equal to the best imported carbons. These carbons were used in the lamps in the General Electric Company's exhibit, and they there "spoke" for themselves. The steadiness and purity of the light were noticeable. The Partridge Carbon Company's motor-brush business is steadily increasing. Several times the company has outgrown its factory facilities and enlarged its plant in consequence, and now it finds itself again in a like position. It recently filled an order for 200,000 carbons for one of its Eastern agencies.

THE WARREN ELECTRIC MANUFACTURING COMPANY, Sandusky, Ohio, occupied a room at the hotel in which it made an interesting display of samples of apparatus. The exhibit consisted of a Scheefer recording wattmeter connected up with a bank of six Shelby incandescent lamps. In this combination a small Diamond transformer was used, the primary being connected to the house circuit, 104 volts. The various component parts of the Warren alternator were also displayed on a large table. These included armature coils, field coils, laminations, etc. There was also a 75-100 kilowatt exciter, exemplifying the type of machine used in connection with the Warren alternator. The house circuit was supplied with current on the occasion of the convention from a Warren alternator at the Sandusky Lighting Company's station. The steadiness of the light in the hotel was perfect as far as the eye could judge. A plentiful supply of literature, pointing out the merits of the Warren apparatus, was distributed by Mr. C. P. Riegger, who had charge of the exhibit. Mr. C. C. Warren, president of the Warren Company; Mr. C. F. Mack, treasurer, and Mr. Frank Warren, were about the hotel much of the time entertaining the [illegible] naturally, dropping a good word now and then for Warren [illegible]. The Warren Company had another interesting [illegible]. It consisted of a sign board placed [illegible] the approach [illegible], near the hotel office, and was a conspicuously brilliant object to all who entered. On the sign the words [illegible] incandescent [illegible] lamps. The brilliant reminder very naturally produced a strong impression upon the mind of the [illegible].

THE GENERAL ELECTRIC COMPANY made a very creditable exhibit, [illegible] Mr. W. F. Hayes, of the Cincinnati office. On a long [illegible] rheostat, with [illegible] horsepower, a Thomson [illegible] wattmeter, a [illegible] connected from the ceiling was a single globe alternating arc lamp which gave a very clear and steady light. [illegible] cost. The lamp is designed for 110-volt direct current circuits, but an adjustable resistance is provided whereby it may be adapted to any line voltage from [illegible] aiding in the diffusion of the light. The single globe alternating current lamp [illegible] the line. The length over all is 23½ inches, and the life is 80 to 100 hours. The reflector is designed with the view of obtaining the best distribution possible with a single-globe lamp. The lower frame is of small dimensions, which feature is an advantage, since the intense light tends to cast dark shadows. It is of narrow rectangular section with the thin side toward the light. This type of lamp is made for both alternating and direct current circuits. The direct current C. A. motor exhibited was designed to take seven to eight amperes at 115 volts, running at a speed of 1000 r. p. m. The two alternating fan motors, both of which were in operation, ran on 125 cycles, 104 volts. One was 12-inch and the other 14-inch. The Thomson alternating voltmeter was a two-coil instrument without permanent magnets. The 2500-watt instrument was of the well-known inclined coil type. Mr. H. W. Hillman, of the lamp department of the General Electric Company's Schenectady works, was also present, and was particular in describing the features and advantages of the lamps exhibited. The burning single globe alternating lamp was furnished with the new carbon of the Partridge Carbon Company, Sandusky, which is claimed to be in every respect equal to the best foreign carbon used in inclosed arc lamps. Among other representatives from the General Electric Company's Cincinnati office were Messrs. F. A. Kelley and W. F. Hayes.

The Modern Round House Turntable.

The economies of railway management do not end with the adoption of the high pressure compound locomotive, or the hundred other contrivances which have been born of necessity, but go on and on, always finding a way to eliminate here or there an unnecessary expenditure.



An Electrically Driven Turntable.

The latest economical development is adaptation of the electric motor to turntables, called the turntable "donkey." The simplicity of the device and the method of operating it are plainly evidenced in the illustrations.

It is the product of the Westinghouse Electric & Manufacturing Company, and consists of its "series reversible" type "F" 10-hp motor, mounted within a heavy cast-iron frame, having a traction wheel which rests upon the rail of the turntable pit. Power is transmitted to this wheel through double reduction gears. The "donkey" frame is connected by draw bar and pin to one end of the turntable at the side, sufficient traction for the driving wheel being secured through the weight of the machine, which is 3700 pounds. Wires are run from the "donkey" to a small platform, located at one side of the centre of the turntable, or other convenient place, at which point is installed a controlling rheostat. By means of this controller the "donkey" may be operated in either direction at will by simply moving a single lever to one or the other side of a neutral point. Current, which may be supplied from the shop lighting or other convenient circuits and may be either alternating or direct and of any standard voltage, is supplied by wires brought to a suitable contact overhead and then led to the controller.

As no changes in the turntable are required for installing the turntable "donkey," the connections between the frame of the latter and the turntable girder being very simple, the cost of installation is low. As compared with the steam operated turntable it is apparent, even to the layman, that electrical power has the advantage, as it is a well recognized fact that the small portable boiler and engine are extremely wasteful of fuel, besides being a source of danger and requiring constant attention.

The comparison with turntables operated by push poles is no less interesting. In one of the installations, located at an important division point, it was necessary to turn 176 engines each twenty-four hours, or about seven per hour. Previous to installing this "donkey," push poles were used, requiring the services of four men, and the operation was a slow one at best. Now, one man does the work in a much shorter time. With turntable "light" the "donkey" will make a complete revolution in thirty seconds, while with a ten wheel locomotive on the table, weighing, with tender, 100 tons, a complete revolution is made in forty-five seconds. This gives therefore the following summary:

Engines turned per day	176
Men required	4
Average time per engine	5 min.
Total time of one man per engine	20 "
Total time for 176 engines	59 hrs.
Total time for 176 engines, with electric donkey	24 "
Time saved	35 "
35 hours at 12½c., amount saved per day	$4.37

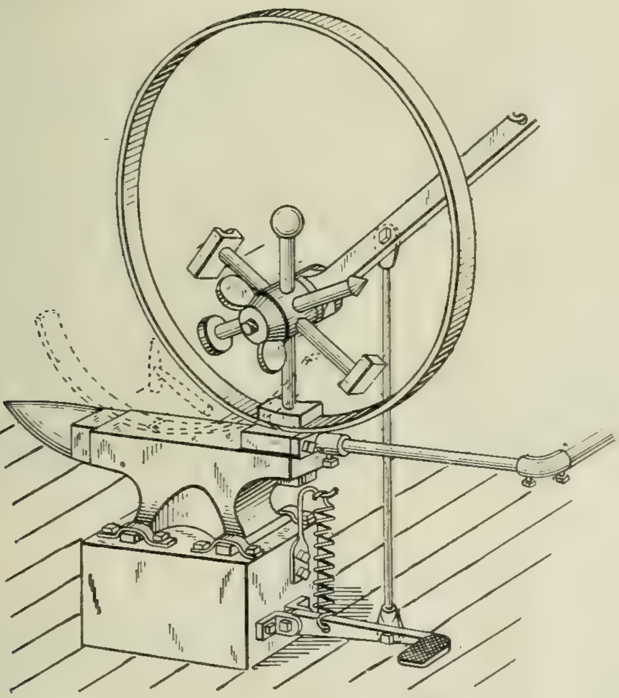
The above calculations assume that the men are employed in wiping engines while not employed in operating the turntable; otherwise the comparison would be still more favorable to electrical operation.

The assumption of five minutes per man on the average is conservative. It is plain that the thirty-five hours saved would supply two day and two night men as wipers on shifts of eight hours each.

It is stated that actual tests have shown that the average power consumed by the electric "donkey" is the equivalent of one-half horse-power hour per engine turned. Assuming 6 pounds of coal per horse-power hour, with coal at $2 per ton, the cost of fuel for turning each locomotive would be 3-10 cent or 53 cents for 176 locomotives.

An Electric Lap-Welding Machine.

A handy machine for use in iron works of almost any variety or magnitude from a blacksmith or bicycle shop to a Bessemer rolling mill is the lap welding, forging and brazing machine lately brought out by the Burton Electric Smelting Company, Boston, Mass. This machine, which is shown in the accompanying illustration, is capable of making a lap weld on an ordinary anvil in direct view of the workman. The piece to be welded rests on an electrode or contact block mounted on the anvil, and connected with one terminal of the source of current, the other terminal being attached to an arm pivoted at some point overhead and capable of being depressed by pressure on a foot lever. As soon as the required heat is obtained the foot lever may be released, and the weld completed by hammer blows with the anvil as a support. The upper terminal or electrode is fitted much after the style of a lathe turret with contacts of different shape for use on welds of different styles, the various contacts radiating from a hub attached to the pivoted arm.

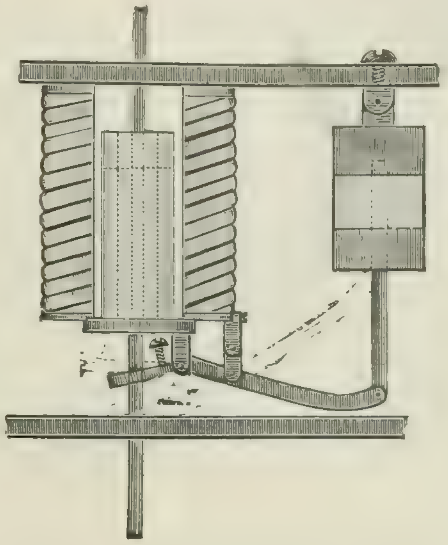

The Burton Lap-Welding Machine.

The advantages of such an equipment are readily recognized from the improved results already obtained with electric butt-welding machines over methods using charcoal or even gas. These advantages are the cleanliness, the readily adjustable heat, the reduction of scale and the generation of heat while the welding process is being effected instead of before.

Mr. George D. Burton and his associates of the Burton Electric Smelting Company are well known already for their work in the design of apparatus for electric heating of metals, the Burton electric forge being quite widely used by prominent concerns the country over. The Burton furnace for ore refining and smelting has also been put on the market, so that the new welding machine is not an experiment on the part of inexperienced designers. A special direct current dynamo of low voltage and large ampere capacity is on the market by the same company for use with this machine, where other sources of current supply are not available.

Inclosed Arc Lamps for Constant Potential Circuits.

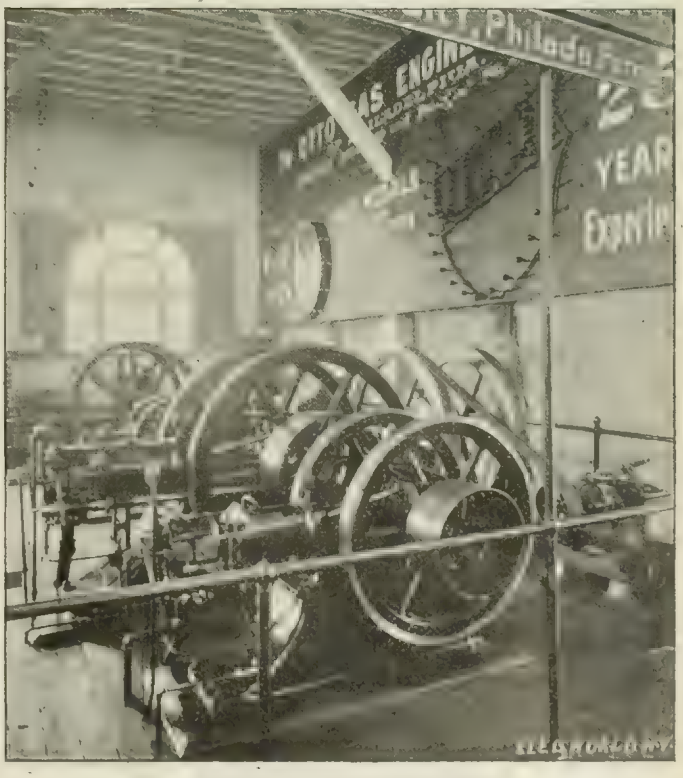
A line of lamps for direct current constant potential circuits has been put on the market by the Morris Inclosed Arc Lamp Company, Chester, Pa. The central parts of the operating mechanism of this lamp appear in the accompanying illustration, which shows the one central solenoid controlling the clutch and the dash pot, which prevents the movement of the former from becoming too sudden for satisfactory working. The core of the solenoid, which is series wound, carries the clutch ring, lowering the latter down as the arc increases in length, thereby cutting down the current, until tripped by striking the frame. Easy access for trimming is obtained by removing the outer globe, which is attached by spring catches, raising the upper carbon and lifting out the inner inclosing globe, which may then be cleaned and replaced with ease. The lamps are wound for 110 volts, unless otherwise specified.


Mechanism of Morris Inclosed Arc Lamp.

Electrical Exhibits at the Trans-Mississippi Exposition—II.*

GAS ENGINE EXHIBITS.

The Otto Gas Engine Works, of Philadelphia, show several engines, all of which are running, and some of which are carrying loads. One drives a marine pump and another works a 10-hp dynamo for lighting the exhibit and a large electrical sign. The engines govern on the "hit or miss" principle, the oil being taken into the cylinder by gravity feed through a needle point valve which is actuated only when the speed is below the governing limit. Electrical ignition is used entirely. The exhibit is in charge of Mr. J. W. Marshall, the general Western agent of the company, with headquarters at Omaha.



Sample Products of the Otto Gas Engine Works.

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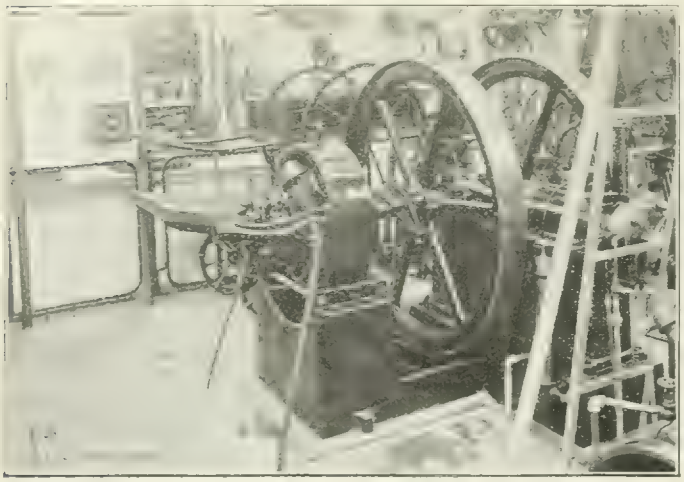
* For other exhibits see The Electrical World, July 9, 1898.

FAIRBANKS, MORSE & CO. show a gas engine coupled by a link coupling to a [illegible] generator made by the Commercial Electric Company, of Indianapolis. The interesting features of this make of engine are as follows: The governor is a shaft governor operating a hook, which, when the speed

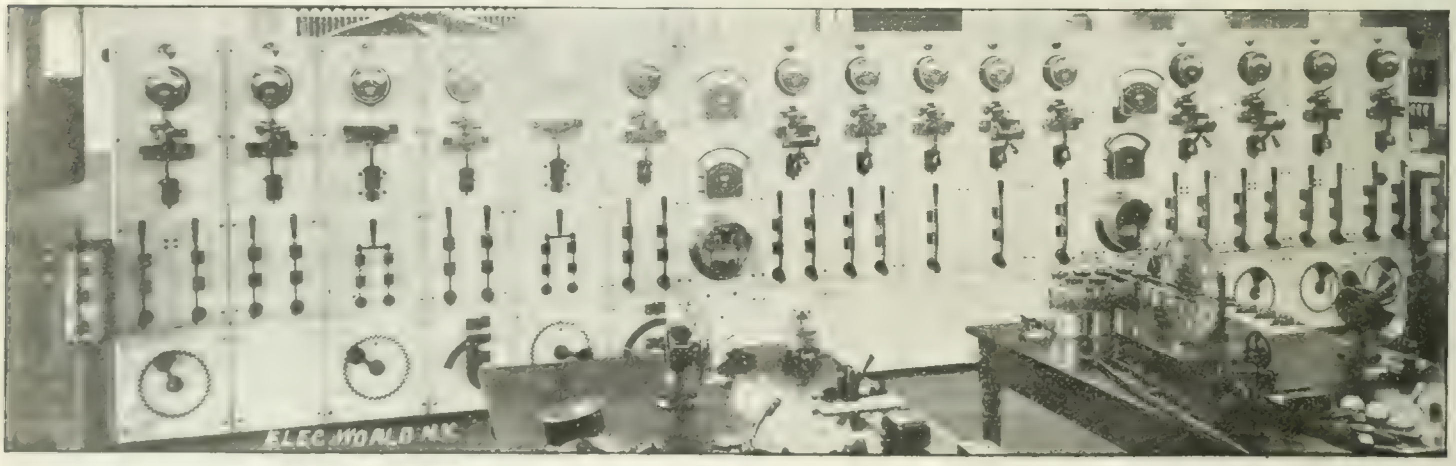


A Direct-Coupled Gas Engine by Fairbanks, Morse & Co.

is above the critical value, hooks the whole valve gear in a position such that the exhaust valve is open, where it remains until the engine slows down to a speed below the critical value. This does away with the compression and following expansion of a new charge of air every idle cycle common to most [illegible] cylinder between active cycles. The starting gear of this engine is also of interest. A small hand pump is arranged to be partially filled with gasoline, so that when operated it pumps a gasoline vapor into the cylinder. A parlor match is inserted in a plug in the cylinder casting, and, with the crank at the proper angle, the match is struck within the cylinder, exploding the charge pumped in by hand and thereby starting the engine. Beside the engines mentioned above, there are shown at the exposition one 4-hp engine geared to a pump, and one 12-hp engine driving a hoist. The latter is arranged to run normally at a low speed, the governor being under the operator's control in such a way that the speed [illegible]

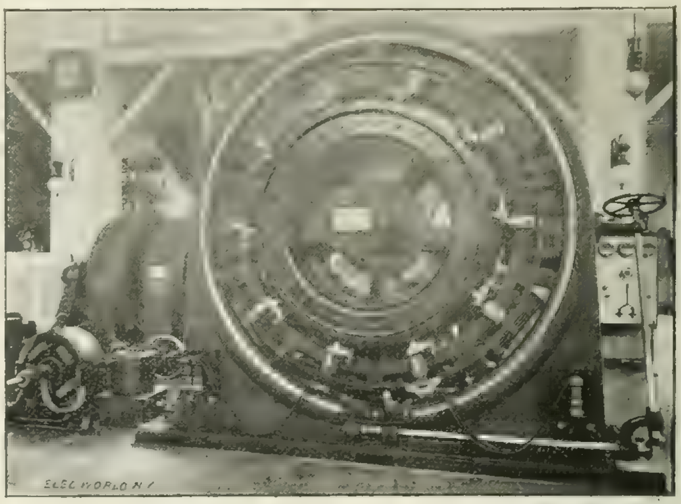
[illegible]

[illegible] circuit of the exposition, and [illegible] sign on which is [illegible]



The Westinghouse Switchboard.

motor and the other as a generator. A complete line of the type C induction motors is shown, ranging in size from a 100-kw down to a 2½-kw machine. In the line of stationary transformers are shown machines ranging from 50 kilowatts to five lights rated capacity. Complete equipments of Wurts' non-

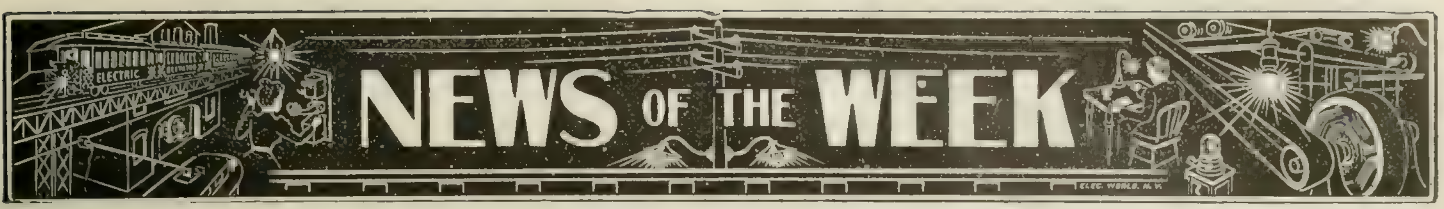


The Westinghouse 1000-hp Dynamo.

arcing lightning arresters with flat spiral choke coils mounted on marble panels for the protection of three-phase 30,000-volt lines are shown. In the line of historical instruments, the original experimental apparatus used by Tesla in his work on the rotary field is included in this exhibit. All sorts of auxiliary apparatus, long-burning arc lamps, washer type switches, plunger type switches, reinforced jaw type switches mounted on handsome pedestals for

The Exhibit of the Weston Electrical Instrument Company.

equalizer use, fan motors, Shallenberger meters, etc., are shown. The exhibit [illegible]



Financial Intelligence.

THE EDISON ELECTRIC ILLUMINATING COMPANY OF NEW YORK presents the following report for July, 1898: Gross earnings, $196,4[illegible]0, an increase over the same month for the year previous of $33,047; net earnings for the same interval, $66,552, an increase of $7,517; for the first seven months of 1898 the gross earnings were $1,738,123, an increase of $346,903; net earnings, $751,760, an increase of $121,011.

THE DIRECTORS OF THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY have authorized the issue of $3,500,000 fifteen-year 5 per cent, gold debenture certificates ,and sold $3,000,000 of such issue. Coupons mature January and July. The Mercantile Trust Company is trustee. The company has placed these certificates without creating any mortgage upon its assets, the company simply covenanting that it will not hereafter create any lien upon its property. The proceeds of the sale will retire outstanding floating and bonded indebtedness of the company, returning to its treasury as available assets stocks and bonds in various lighting and power companies yielding an annual income exceeding one-half of the interest charge of the debenture certificates. The saving in interest to the company will be important.

THE REDUCTION OF THE CAPITALIZATION of the General Electric Company was effected August 17 without any considerable opposition at the special stockholders' meeting in Schenectady, which had been adjourned from August 10. Mr. T. Jefferson Coolidge, seconded by M. Phelan, made the motion of the day in the form of a resolution, declaring that the capital stock of the General Electric Company be reduced from the present amount to $20,827,200, which shall consist of 182,760 shares of common stock, per value $100, and 25,512 shares of preferred stock, par value $100, the now existing common and preferred stock and the number of shares of each holder being respectively reduced to three-fifths of the present amounts. W. L. Putnam, representing the minority preferred stock, moved to adjourn and await the result of Mr. T. H. Livermore's litigation. The motion was put to a stock vote and lost, 243,141 to 9,800. Mr. Putnam also attempted to have a committee appointed to appraise the true valuation of the property, but Messrs. Coolidge and Ames affirmed their reliance on the board of directors, who had carefully considered the matter, and this amendment was also lost. Mr. Putnam protested that the vote was illegal, for four reasons: First, because the charter did not authorize the reduction; second, because such reduction would practically take 40 per cent. from the value of the preferred stock and give it to the common stock; third, because the common shares had been largely overissued and had remained unpaid; fourth, because there was no sufficient justification for reduction on any grounds whatever. Finding that the tide of the reduction movement was too strong to be resisted, Mr. Putnam finally succumbed with a last attempt to have the vote declared void. President Coffin overruled all these objections. The sworn tellers made their report through Mr. Darling, their chief. President Coffin declared that 243,141 votes were cast in favor of reduction and only 9,800 against it, and about $20,000,000 of excessive valuation was swept away in a moment.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
9 Murray St., NEW YORK, August 20, 1898.

THE UNITED STATES GENERAL APPRAISERS have given a decision on the question of the importation of long carbons and consequent avoidance of duty by virtue of the fixed tariff of 90 cents per thousand. The carbon importers have been bringing them in in extra lengths, even up to 36 inches, and cutting them up after paying the duty. The Treasury Department, however, counted every 12 inches as being one stick, and assessed the duty accordingly. The importers protested that this was illegal. The Board of Classification has settled the question by deciding that the goods come under another paragraph of the tariff bill, which provides for a duty of 35 per cent. ad valorem on goods made of carbon.

BIDS FOR PUBLIC LIGHTING IN BROOKLYN.—Bids for the lighting of Brooklyn streets for the coming year were submitted only by the Edison Electric Illuminating Company, of Brooklyn, now part of the Kings County Electric Light Company. The figures were as follows: For more than 3500 arc lights of 1200 candle power each, 34 cents each per night; for less than that number, 35 cents each per night. For current furnished for public buildings, 16½ cents per kilowatt hour. This rate for arc lights is 6 cents less than that charged by the New York Edison Company in Manhattan Borough, and the city officials are anxious to find out the reason why. Competition is practically ended in Brooklyn, the Citizens' Electric Illuminating Company and the Municipal Electric Light Company having been absorbed by the Edison Company, which in turn has combined with the Kings County Electric Light Company. The only competing company now in the field is the Amsterdam Electric Light, Heat & Power Company.

PHILADELPHIA NOTE.

Branch Office of THE ELECTRICAL WORLD,
929 Chestnut Street.
PHILADELPHIA, Pa., August 18 1898.

THE INTERNATIONAL ASSOCIATION FOR TESTING MATERIALS has established an American section, with the secretary's office in the testing laboratory at the City Hall in this city. The executive committee of the association at a recent meeting selected Saturday, August 27, and the Engineers' Club, 1122 Girard Street, as the date and place of the first annual meeting of the American branch of the association. The association, while new in this country, has a comparatively prominent standing in Europe, having about 1300 members. The transactions appear in its official organ, which is entitled "Baumatieralienkunde." Two conventions have been held, one in Zurich in 1895, and the other in Stockholm in 1897.

BUFFALO AND NIAGARA FALLS NOTES.

BUFFALO, N. Y., August 19, 1898.

THE OPENING OF THE LOCKPORT TROLLEY LINE, which is about 25 miles long, was a complete success, everything working perfectly from the start. As with the Niagara Falls line, power is taken from the 11,000-volt mains of the Niagara Power Company. A transformer station has been established at Lockport for the supply of that end of the line.

COUNT A. VALENTINIS AND CHEVALIER A. LUZZATI, of Italy, who have been in this neighborhood some time examining the electrical development connected with the Niagara tunnel, are still at Niagara Falls. They speak of the success of the many undertakings as something wonderful. An examination of the new trolley line to Lockport was made on the turning on of the power.

ENGINEER STOTT, of the Buffalo General Electric Company, appears to have accomplished his purpose in going to Schenectady to get the new apparatus for use here in readiness for shipment. The list includes no less than seventeen transformers for stepping down the Niagara cable current. They will begin to arrive here next week, and will be set up at once in the new light station and other electrical centres of the local companies.

ELECTRIC SUBWAYS IN BUFFALO, under construction at the present time, make of it a most ragged city. Almost the whole of Niagara Street has been traversed, part of the work being still under way. The line through Genesee Street to the Urban flour mill has been tapped and extended through several east side streets in order to bring the current across Main Street under ground for street lighting purposes. None of the cable has been threaded into the new lines yet, except that the new lighting station has now been reached.

THE AMERICAN ELECTRO-THERAPEUTIC SOCIETY will hold its eighth annual meeting in Buffalo September 13-15. Besides the usual exhibitions of improved apparatus there will be present many notable electricians, who will take an active part. Papers will be read by Dr. Apostoli and Dr. Gautier, of Paris; Dr. Felice La Torre, of Rome; Dr. J. Inglis Parsons, of London, and Mr. Nikola Tesla, who is in especial repute here on account of his prediction of the success of the Niagara tunnel long before it was an accomplished fact.

THE GENERAL ELECTRIC COMPANY, of Schenectady, is reported as contemplating a removal of part at least of its works to some point on the Niagara tunnel line, between Buffalo and Niagara Falls, and may do so if a site is furnished. A local paper calls for a committee to take the matter up. It should not be forgotten that this company came near locating here at the time it collected its departments at Schenectady. If the present report is well founded it is certain that the company has increased its faith in the capacity of the Niagara tunnel to produce cheap power.

CHICAGO NOTES.

Branch Office of THE ELECTRICAL WORLD,
936 Monadnock Building,
CHICAGO, Ill., August 19, 1898.

THE CHICAGO BELTING COMPANY'S WORKS at 67-69 Canal Street, Chicago, were destroyed by fire on August 15. The loss to the company is estimated by local papers at $30,000. All losses are said to be covered by insurance.

THE ELECTRICAL CLUB of the Chicago Central Young Men's Christian Association, which was formed for the purpose of giving instruction in practical electrical engineering and also for the promotion of a spirit of fraternity among the men interested in that particular line, is unusually active at the present time, preparing for its next season. The instructors for the following year are Mr. George A. Damon, who is associated with Mr. B. J. Arnold; Mr. Benjamin H. Glover, assistant electrician National Board of Fire Underwriters, and Mr. Truman P. Gaylord, electrical engineer of testing department, Chicago Edison Company. The club is equipping a laboratory, and invites the manufacturers of electrical supplies to help it in this work. To motor manufacturers the club wishes to state that the Cutler-Hammer Manufacturing Company has offered to make a starting box and rheostat to fit any motor. "Who will give us the motor?" A unique electrical entertainment will be given on Friday evening, September 16.

St. Louis Notes.

St. Louis, Mo., August 18, 1898.

NEW ELECTRIC LINE.—D. Houseman, Jr., is trying to interest capitalists in an electric railroad between Bobringville & Kemmswick. The line is expected to run over the telegraph county roads, and it is stated that the necessary franchises have been secured.

SUBURBAN LOOP.—The St. Louis & Suburban Railway Company's loop, for which it has had a franchise for over three months, has not been touched yet. The only action taken by the road was to appoint commissioners to assess what rental should be paid other roads that will be used.

NEW SUBURBAN BRANCH.—A special session of the County Court will be held Saturday to consider the petition of the St. Louis & Kirkwood Railway Company for a franchise to build a line from Brentwood through Clayton, the county seat, to Hodeamont, connecting with the main line of the Suburban.

THE EAST ST. LOUIS ELECTRIC STREET RAILWAY COMPANY and the Belleville & Suburban Railway Company are pushing things along the west ends of their lines. The East St. Louis Company promise a continuous connection between the bridge and the court house in Belleville by September 1.

THE COLLINSVILLE ROAD.—The capitalists interested in the proposed electric railway to Collinsville, Ill., have decided to push the line to completion. They say that a complete right of way has been secured, with the exception of a few feet, and the owners of those will consent to give these lands when the building of the road is an assured fact.

STRIKE ON NEW POWER HOUSE.—Work was closed down on the new power house of the Imperial Electric Light and Power Company this week on account of a strike ordered by the Building Trades Council. Non-union steamfitters employed by the McCloud Contracting Company, of Chicago, have caused the trouble. Between 80 and 100 men are affected by the strike.

KINLOCH EXCHANGE NEARLY READY FOR BUSINESS.—Manager Hauton, of the Kinloch Telephone Company, will begin testing his lines Monday. Within three weeks from date he expects to have the new system ready for business. At first seven girls will be put to work on a switchboard of 100 numbers, and when they become proficient they will in turn instruct other operators until the full quota is ready. No charge for the use of the system will be made until it is in complete working order. 'Phones in the residence districts will be the first put into commission.

Mississippi Notes.

Brookhaven, Miss., August 18, 1898.

THE LOCAL TELEPHONE EXCHANGE, of Brookhaven, Miss., is offered [illegible].

THE COTTON SEED OIL MILLS now being built at Barlow, Miss., are in the market for a 50-light incandescent plant. Address H. H. Barlow.

AN ELECTRIC LIGHT PLANT in Hazelhurst, Miss., will be built by a stock company formed by G. N. Ellis and G. T. Ragsdale. The plant will consist of one 1000-light alternator and one 30-light arc machine. Twenty-five arc lights are to be used in lightning the streets of the city.

THE LOCAL TELEPHONE EXCHANGE in Hazelhurst, Miss., has been bought by Mr. T. Granberry, and the central office is now being removed to new quarters over the Merchants' & Planters' Bank. The exchange now has [illegible] to rebuild the entire system and [illegible].

Mexican Notes.

Monterey, Mexico, August 17, 1898.

A METEOROLOGICAL DEPARTMENT in connection with the Federal [illegible].

[illegible] ELECTRIC LIGHT PLANTS have recently [illegible] Monterey [illegible] for illumination and [illegible].

[illegible] FIRE AND POLICE ALARM system has been placed in [illegible] has been built, [illegible].

[illegible] LIGHT AND POWER PLANT in the city of [illegible] decided to [illegible].

[illegible] IN THE CITY OF MEXICO.—[illegible]

Pacific Coast Notes.

San Francisco, Cal., August 14, 1898.

THE PACIFIC ELECTRIC MOTOR COMPANY has moved its factory and repair shop to 183 Jessie Street, San Francisco.

THE WYBRO-HENDY COMPANY is the name under which Mr. H. C. Wybro will superintend the sales of electric supplies at the uptown store of the Joshua Hendy Machine Works, of San Francisco. The new company carries the Pacific Coast agency of the Walker Company, Cleveland, Ohio.

THE SAN FRANCISCO "CHRONICLE" has installed an American-Ball direct-coupled engine and dynamo for lighting and power purposes. The new 125-volt machine has a capacity of 1000 lamps, and it will replace two Edison generators, driven by a rope transmission, that is out of date.

THE OREGON TELEPHONE & TELEGRAPH COMPANY has elected Mr. J. C. Ainsworth president, Mr. W. B. King having retired from that office. The switchboard capacity of the company's central office in Portland has been increased by fourteen stations, to accommodate a like number of operators.

THE SNOQUALMIE FALLS POWER COMPANY, which is to supply the cities of Seattle and Tacoma, Wash., with electric power generated in a station operated by water power, is reported as having closed a contract with the Westinghouse Electric & Manufacturing Company for four 1500-kw generators.

THE PORTLAND GENERAL ELECTRIC COMPANY'S "Station B" in Oregon City, Ore., is completed, and has all of its twelve sections in operation. It was constructed a few sections at a time. Ten of the sections contain one 6000-volt generator and two vertical turbines each; one section, turbines driving pumps, and one section, two exciters and two turbines. The total generator capacity is 12,800 horse-power. Each exciter has a capacity of 250 kilowatts at 125 r. p. m. The building is a solid block of concrete, and has a length, parallel with the Willamette River, of 364 feet. The voltage is 6000 on the transmission line to Portland, 14.3 miles in length. The station across the river has been sold to a paper mill company.

Canadian Notes.

Ottawa, Ont., August 20, 1898.

THE BELL TELEPHONE COMPANY'S directors have decided to increase the capital stock of the company from $3,168,000 to $3,900,000.

THE OTTAWA ELECTRIC COMPANY is about to increase its plant at No. 2 power house by the addition of a 60-inch waterw heel and a 125-light arc generator.

THE TORONTO ELECTRIC RAILWAY is reported as having entered a suit against the Siemens & Halske Electric Company, of Chicago, for $25,000 for breach of warranty of a generator.

THE MONTREAL ISLAND BELT LINE railway shareholders have authorized the directors of that company to issue new bonds to the extent of $380,000 and to cancel and redeem the old issue of $300,000.

TENDERS ARE INVITED up to August 30 for supplying an incandescent electric lighting plant for the city of Beeton, Ont. Mr. John Galt is the consulting engineer, and Mr. W. H. Mitchell is the chairman of the electric light committee.

THE RATEPAYERS OF THE CITY OF HAMILTON, Ont., have voted in favor of extending the franchise of the Hamilton Street Railway Company for a further period of fifteen years, or until the year 1928. The vote was strongly against the corporation in the proposition to assume control of the street railway.

PROFESSOR CALLENDAR, recently of the staff of McGill University, Montreal, has designed a platinum electrical resistance thermometer capable of measuring temperature to the ten-thousandth part of a degree. The extreme delicacy of the instrument makes it a valuable aid in securing accurate observations of the temperature of lakes' and rivers' water during the various seasons of the year, as no thermometer is available for such minute measurements.

THE CANADIAN MANUFACTURERS' ASSOCIATION, which has for its object the development of the manufacturing industries of Canada, has commenced the publication of a bulletin which will contain the information regarding the export trade of Canadian manufacturers. The association has appointed Tuesday, September 6, to be Manufacturers' Day at the coming Toronto fair, at which time it will hold a special meeting on the fair grounds.

THE TROUBLE BETWEEN THE OTTAWA ELECTRIC STREET RAILWAY COMPANY and its employees is reaching the acute stage. The company has already dismissed a number of its conductors for various reasons, but chiefly, it is said, because they belong to the union. The employees propose to appeal to the public of this city in order to enlist active popular sympathy on their behalf. The employees are asking for a ten hours' day the wage of $1 [illegible] and are now offered $1 [illegible].

General News.

New Incorporations.

THE INTERNATIONAL ELECTRICAL COMPANY, Cleveland, Ohio, has been formed by A. W. [illegible], J. H. [illegible] and Charles Steaton, to manufacture electrical apparatus. Capital stock, $[illegible].

THE WORTHINGTON WATER & LIGHT COMPANY, Worthington, Ind., has been incorporated with a capital stock of $[illegible]. The incorporators are John H. [illegible], B. O. Mayer and J. McClellan.

THE MASON ELECTRIC LIGHT COMPANY, Mason, Tex., has been incorporated with a capital stock of $[illegible]. The incorporators are L. Guggen[illegible], A. M. [illegible], Otto Donch and Richard Grosse.

THE HADAWAY ELECTRIC HEATING & ENGINEERING COMPANY, New York, N. Y., has been incorporated with the following named directors: Harold S. Mackaye and Nelson Hess. Capital stock, $50,000.

THE TRANS MISSISSIPPI TELEPHONE COMPANY, Omaha, Neb., has been incorporated, those interested being William B. Douglas, Warren P. Carlisle and W. P. Lathrop. The capital stock of the new company is $10,000.

THE QUAKER CITY TELEPHONE COMPANY, Quaker City, Ohio, has been incorporated with a capital stock of $500. Among those interested in the new enterprise are John R. Hall, J. W. Hill, H. S. Hartley and J. T. Douglas.

THE MORAL TELEPHONE COMPANY, Moral, Okla., has been chartered with a capital stock of $2000. It will run a line from Moral to Tecumseh, Lexington and Purcell. L. M. Lamm is president, and L. P. R. Miller treasurer.

THE GOSHEN TELEPHONE COMPANY, Goshen, Ind., has been formed with a capital stock of $30,000. The directors of the new company are James A. Arthur, George D. Lint and Wilson Roose, of Goshen; Edwin L. Barber, of Wauseon, and James S. Brailey, Jr., of Toledo, Ohio.

A COMPANY was organized August 18 in Philadelphia, Pa., for the construction and operation of telephone, electric light and electric railway plants in Southern and Middle States, the head offices to be at Atlanta, Ga. Mr. J. M. Wood, of Wilmington, N. C., was appointed general manager and purchasing agent. The company already has some franchises, and is in the market for electrical supplies.

THE ESMOND ELECTRIC TRACTION & SIGNAL COMPANY has been chartered in Charleston, W. Va., for the purpose of building, equipping and maintaining railways and signals and signal stations, and furnishing electric heat, light and power. The shareholders are D. N. Maxon, G. E. Cruse, C. S. Johns, D. A. Davies and R. H. E. Starr, all of New York. The capital stock subscribed is $500.

THE ONTARIO TELEPHONE & SWITCHBOARD CONSTRUCTION COMPANY, LIMITED, Toronto, Ont., has been incorporated with a capital stock of $75,000. The incorporators are Robert Fox, T. H. Smallman, F. B. Leys, T. H. Purdon, R. A. Bayly, John Labatt, Moses Masuret, John Milne, Dr. J. D. Wilson and J. R. Minhinnick, of London, and R. H. Evans and H. C. Walters, of Detroit.

THE DETROIT, UTICA & ROMEO RAILWAY COMPANY, Detroit, Mich., has been formed with a capital stock of $300,000, for the purpose of constructing and operating a suburban line that will connect Romeo and intervening points with Detroit. Among those interested are Alexander A. McVittie, Frank E. Kirby, Frank D. Andrus and Elliott G . Stevenson, of Detroit; George B. Davis, of Utica, and Marvil I. Brabb, of Romeo.

THE TELEGRAPH AND TELEPHONE.

KINGFISHER, OKLA.—Kingfisher is preparing to build a telephone system.

WORTHINGTON, MINN.—The Midland Telephone Company's line is now being constructed between Worthington, Rushmore, Adrian, St. Kilian and Ellsworth.

WICHITA, KAN.—Construction work has been begun on a second telephone line from here to Wellington. The line will run to Mayfield, Milan, Argonia, Conway Springs and Harper.

DESHLER, OHIO.—The Bell Telephone Company has purchased the lines of C. F. Heidley, of Leipsic, and will have in this city a general station for many of the adjoining towns.

MACKINAC ISLAND, MICH.—Mackinac Island is to have a telephone system. The Village Council has passed an ordinance granting a franchise to R. C. Stephenson, of Rochester, Ind.

CINCINNATI, OHIO.—The City & Suburban Telegraph Association of this city has just completed a long-distance copper metallic circuit between this city and Hillsboro, via Williamsburg, Ohio, for through business.

MINONK, ILL.—The McLean Telephone Company was granted a franchise at a meeting of the City Council last week. This gives the company entrance into the city and the right to erect poles and lines along the streets.

LORAMIE, OHIO.—At a special meeting of the City Council the Union Central Long Distance Telephone Company was granted the privilege of building a line through this city. Right of way has also been secured from Minster via Houston to Sidney.

LA CROSSE, WIS.—The La Crosse & Southeastern Telephone Company has just completed a new metallic line to West Salem, Bangor and Sparta, connecting with the telephone line at La Crosse. This line connects also with Norwalk, Wilton, Ontario, Leon, Melvina and Tomah.

INDEPENDENCE, MO.—The American Telegraph & Telephone Company, which was recently granted a franchise over the streets of this place, will begin work on the line at once. The work will be pushed to compeltion, and the city will have the benefit of a long-distance telephone connection with Kansas City, St. Louis and Chicago.

POTTSVILLE, PA.—J. Jerome O'Neill, electrical contractor, of Lost Creek, has been awarded the contract by Superintendent Zehner, of the Lehigh Coal & Navigation Company, and the Tamaqua & Lansford Street Railway Company, to equip an exchange and twenty-three stations. The line will extend from Summit Hill to Nesquehoning, through Lansford and Tamaqua, connecting all the Lehigh Coal & Navigation mines, offices, shops and electric railway offices.

WASHINGTON, D. C.—General Greely has been informed by Colonel Allen at Ponce, Porto Rico, that the telegraph lines now extend from Ponce through Guayama and Arroyo to the headquarters of General Brooke, through Guayama to the headquarters of General Wilson, through Ajuntas and Utuado to the headquarters of General Stone and along the coast to Guanica. These lines all extend to the cable station, and they place this country in communication with more than half of the island of Porto Rico.

ST. PAUL, MINN.—The Mississippi Valley Telephone Company is making rapid progress in its exchanges at St. Paul and Minneapolis. The conduit work is all completed in both cities, and the outside work is well under way at the latter city. Mr. J. C. Hubinger, president, expects to make this exchange one of the strongest independent systems in the country, and when completed in the two cities it will have from 10,000 to 12,000 subscribers. The Stromberg-Carlson central energy telephones and switchboard will be used throughout.

ELECTRIC LIGHT AND POWER.

MATTOON, ILL.—The Mattoon Light, Heat & Power Company has been granted a twenty-year franchise by the City Council, and will at once begin the work of building a plant.

BORDENTOWN, PA.—The Monmouth Traction Company has absorbed a controlling interest in the Bordentown electric light plant. A large supply of material has arrived from Williamsport, Pa., for the purpose of increasing the size of the plant.

MOUNT PLEASANT, TEX.—Mount Pleasant is to have an electric light plant. It will be owned and operated by Davis Brothers, millers, who will utilize the engine and machinery of their mill. The plant will probably be in operation by September 15.

TRENTON, TENN.—A bill was filed in chancery here by Keenan & Wade, owners of the electric light plant, against the city, claiming a failure on the part of the Mayor and the Board of Aldermen to comply with a contract made with them to purchase the light plant for the sum of $8000.

QUINCY, ILL.—Mr. J. C. Hubinger, of Keokuk, Ia., has purchased the old ice-house property on Front Street, between Maine and Hampshire, for the sum of $4000. The lot is 101 by 100 feet, and on it will be built the power house for Mr. Hubinger's proposed electric light and steam heating plants.

CHICAGO, ILL.—Chicago Edison interests, acting presumably for the Commonwealth Electric Company, have arranged to purchase another electric lighting plant on the northwest side. The property is located at Milwaukee and Western Avenues, and is known in electrical circles as the "Miller" plant. It is said that the purchase price will be about $29,000.

BRISTOL, TENN.—The Bristol, Virginia Corporation has just completed the construction of an artesian well, and is about to purchase machinery for pumping from the same, and also in connection therewith for lighting the streets by means of some sixty or seventy-five arc lights. Mr. C. W. Hanna is the proper person to address with regard to estimates for this equipment.

REDLANDS, CAL.—A certificate of increase of the capital stock of the Redlands Electric Light & Power Company was filed in San Bernardino by W. J. Curtis, atttorney for the company. The increase is from $200,000 to $500,000, and is made in order to extend the scope of the company's operations, improve the plant, circuit lines, property, etc.

PASADENA, CAL.—The Edison Electric Company, of Los Angeles, has purchased the entire stock of the Pasadena Electric Light Company. About October 1 this company will begin furnishing power to the Edison Electric Company and the Los Angeles Railway Company in Los Angeles, and the Pasadena Electric Light Company and the Pasadena & Los Angeles Electric Railway Company. The officers of the company are George H. Barker, president; William R. Staats, secretary; John B. Miller, treasurer; W. S. Wright, attorney. The new company proposes to make many improvements, introduce water power and reduce rates.

THE ELECTRIC RAILWAY.

MARION, IND.—Electric street cars are now running from Marion to Summitville.

SOLVAY, N. Y.—The Board of Trustees of this village has granted a franchise to the Syracuse, Skaneateles & Moravia Railroad Company to build its road through the village.

PHILADELPHIA, PA.—The Southwestern Street Railway Company has begun the work of laying track for its line through the hitherto undeveloped country in the southwestern section of the city, from Mayomensing Avenue to the county line.

PLAINFIELD, N. J.—At a recent meeting of the Common Council the Plainfield Street Railway Company was granted a franchise for an electric railway through the streets of Plainfield to connect with the Elizabeth & Westfield Street Railway Company.

MILWAUKEE, WIS.—A building permit has been issued to the Milwaukee Electric Railway & Light Company to erect its new power station at the corner of River and Oneida Streets. The building is to be of brick and stone, 100 by 130 feet. The cost is given as $98,000.

BUFFALO, N. Y.—Mayor Diehl has signed the resolution of the Common Council so amending the grant of the Buffalo Traction Company as to revoke the rebate check and 4-cent fare provision, and to permit a 5-cent fare and a system of transfers between all lines in the city.

JACKSON, MICH.—A decree has been entered in the Circuit Court, ordering the sale of the street railway by the Circuit Court commissioner, naming the time after August 31, to satisfy the mortgage held by the Fidelity Loan & Trust Company. The amount claimed is $171,829.50. The property has been in the hands of a receiver for the past year.

BROOKLYN, N. Y.—The plans and specifications for the construction of the incline at Flatbush and Atlantic Avenues, which will connect the Brooklyn Elevated Railroad system and the surface line of the Long Island Railroad on Atlantic Avenue, have been completed, and bids for the immediate construction of the work are now being received.

CHESTER, PA.—The Wilmington extension of the Union Traction Company's line, which is to connect the city of Philadelphia with Wilmington, is well under way. The tracks have been laid through this city and the men are now working on the section that leads to Clarmont, Del. It is thought that the through line will be completed within two weeks.

WEEHAWKEN, N. J.—The New Jersey Elevating & [illegible] Company has begun the construction of an inclined railroad which will hoist two score of passengers at one time nearly 200 feet within a short horizontal distance. The new railroad will [illegible] feet, and either steam or electricity will be used as a motive power. The grade is said to be the steepest traversed by any railroad in the country—72 in 100 feet—and will constitute the road practically an elevator.

DEFIANCE, OHIO.—Some months ago Mr. W. R. Faben, receiver of the Defiance Light & Railway Company, made application to Judge Hubbard for authority to sell the electric railway property in this city. At that time the creditors of the company objected, but now Judge Hubbard has given permission to sell the electric road. It is stated that the road will be sold in a few days to parties who will put it in operation. The road has not been running for more than a year.

ST. LOUIS, MO.—The stockholders of the electric railway company which contemplated the construction of an electric railroad from East St. Louis to Edwardsville and Alton have sold the franchise to the Mississippi Valley Electric Railway Company, of which J. H. Mehling, of St. Louis, is president. The Mississippi Valley Company proposes to construct two car lines, one from East St. Louis to Alton, via Brooklyn, Madison and Granite City. The other road will be from East St. Louis to Edwardsville, via Collinsville and Glen Carbon.

PERSONAL NOTE.

MR. MARTIN J. INSULL, of Chicago, formerly of the engineering firm of Sargent & Lundy, has been a visitor in New York during the last week. While there, Mr. Insull arranged with the C & C Electric Company to represent it in the Chicago territory, with headquarters in rooms 1012 to 1013 Monadnock Block. Messrs. Sargent & Lundy have during the past year represented the C & C Electric Company in Chicago, with Mr. Insull in charge of the electrical department, but with Mr. Insull's recent withdrawal from the firm the C & C agency was relinquished. Mr. Insull's long experience in the electrical field, his extensive acquaintance, his thorough familiarity with C & C apparatus and the excellence of the product of the C & C Electric Company should assure the success of his efforts.

Trade and Industrial Notes.

THE WASHINGTON ELECTRIC LIGHT COMPANY, Washington, Pa., is increasing its plant by the addition of a 200-hp engine, built by the Ball Engine Company, Erie, Pa.

THE WESTERN BELL WORKS, 69-71 West Jackson Boulevard, Chicago, are now owned solely by Mr. W. S. Hodgman. The business will be actively pushed under his personal supervision.

A NEW FACTORY for the Western Electric Company is to be built on South Clinton Street, Chicago, Ill. The building will be of brick ten stories high, 180x100 feet, and will cost about $150,000.

THE ST. AGNES HOSPITAL, Philadelphia, is to have an isolated electric plant. The engines, which are to be built by the Ball Engine Company, Erie, Pa., will be direct connected to Eddy dynamos.

THE DEARBORN DRUG & CHEMICAL WORKS, of Chicago, have recently analyzed fourteen boiler-feed waters and shipped two carloads of suitable scale solvents to large sugar concerns in the Hawaiian Islands.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING Company, Chicago, Ill., reports a large demand for its dividend circuit toll line telephones, which the company guarantees to be free from the claims of the Carty patent and to be superior to the bridging system.

THE SCHEEFER METERS AND TRANSFORMERS will be handled in the States of [illegible] and [illegible] by the Illinois Electric Company, 239 [illegible] Street, Chicago, [illegible] has just secured the exclusive agency for these States. The company states that it is in a position to make prompt shipments [illegible]

[illegible] & Co., [illegible] Street, New York City, report increased business on Partridge carbons, Quaker City dynamos and motors and No- [illegible] manufacturer of [illegible] H. M. Shaw & Co. are [illegible] of any place it [illegible]

SELF-LUBRICATING CARBON BRUSHES will have their merits ex- [illegible] Association convention [illegible] Partridge Carbon Company, of Sandusky, Ohio, who will attend the convention for this purpose. These brushes are [illegible]

[illegible]

[illegible]

[illegible]

that no expense should be spared to get the best and most reliable. The adoption of Walker machinery for the main generators is, hence, appreciated by the Walker Company.

THE NEW YORK & OHIO COMPANY, manufacturer of the celebrated Packard transformer, has recently brought out its latest model, which is to be known as "Model 98." The results secured on this new model are considerably ahead of anything that has been obtained heretofore in the way of regulation and efficiency. The Electric Appliance Company, general Western agents for the Packard transformer, is ditributing special circulars of the same, giving tabulated results of a number of tests. The manufacturers of this transformer are prepared to guarantee these results on each and every transformer sold, and a large fall trade is looked for on the "Model 98."

THE MASON & RICHARDS COMPANY, Security Building, St. Louis, Mo., states that in addition to the agencies of the Walker Company and the Keystone Electric Company it has selling agencies for the following desirable companies: Cutter Company, "I-T-E" circuit breakers; Keystone Electrical Instrument Company, instruments; Raster Carbon Rheostat Company, rheostats, dimmers, etc.; Electric Railway Equipment Company, railway supplies; Simonds Manufacturing Company, gears and pinions; Partridge Carbon Company, carbon brushes; K. & W. Company, incandescent lamps; Ham Sand Box Company, sand boxes; Diamond State Fibre Company, fibre; Monarch Stove Company, track cleaners, and other companies, enabling it to quote attractive prices on all sorts of electric railway material and supplies.

THE "JAGABI" PORTABLE TESTING SET.—Mr. J. G. Biddle, 910 Drexel Building, Philadelphia, reports a very good demand for the new "Jagabi" portable testing set, which he is selling for Willyoung & Co. The Philadelphia & Reading Railway Company has ordered several sets for testing the signal systems on its various divisions, and among other recent customers may be mentioned the United States Naval Academy, Central Union Telephone Company, Jenney Electric Motor Company, Ahearn & Soper, J. H. Bunnell & Co., Western Electric Company, engineer's office District of Columbia, etc. The "Jagabi" portable testing set is probably the most compact instrument of its class on the market. It comprises a Wheatstone bridge, rheostat, D'Arsonval galvanometer, silver chloride battery and keys for galvanometer and battery, all mounted in a handsomely finished mahogany case. The theoretical range of measurement is from one one-thousandth ohm to over eleven megohms. Mr. Biddle will be glad to mail descriptive pamphlet No. 295 to anyone interested in the subject.

RHEOSTATIC DEVICES OF ALL STANDARD TYPES, including automatic motor starters, field rheostats, theatre dimmers, constant potential arc light resistances, etc., are now on the market, with carbon as the resisting material, as made up by the Raster Carbon Rheostat Company, Ashland Block, Chicago, Ill. The advantages of this material are obvious on a little thought. It will stand a temperature far greater than that of any metallic resistance without breakdown. Its resistance is practically unaffected by the temperature, so that like results are always obtained on the same adjustment of the rheostat handle. There are no coils to sag or cross or break when rendered brittle by heating. These advantages have always been recognized, but difficulties have been found in the construction of carbon rheostats, particularly in the contacts with the carbon. This difficulty has been overcome by the Raster Carbon Rheostat Company by the use of a special composition. The external appearance of these rheostats is very similar to that of open-coil instruments, the same provision being made for ventilation and a thorough circulation of air over the surfaces of the resisting parts.

THE LARGEST ARC DYNAMO.—There is now nearing completion at the Rushmore Dynamo Works, Jersey City, what will be the largest arc machine ever constructed. It will operate on the new multi-circuit system lately perfected by Mr. Rushmore, and at 500 r. p. m. will supply two independent circuits of 150 ten-ampere arc lamps each, or a total of 300 arcs. This is said to be double the capacity of the largest machines now in service. The machine has four poles, and resembles an ordinary constant potential generator. Unlike other so-called multi-circuit machines, the circuits are in parallel and cannot be connected in series. Each circuit has a separate pair of brushes and brush rocker, and the regulation is effected by a slight automatic shifting of the rockers. There is no sparking, and either circuit may be opened or short circuited under any load without the least effect on the other circuit. Mr. Rushmore is now designing a much larger machine to supply four circuits and be coupled direct to a Willans engine. The machines will be put in under the fullest guarantees, and it is expected that the efficiency will be nearly as high as in the latest constant potential generators of the same kilowatt capacity.

TRADE AND MISCELLANEOUS PUBLICATIONS.

ALL STYLES OF CONVEYING MACHINERY from chain links to electric motors are described in a special price list of the Jeffrey Manufacturing Company, Columbus, Ohio. Of particular interest to electrical readers are the coal and ash handling equipment for power plants, Jeffrey mine equipments, including electric locomotives, coal cutters, drills and other parts of complete outfits and motor driven spiral chain and belt conveyors for all sorts of [illegible] handling operation.

"SNOW SWEEPERS, SNOW PLOWS AND TRACK SCRAPERS" is the title of a special catalogue dated August, [illegible], published by the J. G. Brill Company, of Philadelphia. Electric railway managers may not think this a [illegible] subject in the present hot weather, but they are admonished [illegible] "In time of peace prepare for war." Besides the [illegible] sweepers and plows the catalogue describes an [illegible] construction car, and illustrates one [illegible] upon the [illegible] & Cleveland Railway. It is [illegible] interchangeable nose and heat plow and [illegible] it can be used in summer as a [illegible] for hauling cars or trains, its weight and [illegible] to the latter service.

[illegible] pamphlet published by the [illegible] Company, of New York City, the contents being written by Mr. Henry [illegible] describes the [illegible] method of timing toll messages in telephone service, showing the errors likely to occur with clocks and personal estimation, and the advantages of the calculagraph over clocks, ordinary time stamps or stop watches. The calculagraph combines the good points of the time stamp and stop watch, or, in fact, a battery of stop watches, in that there is no necessity for any mental subtraction of the time of connection from the time of disconnection, the calculagraph doing this work automatically and stamping the slip or ticket with the time interval, and if desirable with the time of day also. One calculagraph will handle also as many toll line trunks as one or even several operators can manipulate, since the instrument does not need to be devoted exclusively to one line as does the stop watch while that line is in service, but may print tickets as fast as they can be slipped in.

"MICA AND MICANITE" is the name of a new catalogue recently issued by the Mica Insulator Company, of New York, and full of information for the electrical engineer, manufacturer and street railway man. An illustrated account of mica mining in India makes a capital introduction to the catalogue. Micanite is shown to be truly American, but although only five years old it is known in every country that can boast of an electric dynamo or motor. The work includes tables giving data of all kinds of some twenty-five different insulating materials. There is an article upon the construction of commutators which includes tables of various data and sketches of the latest designs. Micanite plate, flexible micanite plate, micanite cloth and paper, red paper and mica insulations, micanite rings, troughs, washers, tubes, spools, cylinders, etc., have each their descriptive page. Complete insulations for fifty-one different types of street railway motor commutators are kept in stock. The number of types will give an idea of the extent of the electric railway business. The other materials manufactured by the company include "Empire" oiled cloths, oiled papers, oiled linen, oiled asbestos, etc., and similar materials treated with "M I C Compound."

"PARTY LINE SERVICE" is the title of a wall poster lately issued by the Western Telephone Construction Company, of Chicago. The poster goes most elaborately into the details concerning the general construction of series and bridging party line systems, and describes the Western "Express" long-distance telephone, which is made for both series and bridging work. The means adopted for avoiding the Carty patent on bridging bells are explained, consisting of a novel arrangement of the generator and bell circuits by which the generator, instead of being normally on open circuit and bridged onto the line when in use, is normally on short circuit in series with the local ringing bells. When its crank is turned, however, the short circuit is opened as in ordinary exchange and series work, and a low resistance coil is shunted around the ringing coils so that the high resistance of the latter does not impede the generator current to line. One advantage of this arrangement is that the ringing coils at the transmitting station do not shunt off any of the current. The poster also gives detailed directions for the running of party lines, and describes the special apparatus manufactured by the company for the equipment of junction or switching stations for use on bridged toll lines. The methods of transposing metallic circuits and of protecting the instruments from lighting are explained, and the various parts of the Western Telephone Construction Company's equipments are described in full. A novelty brought out by the company and described in this poster is the H. C. D. combined carbon and fuse lightning arrester, consisting of the usual carbon blocks, with mica separating strips, to give the lightning a discharge path to ground, and fuse strips between these blocks and the instruments to cut off any excess currents from the latter.

Directory of Scientific Societies, Associations, Etc., and Meetings of the Same.

CHICAGO ELECTRICAL ASSOCIATION.—Meetings, third Friday of each month; J. R. Cravath, secretary.

THE NEW YORK ELECTRICAL SOCIETY.—President, Gano S. Dunn; secretary, George H. Guy, New York.

ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA., Pittsburg, Pa.—Meetings, third Tuesday of each month.

CANADIAN ELECTRICAL ASSOCIATION.—President, William H. Browne, Montreal; secretary, C. H. Mortimer, Toronto, Ont.

FRANKLIN INSTITUTE (Electrical Section), Philadelphia, Pa.—Secretary, William H. Wahl.

MASSACHUSETTS CHARITABLE MECHANIC ASSOCIATION, Boston, Mass.—Exhibition of Motor Carriages, October 10 to December 3, 1898.

NORTHWESTERN ELECTRICAL ASSOCIATION.—President, F. A. Copeland, La Crosse, Wis.; secretary, Thomas R. Mercein, Milwaukee, Wis.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. —F. W. Putnam, secretary, Salem, Mass.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, New York.—President, Dr. A. E. Kennelly; secretary, Ralph W. Pope. Meeting, third Wednesday of each month.

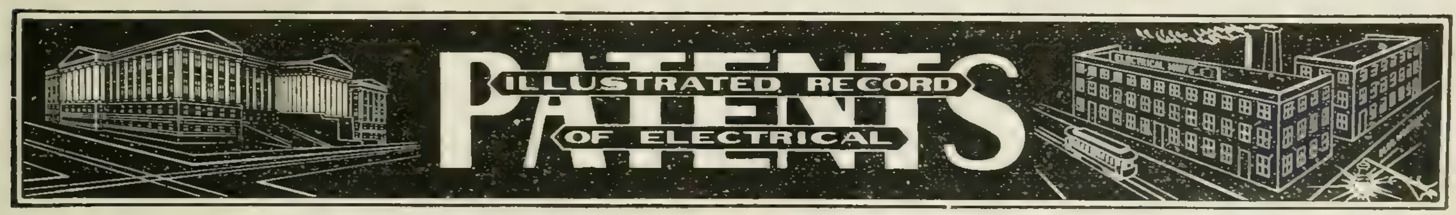
NATIONAL ELECTRIC LIGHT ASSOCIATION.—President, A. M. Young, Waterbury, Conn; secretary, George F. Porter, New York. Next meeting, New York, May or June, 1899.

AMERICAN STREET RAILWAY ASSOCIATION.—President, A. E. Lang, Toledo, Ohio; secretary, T. C. Penington, Chicago, Ill. Next meeting, Boston, Mass., September 6, 7, 8 and 9, 1898.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS.—President, W. W. Ryder, Chicago; secretary, P. W. Drew, Milwaukee, Wis. Next meeting, Wilmington, N. C., June 19, 1899.

Business Notice.

THE ILLUSTRATIONS in this issue were made by the Photo-Engraving Company, 9-15 Murray Street, New York City.



UNITED STATES PATENTS ISSUED AUGUST 16, 1898.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

609,015. ELECTRIC ELEVATOR; R. Eickemeyer, of Yonkers, N. Y. App. filed Jan. 5, 1891. The combination of an elevator, and its hoisting mechanism; an electric motor coupled thereto, and a dynamo-electric governor mechanically driven by said motor for generating electricity, and distributing it in the magnetic field of the motor, and weakening said field, in proportion to any increase of speed in the elevator, beyond its desired or predetermined rate.

609,016. ELECTRIC ELEVATOR; R. Eickemeyer, of Yonkers, N. Y. App. filed May 3, 1892. In elevator machinery, the combination with the traveling car body or platform, of a compound motor, a resistance in shunt relation to the series coil of said motor, and a solenoid automatically controlling the magnetizing power of said series field coil by gradually short circuiting said resistance.

609,043. MOTOR CAR; C. O. Palmer, of Cleveland, Ohio. App. filed April 18, 1894. The combination of a car, a motor, a driving wheel driven by said motor, a friction controlled driving connection from said motor to the car axle, a reel and a flexible conductor wound on said reel and connected with both the motor and a dynamo, engine or other source of energy, together with a mining machine, a horizontal pulley on said mining machine, and a flexible band connection between the mining machine pulley and the motor pulley.

609,09[illegible]. ELECTRIC CONTROLLER; J. D. Forrer, of Johnstown, Pa. App. filed July 11, 1898. A pair of concentric shafts, operating levers for the same, mechanism permitting independent rotation of said levers, but preventing independent vertical movement of the same and a lock for preventing simultaneous vertical movement except at a predetermined position.

609,124. ELECTRIC BRAKE; Ernest B. Skinner, of Ogden, Utah. App. filed Oct. 30, 1897. In an electric brake, a solenoid and plunger therefor for operating the brake mechanism, a second solenoid disposed at right angles to the first mentioned solenoid, a lever connected at one end to the plunger of the smaller solenoid and at the other end to links, which are connected to a plate carrying a shoe, a plate having a projecting portion for engagement with the end of the lever beyond the links, a shoe carried by said plate and a spring positioned between the plunger of the smaller solenoid and the links to operate upon the lever, adjacent to the plunger of the smaller solenoid.

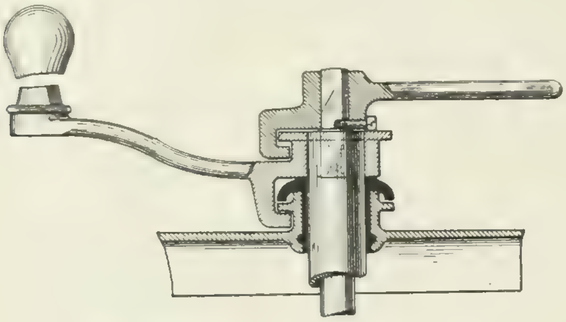
609,142. COMBINED BATTERY AND ELECTRIC CELL; J. C. Dagoneau, of Beaufort, France. App. filed Jan. 15, 1895. In a combined battery and electrolytic cell, the combination of a cell or container containing sulphate of copper, an interior cell or container contained therein and comprising a rectangular framework of slats and membranes secured upon this framework, and constituting the walls of the interior cell, a zinc element and dilute sulphuric acid contained in the said interior cell, suspension bars adapted to suspend the articles to be plated, circuit connection between the zinc plate and the bars and one or more perforated lead plates in the interior cell upon which a copper deposit will be made.

609,154. ELECTRIC TELEGRAPHY; O. J. Lodge, of Liverpool, England. App. filed Feb. 1, 1898. In a system of Hertzian wave telegraphy, the combination, with a pair of capacity areas, of electrical means having a spark gap inserted between them and serving to syntonize them, and means for bridging or shunting the spark gap whereby the apparatus is adaptable for use at will, either as a radiator or resonator.

609,173. TELEPHONE SYSTEM; A. F. Swan, of Bayonne, N. J. App. filed Sept. 29, 1897. The combination with the telephone apparatus, the line and the switch barrel moved by makes and breaks in the line, of the movable switch arms directly controlling the circuit through the apparatus, and means for operatively actuating the arms by the movement of the switch barrel.

609,188. ELECTRICAL TRACTION; W. Kingsland, of Llandudno, Eng. App. filed Dec. 23, 1897. In electrical traction, the combination with a continuous main electrical conductor, sectional working conductors from which the motor car directly collects the current, a number of sectional auxiliary conductors, one such for every sectional working conductor, and through which auxiliary sectional conductors the current is passed from the main conductor to the sectional working conductors, commutator switches situated at each end of the sectional auxiliary conductors, and electromagnets having soft-iron armatures fixed on rocking shafts whereby the commutator switches are operated; of auxiliary commutator switches, one such for each electromagnet, also operated by the rocking shaft to control the action of the electromagnet by connecting it with one or other of two adjacent sectional working conductors whereby the electromagnets may be energized by a current coming from one or other of two adjacent sectional working conductors.

609,229. TELEPHONE SYSTEM; C. E. Egan, B. L. Lawton and E. C. Wilcox, of Meriden, Conn. App. filed April 9, 1897. In telephone systems, spring jacks, each provided with a central telephone connecting spring, a generator connecting spring, and a subscribers' communicating spring; a plunger fitted to reciprocate in each spring jack to engage either of the first two named springs; and a pair of connected plugs, each fitted to operate a plunger and provided with a metallic nib fitted to engage a subscribers' communicating spring.



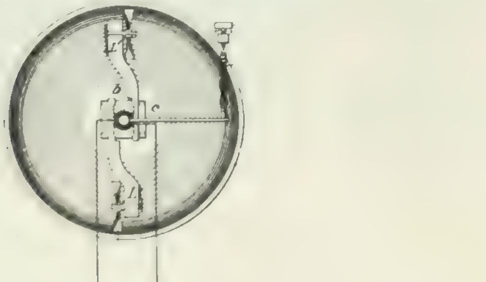
No. 609,092 —Electric Controller.

609,231. MEANS FOR INDICATING A SHIP'S ROLL; J. J. Hicks and G. H. Zeal, of London, Eng. App. filed Nov. 18, 1897. The combination of an annular tubular glass chamber half filled with mercury, a vertical board or plate carrying such chamber and adapted to oscillate it, and an annular scale surrounding the same.

609,245. ELECTRICAL CIRCUIT CONTROLLER; N. Tesla, of New York, N. Y. App. filed Dec. 2, 1897. The combination with a receptacle for containing a conducting fluid and a series of spaced conductors thereon, of a duct having an orifice directed toward said conductors and forming a conduit through which the fluid, when the receptacle is rotated, is forced and thrown upon the conductors.

609,246. ELECTRIC CIRCUIT CONTROLLER; N. Tesla, of New York, N. Y. App. filed Dec. 28, 1897. A circuit controller, comprising in combination means for producing streams or jets of conducting liquid forming the terminals, and means for bringing the jets or streams of the respective terminals into intermittent contact with each other.

609,247. ELECTRIC CIRCUIT CONTROLLER; N. Tesla, of New York, N. Y. App. filed March 12, 1898. The combination with a receptacle mounted to revolve upon an axis inclined to the vertical, of a spindle within the receptacle and eccentric with its axis, a weight eccentric to the spindle and a terminal carried by the spindle and adapted to be rotated



No. 609,[illegible].—Electric Circuit Controller.

[illegible]

[illegible]. ELECTRIC CIRCUIT CONTROLLER; N. Tesla, of New York, N. Y. [illegible]

[illegible]. ELECTRIC CIRCUIT CONTROLLER; N. Tesla, of New York, N. Y. [illegible]

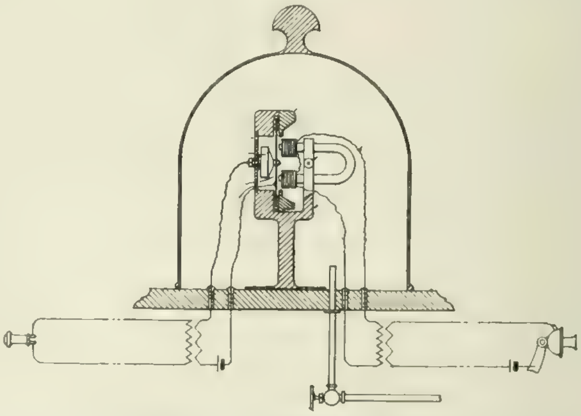
concentrically with the receptacle, and a gyrostatic disc carried by the support and adapted, when rotating, to oppose its movement in the direction of rotating of the receptacle.

609,250. ELECTRICAL IGNITER FOR GAS ENGINES; Nikola Tesla, of New York, N. Y. App. filed Feb. 17, 1897. In an apparatus which depends for its operation or effect upon the production of a sudden electric discharge at a given instant, or at predetermined intervals of time, the combination with a moving part of said apparatus of a switch of commutator, a condenser, a charging circuit for the same, a primary circuit through which the condenser discharges, and a secondary circuit in inductive relation to the said primary circuit, and connected with the terminals at the point in the apparatus where the discharge is required, the switch or commutator being operated by the said moving part to effect the discharge of the condenser at the proper intervals.

609,251. ELECTRIC CIRCUIT CONTROLLER; N. Tesla, of New York, N. Y. App. filed June 3, 1897. A circuit controller, comprising, in combination, a receptacle containing a fluid, means for rotating the receptacle and a terminal supported independently of the receptacle and adapted to make and break electric connection with the receptacle through the fluid.

609,252. ELECTRIC RAIL BOND; J. S. Tucker, of Chicago, Ill. App. filed Jan. 20, 1897. A rail bond, comprising a conductor having its end portions provided with inwardly tapering enlarged heads, said heads being provided at their inner or smaller ends with flanges.

609,274. SYSTEM OF CONTROL OF ELECTRIC MOTORS; E. R. Gill, of Englewood, N. J. App. filed April 4, 1898. In a circuit governing switch, two sets of stationary contacts, a pivoted lever moving over the same and carrying one end of the circuit to be governed; in combination with a brush selector whereby the circuit end on said lever may be brought into electrical relation with one or the other set of stationary contacts.



No. 609,374.—Telephone Repeater.

609,288. MEANS FOR FASTENING INSULATOR PINS TO CROSS ARMS; L. Mitchell, of Augusta, Ga. App. filed May 10, 1898. An insulator pin provided with an annular groove in its shank triangular in cross section, and an open ring of a spring material adapted to be contained within the said groove.

609,298. PRIMARY BATTERY; W. Rowbotham, of London, Eng. App. filed Feb. 24, 1898. A primary battery, comprising a plurality of cells having each an open and a closed compartment, porous tubes extending through the open compartment and opening into the closed compartment, the negative electrode rods located in said tubes, a closed tank for the exciting and depolarizing fluid, having flow and return pipe connections to the closed compartments, and means for supplying water to the open compartments.

609,300. WINDING MACHINE; E. J. Satterwhite, of Falls City, Neb. App. filed Sept. 10, 1897. A winding machine, comprising a reciprocating carrier, a shifting mechanism located upon the carrier to change the direction of its travel, and rotary stops, each located at one end of the path of the carriage and adapted to engage and operate said shifting mechanism.

609,309. FIRE ALARM; H. Tersling, of Copenhagen, Denmark. App. filed March 15, 1897. The combination of a three-armed pawl, means for tripping one arm of said pawl, a member restrained by a second arm of the pawl and a supporting arm having a shoulder capable of holding the third arm of the pawl.

609,330. TELEPHONE MEASURED SERVICE SYSTEM; W. W. Dean, of Boston, Mass. App. filed Nov. 16, 189[illegible]. The combination in a telephone exchange system of a subscriber's circuit connecting two substations with a central station, call-sending devices at the substations, call-answering devices at the central station, and two call-receiving mechanisms associated with said circuit at the central station, actuated by the normal operation respectively of the call-sending device of either substation and the central call-answering devices for alternatively counting and registering the calls of the said stations.

[illegible]. ELECTRICAL CONDUIT BOX; H. Krantz, of New York, N. Y. App. filed May [illegible]. A split conduit box provided with corresponding [illegible] on the two parts of the box to form the outlet openings for the conduits, in combination with closing discs held in place by the two parts of the box when fitted together.

609,374. TELEPHONE REPEATER OR RELAY; J. S. Stone, of Boston, Mass. App. filed Dec. [illegible]. A telephone relay, comprising an electromagnet in one circuit, transmitting electrodes in a second circuit, a diaphragm common to both said electromagnet and said transmitting electrodes, and a vacuum [illegible] said magnet, electrodes and diaphragm.

The Electrical World.

Vol. XXXII. NEW YORK, SEPTEMBER 3, 1898. No. 10.

PUBLISHED EVERY SATURDAY BY

The W. J. JOHNSTON COMPANY,

9 Murray Street, New York.

Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York.

New England Office, 620 Atlantic Ave., Boston.
Western Office, 936 Monadnock Block, Chicago.
Philadelphia Office, 929 Chestnut Street.

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THE ELECTRICAL WORLD,

9 Murray Street, New York.

Vol. XXXII. NEW YORK, SEPTEMBER 3, 1893. No. 10.

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THE PROPER SIZE OF METERS.

There may be found in another column an abstract of an interesting paper on the electric meter recently read by one of the authorities on this subject, Mr. Caryl D. Haskins. The writer brings out many interesting points and valuable suggestions, one of the latter being his advice as to the sizes of meters for variable loads. He advises the use wherever possible of smaller capacity meters than those now customary, especially for highly fluctuating loads, risking an occasional burnout for the added income obtainable from a better average percentage load on the meter. The importance of overload accuracy is also emphasized, even to the neglect of the light-load accuracy, for the reason that one hour's overload is worth much more than one hour of light load, and should be measured with corresponding accuracy. This may be the case where the average time of overload is equal to that on light load, but in ordinary, and especially in residence, service the meter is on a very light load 90 per cent., or perhaps 99 per cent., of the time, and on overload very rarely. The relative number of ampere hours at light and at heavy loads is the true measure of the relative accuracy required.

What is really wanted is accuracy over a considerable range, and what is needed in residence lighting—which is perhaps the most difficult load to measure—is an enormous overload capacity without burnouts. The average residence, which is wired, to cite a concrete example, for thirty lights, may have a daily load peak of six or eight lights, and an average load for the twenty-four hours of one or two lights, the average load on a 30-light meter being thus from 3 to 6 per cent. of its rated capacity, which is liable to introduce a great error in favor of the consumer at the expense of the central station. If, however, meters were capable of standing a continuous overload several times their rated capacity without endangering their structure and without introducing too great a voltage drop in the line, such an installation could be fed, for example, through a 10-light meter, which change would give a triple increase of the average percentage load, and in consequence a great increase of the accuracy of its measurement. Unfortunately, the electrical meter, to prevent too great an accumulation of dust in and about the jewel or the clockwork, must be carefully protected against ventilation, and this reduces most seriously the current-carrying capacity of the series coils. If some means could be found of increasing their radiating surface or of ventilating them without introducing air currents into the parts of the meter where dust is not wanted, it would be a great advance in the art of meter construction.

THE WORK OF THE ELECTRIC VEHICLE COMPANY.

There appears on another page of this paper a description of the elaborate work undertaken by the Electric Vehicle Company in its development of electrically propelled vehicles in New York City The work deserves the highest commendation, owing to the enormous expense it necessitates and the rather uncertain character of the returns. Unlike a large amount of experimental work it does not in general establish a broad monopoly by patent rights over the results obtained. A large part of the work, such, for example, as the design of the elaborate apparatus necessary for rapidly handling the heavy battery trays, consists of details on which no broad fundamental patents can be obtained, but nevertheless its cost is very great. The work is thus as much to the value of the public and future competitors as to the company itself, the only advantage which the latter can expect being the reputation which it can acquire, through careful engineering and upright business dealing, of being the pioneer and most reliable establishment in its chosen field. This field is, however, a broad one and such a reputation a few years hence will be an asset of no mean value.

The first impression invariably given a superficial observer is one of wonder at the intricacy of the apparatus required for the apparently simple process of moving a battery from a vehicle to the charging table and vice versa. The difficult requirements which must be met, however, are obvious on a little thought. It is not a question unfortunately of manipulating one battery or a dozen batteries, but several hundred must be provided for, each weighing so much that rapid manipulation by hand is out of the question; therefore the number of charging tables must be very great, and some means must be provided for distributing the batteries from the vehicle position or positions to these many tables and vice versa. This requires means for independent movement in the directions of the three rectangular axes. The most simple, reliable and commonly used method of accomplishing this effect is the use of a crane, the bridge of which is capable of moving longitudinally along the ways, the trolley laterally along the bridge and the grab vertically from the trolley. In this particular installation the use of the trolley has been abandoned and a number of fixed grabs or hooks substituted in order to give the crane bridge the capacity for carrying more than one battery on each trip. To obtain lateral movement a separate endless chain conveying table is used, the batteries being deposited thereon or picked up therefrom by the crane hooks. The vehicle itself is one of the most serious difficulties for the reason that it is an unwieldy thing to get accurately in one position, and its springs and ability to roll make it such an annoyingly yielding receptacle for the insertion or withdrawal horizontally of a heavy clumsy load. It must be accurately centred and held from moving sideways. Its body must also be rigidly fastened so that it cannot move endways or up and down, and these various gripping and adjusting devices must be handled rapidly with a minimum of attendance. The problem is an intricate one, with no similar precedents, and the behavior of the installation will be watched with great curiosity by those interested in electrical vehicles the world over.

THE TELEPHONE IN ENGLAND.

There has lately been presented to the House of Commons the report of a committee appointed to investigate the telephone industry in England and make suggestions as to its best treatment by the Government in the future. As is well known, the telegraph service of Great Britain is in the hands of the Government, being a department of the Post Office, and some years ago the telephone [illegible] considered to be a department of the telegraph service, was first let out to various licensees, but afterward the exchange service was put under the control of one private company, known as the National Telephone Company, the agreement with which will expire in 1911. The trunk lines are owned and operated by the Post Office.

Some parts of the committee's report suggest interesting developments which may be profitably considered in other countries. One [illegible] [illegible] The [illegible] telephone service are shown by a comparison with the telegraph business, in [illegible] would practically be restricted to those able to bear the expense of a private line, and such subscribers could only communicate with individuals similarly situated. The message rate system so widely used in this country overcomes to a certain extent the first difficulty, since the charges are largely proportional to the amount of the service rendered, but the British committee upholds a plan whereby messages can also be sent to non-subscribers, which plan is in use in Switzerland, where for all messages actually sent subscribers and the public alike pay the same fixed toll, and messages can be delivered to non-subscribers by express messengers. In this way each instrument, but for the limitations imposed by the subscriber, becomes practically a toll telephone, and messages can be sent not only to subscribers but to any one accessible to a messenger.

The municipalization of public services has come into considerable prominence in this country of late, but the telephone systems have never been invaded in this manner. The committee referred to above proposes that the local authorities or municipalities shall establish telephone systems in their respective districts in competition with the system of the National Telephone Company, and in conformity with various requirements which will make these systems uniform, so that they may be readily consolidated when the Post Office sees fit to take active control of the system the country over. As the committee points out, the telephone business is as much or more of a natural monopoly than is the telegraph business, and the working of two independent systems in one locality is not only a hardship on the competing companies but on the public as well, so that the committee's suggestions as to a means of breaking down the power of the present monopoly in England in order to establish another which shall be managed for the public good is certainly inconsistent with the public's welfare in the meantime.

THE GENERAL ELECTRIC COMPANY'S PERMANENT EXHIBIT.

There may be found on other pages of this paper a description of the magnificent water power development and electric transmission plant of the Hudson River Power Transmission Company, near Mechanicville, N. Y. A large part of the power from this work will be used by the General Electric Company at Schenectady. The latter company has also recently acquired the local street railway and lighting plants in Schenectady, and will naturally proceed to modernize these and interlink them electrically with its factory power sources, and hence with the transmission system from Mechanicville. When this system is completed it will be a conspicuous example of the flexibility of the electric transmission and distribution of power now obtainable with the aid of stationary and rotary transformers. High-tension multiphase currents will enter the works, and there be transformed by means of motor-generators to direct current at 500 volts, and by means of rotary converters to direct current at 250 volts. Frequency changers will allow the supply of the existing public lighting circuits at the proper periodicity, series arc machines may be driven by alternating-current motors and the street railway system can be supplied by any one of several different methods. Existing power equipments can be kept in reserve to feed into the system at any one point, and by means of the reversibility of the various interlinking machines they can supply power to any other part. The use of a generous storage battery on any of the direct-current derivations will render the whole system safe against a brief shutdown of the source of power. The system in general, in connection with the magnificent works of the company, will make a most convincing exhibit to intending purchasers of the ability of the company in its various lines of work.

Programme of the Coming Convention of the American Street Railway Association.

The following is the programme of the seventeenth annual meeting of the American Street Railway Association, to be held in Boston, Mass., September 6 to 9, 1898:

TUESDAY.

10 A. M.—Meeting called to order by Albion E. Lang, president. Calling of the roll. Invitation extended to join the Association. Address of the president. Report of the Executive Committee. Report of the secretary and treasurer. Reading of paper on "Comparative Earnings and Economy of Operation Between Single and Double Truck Cars for City Use," by Richard McCulloch, electrical engineer, Cass Avenue and Citizens' Street Railway Companies, St. Louis, Mo. Reading of paper on "Municipal Ownership of Street Railways." In the afternoon there will be a trip to Concord and Lexington and in the evening a reception at the hall.

WEDNESDAY.

Convene at 9:30 A. M. Reading of paper on "Maintenance and Equipment of Electric Cars for Street Railways," by M. S. Hopkins, electrician, Columbus Street Railway Company, Columbus, Ohio. Reading of paper on "Carrying of United States Mail Matter on Street Railways," by W. S. Dimmock, general superintendent, Omaha & Council Bluffs Railway and Bridge Company, Council Bluffs, Ia. Appointment of committee on nomination of officers and selection of next place of meeting. In the afternoon there will be an excursion down the harbor and a clambake at Nantasket Beach.

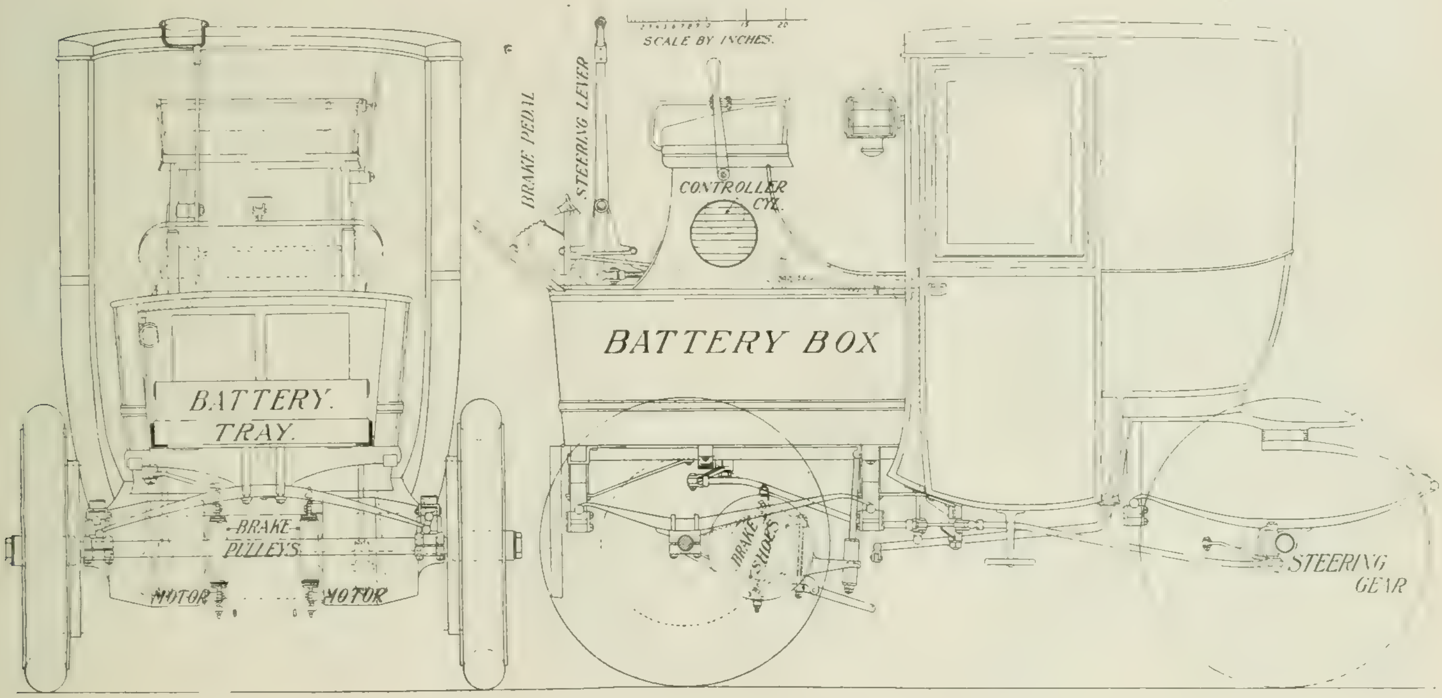


FIG. 2.—SIDE AND END ELEVATIONS OF ELECTRIC BROUGHAM.

THURSDAY.

Convene at 9:30 A. M. Reading of paper on "To What Extent Should Street Railway Companies Engage in the Amusement Business," by Walton H. Holmes, general manager, Metropolitan Street Railway Company, Kansas City, Mo. Reading of paper on "Inspection and Testing of Motors and Car Equipments by Street Railway Companies," by Frederick D. Perkins, electrical engineer, Toledo Traction Company, Toledo, Ohio. Election of officers. In the afternoon there will be a trip to Plymouth and the annual dinner will be held at the Hotel Brunswick at 7 P. M.

FRIDAY.

Convene at 9:30 A. M. Reading of paper on "Cost of Electric Power for Street Railways at Switchboard, Both Steam and Water," by R. W. Conant, electrical engineer, Boston Elevated Railroad Company, Boston, Mass. Report of committee on standing rules for government of conductors and motormen. Unfinished business. Installation of officers. Adjournment. In the afternoon a trolley excursion to Norumbega Park will be arranged for those who desire to attend.

The New Station of the Electric Vehicle Company.

The construction of the most elaborately equipped charging station for electric vehicles in the United States, and probably in the world, has just been completed in New York city. This work has been done by the Electric Vehicle Company, the successor of the Electric Carriage & Wagon Company, whose vehicles and station were described in THE ELECTRICAL WORLD of August 14 and 21, 1897. In these articles the vehicles themselves were fully described, so that but a brief mention of the essential points and the improvements over the older types is necessary here.

THE VEHICLES.

The original equipment of the old company was twelve hansom cabs and one brougham, while the new company is about to put into service fifty hansoms and the same number of broughams. The cabs are, as shown in the accompanying illustrations, Fig. 1, four-wheelers, driven by motors geared to the forward wheels and supplied with current from the battery box, situated under the driver's seat back of the passengers' compartment. Their running gear is practically the same as that shown in the elevations of the brougham, Fig. 2. Of the external and visible improvements over the old type one is an increase in the height of the hood, the older vehicles being so low as to have an unprepossessingly squatty appearance compared with horse-drawn cabs. A dashboard has been added to the front of the vehicle to improve its appearance and to give the occupant a sense of security that was lacking with the open fronts of the former vehicle. Another change is the use of solid discs instead of spokes for the wheels. At first sight a return to first principles of the wheels of ancient Egypt is the impression given, but in reality quite an improvement is made in that the wheel has a much less intricate surface, and is, therefore, more readily cleaned. The body of the wheel is composed of two steel discs one-sixteenth of an inch in thickness, dished so as to give a maximum breadth at the hub, and a minimum at the periphery. The discs do not meet at the latter point, but are separated by a wooden rim over which is a crescent-shaped steel rim to receive the tire, which is 5-inch single-tube pneumatic, the rubber walls of which are about three-quarters of an inch in thickness. All four of the wheels are 36 inches in diameter.

The batteries consist of forty-eight cells of Chloride accumulators of the F. V. type. The plates are separated by perforated corrugated hard rubber sheets, the battery jars being of hard rubber separated from each other by glass plates. Instead of mounting the cells, as was done in the older vehicles, in four separate trays which could be removed independently, thus dividing the weight so that they could be removed by hand, the batteries in the new vehicles are mounted in one substantial tray, consisting of an angle iron frame lined with wood. This change is allowable on account of the power equipment described below for removing and replacing the batteries in the vehicles. The trays, instead of resting on rollers within the vehicles, slide in on angle iron guides, the battery chamber being entirely lined with lead and drained with gutters and spouts, so that any acid which may spill will not run out around the door or over the running gear and destroy the finish on the exterior of the vehicle. The battery equipment is somewhat heavier than on the old vehicles, weighing as it does about 1300 pounds.

The new controller, instead of being fitted with a reverse position, as was the former controller, is fitted with a separate but interlocking reversing switch, so that the three speed positions apply to either forward or backward running. No magnetic blowout is used with this controller, and each contact is made doubly certain by the use of two independent contact fingers in each division. See Fig. 3. The speed variation is obtained by means of a division of the battery into two groups, which may be placed in series or multiple, the third or highest speed being obtained by a rearrangement of the series field coils of the two motors from a series to a multiple combination. See Fig. 4.

In the main circuit there is also what is called an emergency switch, in such a position that the driver can strike it with his heel and open the main circuit in case for any reason the controller becomes inoperative. The blade of the emergency switch is also removable, and can be taken out when the driver leaves the vehicle, rendering it impossible for any unauthorized person to set the carriage in motion. A special charging plug is also attached to the circuits and mounted in the battery chamber for charging the battery in place in the vehicle. This will prove useful when the battery is charged at points other than the main station described below, and several such points will be equipped with charging connections by the various direct-current supply companies in and about the Greater New York. One is already in service at Coney Island, and another is about to be put in service in the downtown part of New York city at the Duane Street station of the Edison Electric Illuminating Company.

The motors are four-polar, and are rated at 2 horse-power at about 700 r. p. m., thus giving the vehicle a speed of 12 miles per hour. The pinion on the motor shaft engages directly with an internal gear fastened on the wheel disc, the two independent motors allowing for turning sharp corners without differential arrangements of vehicle frame. Braking is effected by means of brake shoes acting on wheels on the motor shafts. The steering gear is practically the same as on the older vehicles, the only difference being the removal of the pivots from within the wheel hub to a point just outside, the pivots being inclined somewhat so that the extensions of their axes approach the point of contact of the wheel and ground.

THE CHARGING STATION.

The new station is centrally located, and is, oddly enough, in the immediate neighborhood of the establishments of the largest houses interested in horses and horse-drawn vehicles, such as the American Horse Exchange, Tattersalls, Ltd., etc. The station which is almost [illegible] [illegible] from Broadway at one end and Seventh Avenue at the other, and is located between Fifty-second and Fifty-third Streets. The building consisted, before the vehicle company made use of it, of a single large room undivided by floors or partition walls, covered with a trussed roof. The Broadway end is now occupied by a tier of offices, waiting rooms, stock rooms and a gallery, and adjacent to the north wall of the station is the battery charging room, some 36 x 130 feet in size. This room is 11 feet in height, above it being a carriage storage room supported on 25-inch steel girders. The latter is reached by two electric vehicle elevators. The charging room is filled with tables on which the batteries stand while receiving their charge. There is room for some 200 of these tables, about 150 being installed at present in eight regular rows lengthwise of the room. The tables, as shown in Fig. 5, consist simply of strongly braced wooden structures put together with wooden dowel pins, no iron whatever being used in their construction, and painted black with P. & B. compound. Iron dowel pins projecting upwardly from the cement floor into holes in the table legs keep them in place, although they are not bolted down in any way, and may, therefore, when rotted by the acid fumes, be readily picked up and removed by the crane serving the room. Mounted upon them are four simple U-shaped pivoted castings, the weight of the battery coming down on the short leg of the U, causing the contact attached to the longer leg to bear against the contact terminal of the battery tray. One pair of diagonal contacts is cross-connected, so that the two groups of cells (forty-eight in number) are connected up in series for charging. The battery charging room is inclosed except at its ends and is ventilated by a 48-inch exhaust fan drawing air from the middle of the room.

The tables are supplied with current through twelve conductor lead-covered cables below the floor level, from what are known as the indicator boards. These, as shown in Fig. 6, are slate panels, each fitted with two pilot lamps, eight simple solenoidal ammeters and

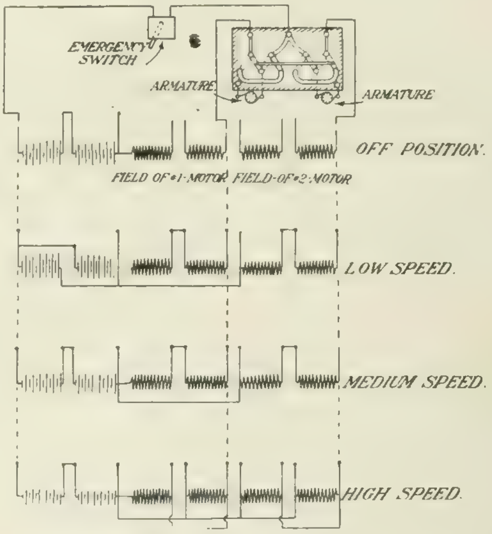


Fig 4.—Controller Combination.

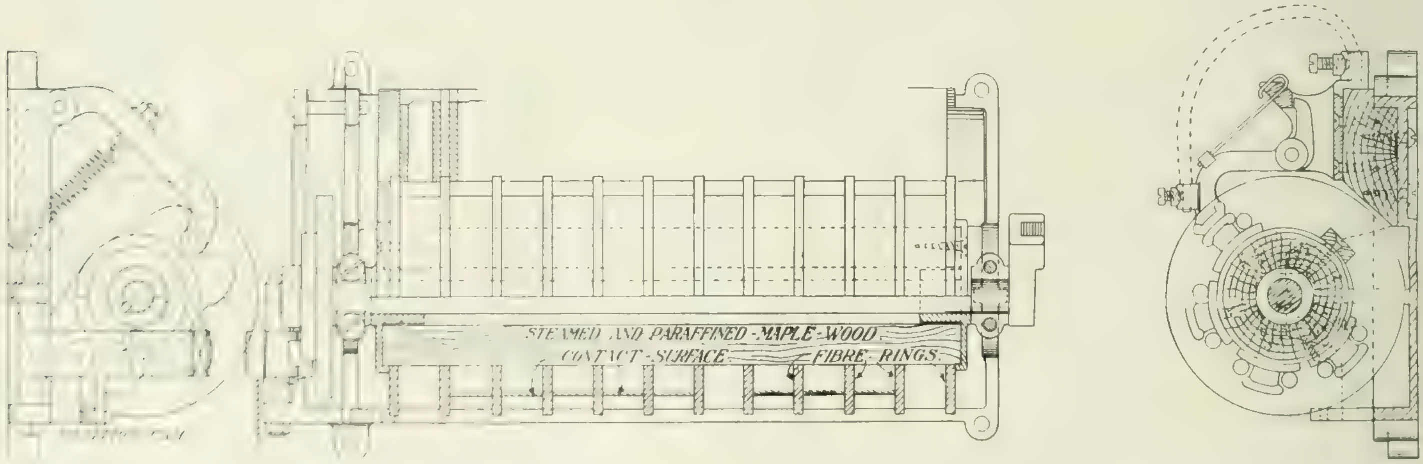


Fig. 3.—End Elevation, Plan and Cross Section of Controller.

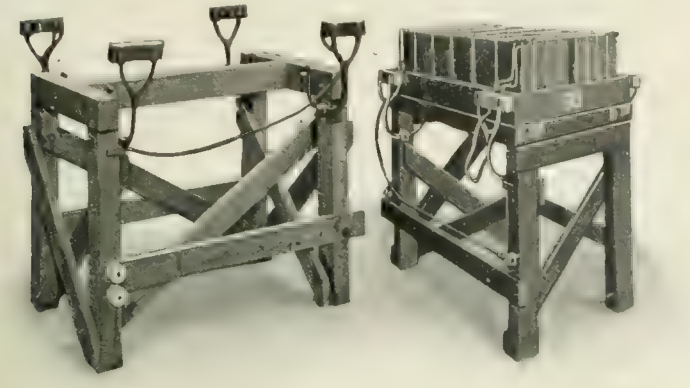


Fig. 5.—The Charging Tables.

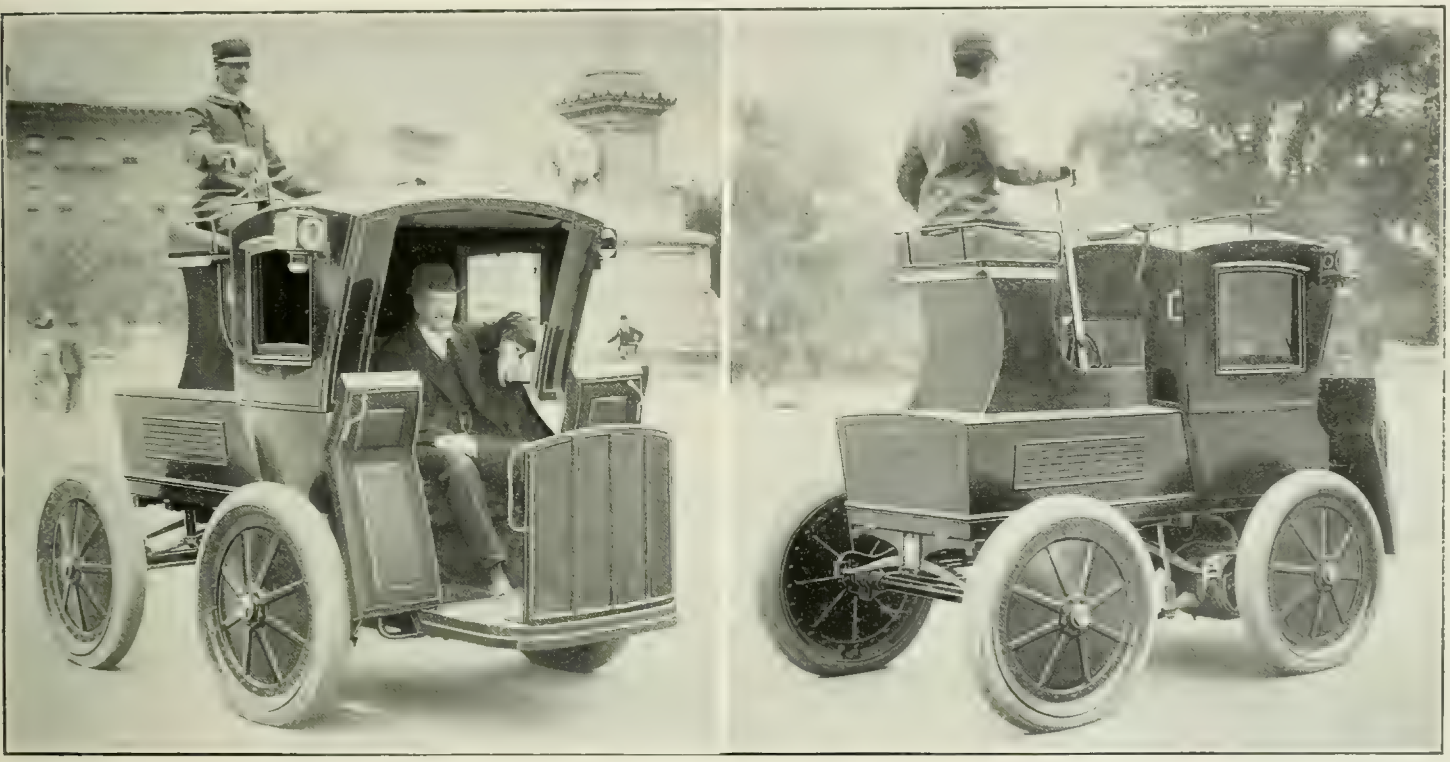


Fig. 1.—Two Views of the Hansom.

eight four-position rotary switches. Each battery table is supplied with current through one of these switches and ammeters, the latter consisting simply of a vertical plunger, supported on a helical spring and surrounded by a solenoid, which tends to draw it down. Attached to the plunger is a carbon disc which strikes one contact when the current reaches 50 amperes, this contact closing the circuit through the green pilot lamp. If the current falls below 10 amperes the disc rises to a point at which it strikes a contact, illuminating the red pilot lamp. In this way the lamps give positive visual indications, which can be seen from any part of the charging room, that one of the batteries attached to that panel is receiving either an excessive charging current or one which should, to economize time, be increased. The current supplied to the batteries is adjusted by the four-position rotary switch, the four different positions connecting the battery terminal respectively to four bus bars with voltages differing from each other by about 5 volts. When a battery is first brought in for charging it is connected to the bus bar giving the lowest voltage, and when on this bus the charging current becomes less than 10 amperes the red lamp is illuminated. The attendant then turns the switch to throw the battery onto the next higher bus, and so on until, when the red lamp shines on the highest voltage, the charging process is complete and the battery may be removed. Since one pair of pilot lamps serves for the eight tables connected to the one panel of the indicator board, some means must be provided for preventing any indicating solenoid from illuminating the red lamp when there is no battery on the corresponding table, and consequently no current in the solenoid. This is accomplished by means of a pair of contact rings attached to each rotary switch, the contact bearing thereon cutting off the lamps from the contacts of the corresponding indicator when the switch is on open circuit; thus the lamps indicate only for tables in actual service, and if more than one table is in service on one indicator board the attendant can readily tell which one is affecting the lamps by a glance at the ammeters. One-half of the indicator boards is supplied with current from the positive side of the three-wire 240-volt system; the other half from the negative side, and the demand for current is equalized between the two sides by the simple process of running in no neutral. On this account the aggregate current taken on the positive side must, of course, equal that on the negative side, and on whichever side there are fewer batteries the rate of charging will be more rapid. When, however, the station is fully loaded it will be a simple matter to equalize the number of charging tables in use on the two sides of the system.

The current reaches the indicator panels from the main board by eight bus bars (four positive and four negative) of rectangular cross section, varying from ¼ x 1 inch to ⅜ x 1¼ inches. This board, which is shown in Fig. 7, is a handsome structure of Vermont marble divided into nine panels and inclosed in a glass case to keep out acid fumes. One of the panels controls the various

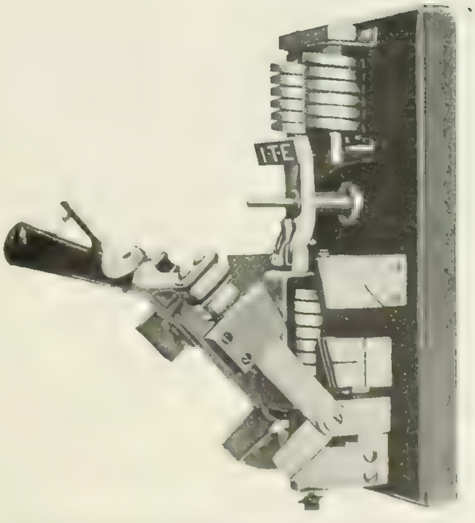


Fig. 8.—One of the Overload and Underload Circuit Breakers.

light and motor circuits of the station, the other eight supplying the eight bus bars referred to above. The voltage differentiation is obtained by means of two boosters coupled to one motor, which give the highest voltage on the positive and negative sides respectively, the next highest being that of the supply mains themselves. The two lower voltages are obtained by passing the current through large enamel rheostats, the resistance of which can be varied by hand. The panels each contain an illuminated dial Weston voltmeter and ammeter and a Bristol recording voltmeter and ammeter. A voltmeter switch on each panel allows the corresponding indicating instrument to be connected to measure up the voltage on the incoming supply bus or the bus attached to that panel. Below the measuring instruments are a single-pole switch and a circuit breaker. The latter (see Fig. 8) is fitted for an underload release as well as the customary overload. The underload release is effected by a magnet energizd by a winding above the other parts of the breaker, the armature of which is attached to a pin which, shortly after the armature is released, strikes the trigger in such a way that it is tripped just as though struck by the regulation overload device. Current is supplied from the underground mains of the Edison Electric Illuminating Company over two independent services, the incoming cables having a cross section of 1.250.000 cm. The Edison Company has a station only about 600 feet away, so that the drop is but slight.

HANDLING THE BATTERIES.

The design and construction of the machinery for removing the batteries from the carriages and placing them upon the charging tables and vice versa was no easy task. The trays, with their accumulators, weighing about 1300 pounds, must be pulled from a position on a spring supported wheeled vehicle and transported to any one of 200 positions in the charging room, and vice versa. As may be seen, this manipulation is more difficult than the removal of battery trays hung under a street car truck, as in the latest designs of battery traction equipments, since the tray must be moved out horizontally to and from its place instead of vertically. The manipulation resembles more than anything else the handling [illegible] steel billets in the reheating furnaces of rolling mills, [illegible]

[illegible] will be described. The vehicle is first moved onto a platform, of which two [illegible] (see Figs. 9 and 10), with its battery end toward the latter. If the [illegible]

is divided into two parts, on one of which rest the forward wheels and on the other the rear wheels, these two parts being laterally and independently movable. Once on this platform, a long horizontal shoe, shown best in Fig. 11, is advanced toward each side of the vehicle by two hydraulic cylinders, the shoe being of a proper height to push against the wheel hubs, centring the vehicle, which moves without slipping of the wheels, owing to the movable nature of the platforms below it, into the proper position. The vehicle

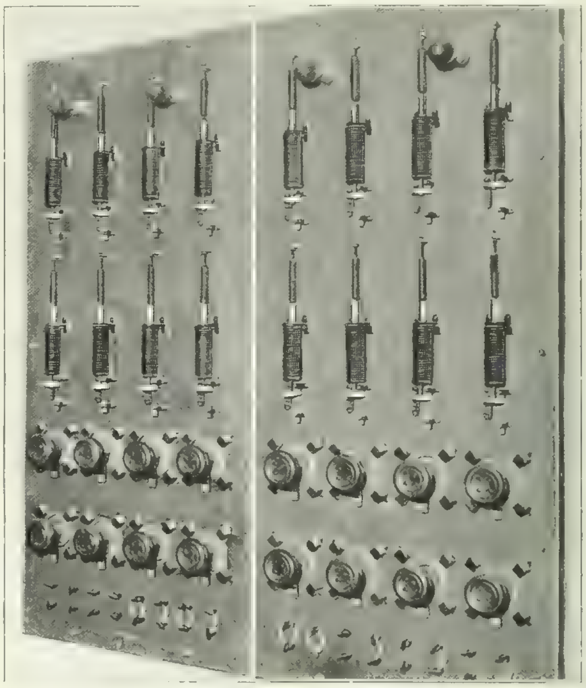


Fig. 6.—Two Panels of the Indicator Board.

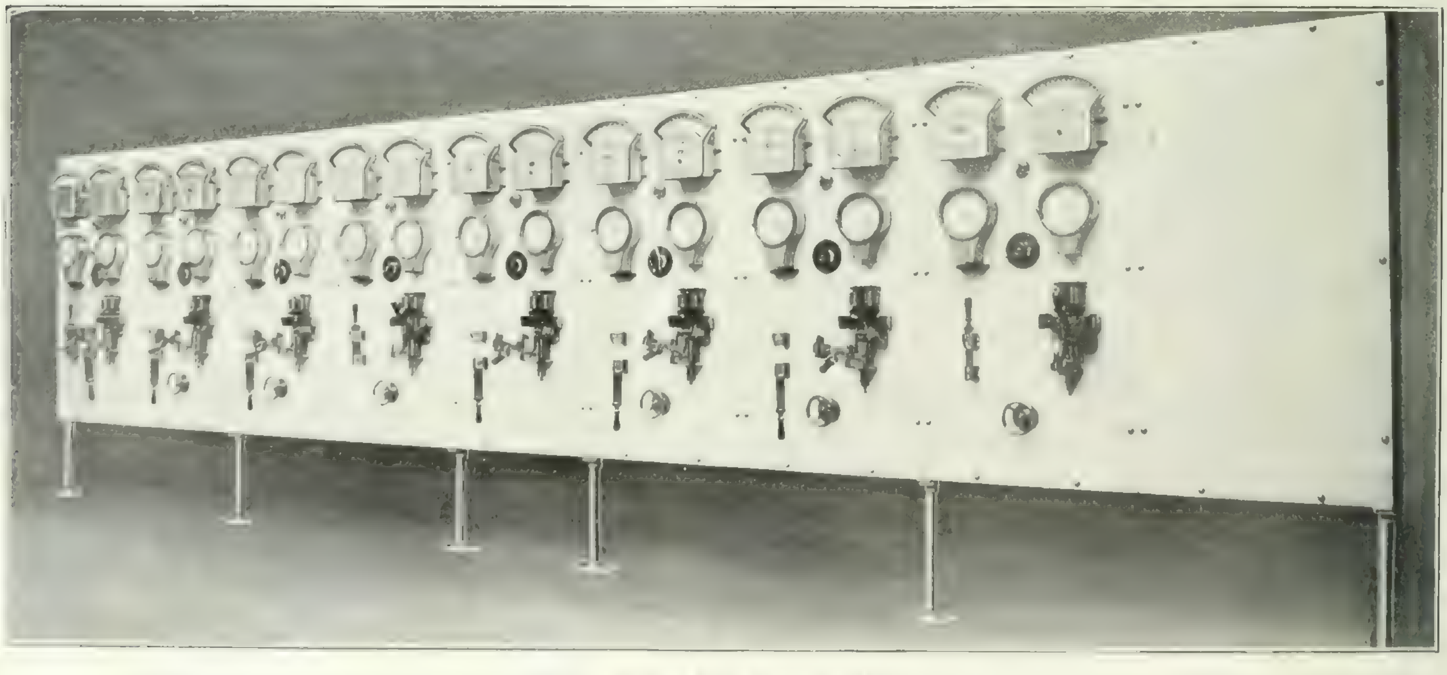


Fig. 7.—The Main Switchboard.

[illegible] advancing end [illegible] from the table toward which it advances. When in the proper position two hydraulic cylinders (see Fig. 11) below the sliding platforms lift their cross-heads through the [illegible] to allow the motion [illegible] it off from its spring [illegible] This is necessary, since if it were not done, the removal of the heavy battery would allow the [illegible] the battery compartment dependent on the [illegible]

The body being raised to the proper height there advanced toward the open door of the battery chamber a hook attached to the piston of the horizontal hydraulic cylinder shown in Fig. 12. This latches into the frame of the battery tray and on the application of pressure pulls the latter out onto what is known as the conveyor table. The latter consists of a runway across the whole front of the battery charging room, equipped with a chain conveyor with frames attached thereto on which the battery trays may be carried to any desired position along the table.

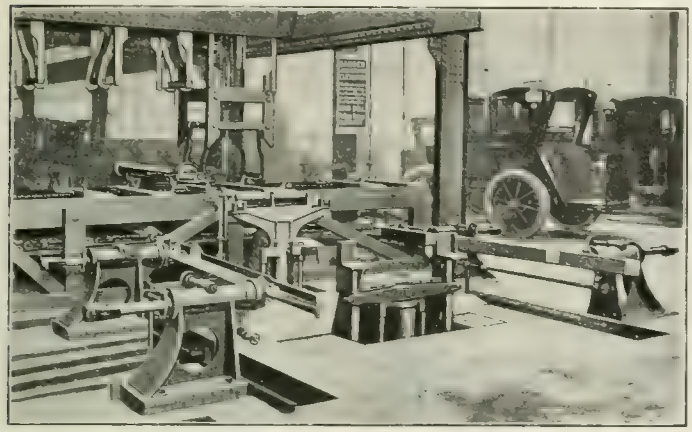


Fig. 11.—Vehicle Platform Showing Centring and Lifting Apparatus.

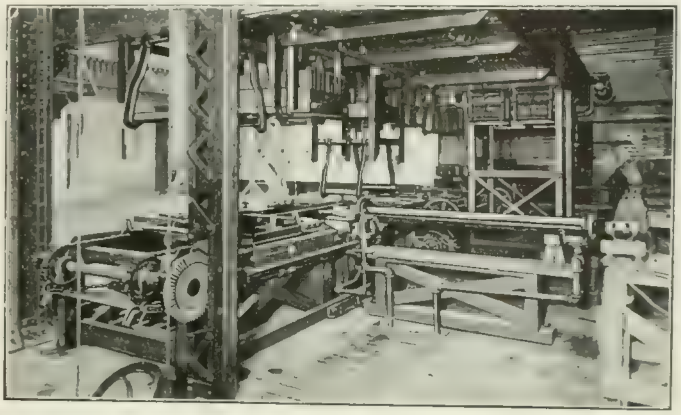


Fig. 12.—Crane and Conveyor Table from Behind, Showing Push and Pull Cylinder.

Above the table is an 8-ton crane (see Figs. 9 and 10), its bridge spanning the battery charging room and carrying, instead of a trolley, eight hooks or grabs, shown clearly in Figs. 9, 10 and 12. Any one of these hooks may be made to descend and catch under the two sides of the battery tray and lift the latter to a level immediately below the crane bridge. One tray is so shown in Fig. 10. The crane then moves as a whole down the length of the battery room to a position over the battery charging table on which it is desired to deposit the tray. In lowering the hooks the tray is deposited, its own weight closing the contacts for charging its cells, as described above and shown in Fig. 5. The crane may be then removed to any other position, its eight hooks moving respectively over the eight rows of charging tables up and down the room and enabling one tray of batteries to be picked up from any one of these rows each time it passes over them. Returning to the position over the conveyor table the batteries may be lowered onto the latter and moved along until they arrive at a position opposite the vehicle to be loaded, when they are in turn pushed in by the same hydraulic cylinder which pulls the exhausted sets out. There are two platforms on which the vehicles can approach the conveyor table, and, the capacity of the crane being several sets of batteries with which it can be fully loaded before it moves back over the charging tables, returning again with several fresh batteries, it is expected that the accumulators in any carriage can be replaced inside of three minutes' time and a capacity of about twenty carriages per hour can be obtained. Carriages have already been loaded in three and one-half minutes.

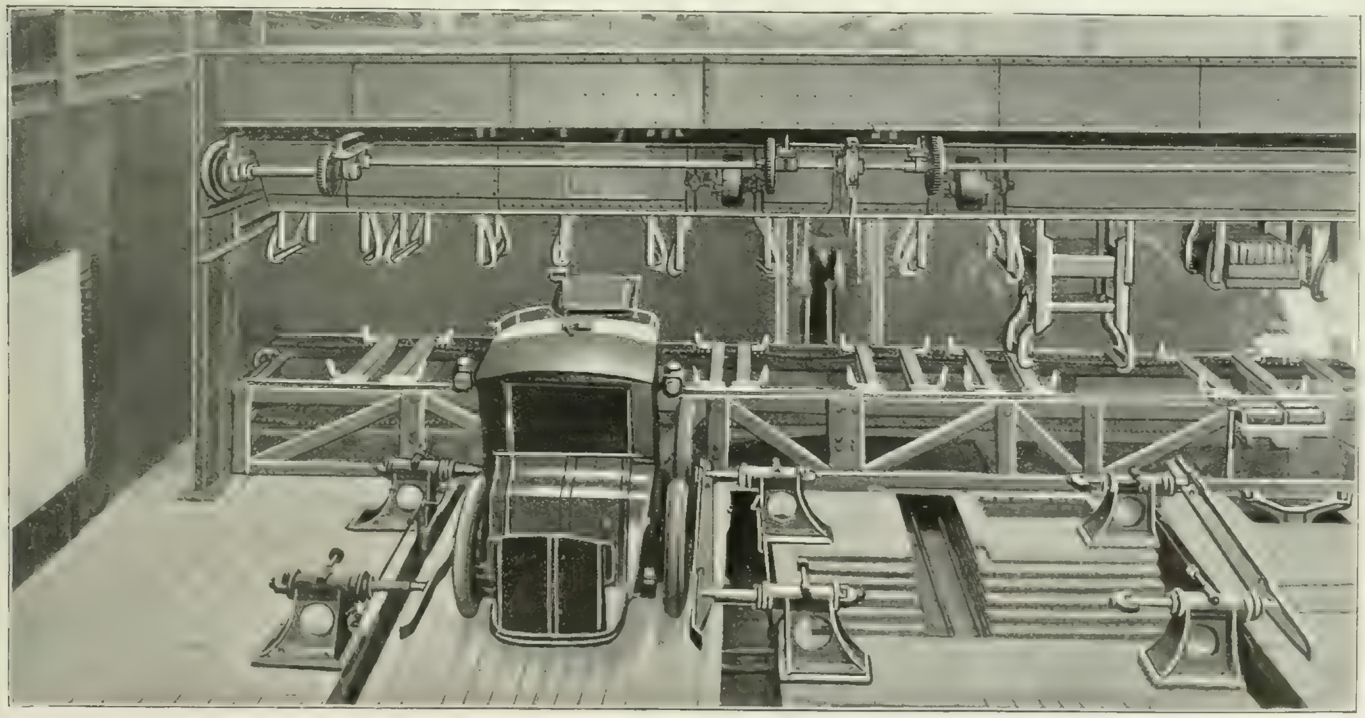


Fig. 9.—View of Crane, Conveyor Table and Vehicle Platform from the Gallery.

The various movements of the conveyor table, crane, hoist, etc., are effected by electric motors, all of which, some fourteen in number, are of the same make and size, 5 horse-power, so that their parts are interchangeable. The conveyor table and bridge mechanism of the crane are each fitted wih a reserve motor for emergency use. Beside the two loading platforms in front of the conveyor table there is a third in reserve fitted to unload onto a small car, on which the batteries can be wheeled under any hook of the crane. The whole plant is interlocking, the conveyor table motor being inoperative when the conveying chains are latched, the bridge travel motor being inoperative when the bridge is latched, and also when any one of the hooks is down. Everything can be manipulated from one platform which hangs from the crane to a position near the ground, running in an aisle down the middle of the battery room. A man is shown standing in this platform in Figs. 9 and 10. When the crane has advanced to a position over the conveyor table, the controlling handles of the latter and the valve spindles of the various hydraulic cylinders are within easy reach from the platform, so that one man alone can handle the batteries from the vehicle to the charging tables. The various movements are well equipped with braking mechanisms, the hoists and conveyor table having electric brakes and the bridge travel a hand brake. The conveyor table is also fitted with limit stop switches, so that if the attendant is careless and leaves the conveyor running, in which case the trays thereon would be tipped off the end, the switch arm is struck by the battery tray which cuts off the current and applies the electric brake.

Water pressure for the various hydraulic cylinders is supplied by a triplex pump belted to a motor similar to those used on the crane, conveyor table, etc. A 36-inch tank about 9 feet high gives an ample air cushion, the water pressure being 150 pounds to the square inch. A Mason by-pass valve is now in use to prevent the pressure rising too high, but there will be substituted for this an automatic motor controller which will start and stop the motor at such times as to maintain the proper water pressure.

The work was designed and carried out under the direction of Mr. [illegible] previously had similar experience in [illegible] Chicago & Englewood [illegible] Mr. [illegible] in the work by Mr. [illegible] of construction.

[illegible] the work were [illegible] carried out by [illegible] Edgemoor Bridge Company; crane and special hydraulic and transfer table work, William Sellers & Co., Philadelphia; motors, Westinghouse Electric & Manufacturing Company; boosters, Western Electric Company; main switchboard, Albert & J. M. Anderson Manufacturing Company; [illegible] Battery Company; electric elevators, George T. McLauthlin Company; exhaust plant, B. F. Sturtevant Company; [illegible] Company; circuit breakers, Cutter Electrical and Manufacturing Company; vehicle wire and charging cables, the Okonite Company; pumps, Goulds Manufacturing Company; vehicle bodies, Specialty Carriage Company; running gear, P. H. Morris, Philadelphia. There were in all over forty contractors connected with the work.

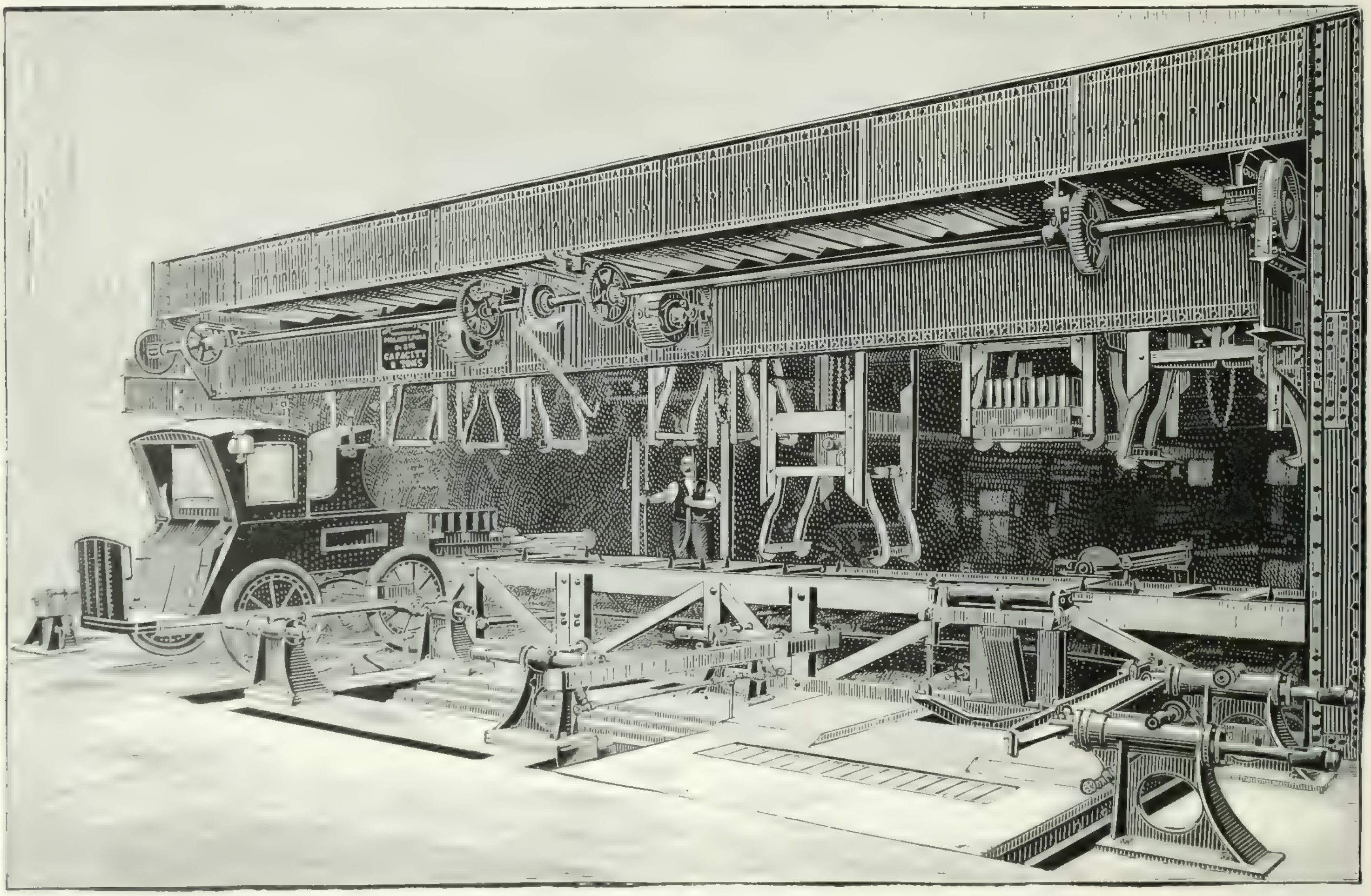


Fig. [illegible] Hansom on One Platform, Its Battery on the Conveyor Table, and Another Battery in the Crane.

Electrical Education for All Engineers.

The following is a brief abstract of the paper, read at the recent meeting of the Society for the Promotion of Engineering Education, on "Electricity in Engineering Courses Other than Electrical," by J. P. Jackson, professor of electrical engineering, Pennsylvania State College:

The present extended use of electricity in industrial undertakings has made a knowledge of its control indispensable to the well-rounded engineer.

College courses preparing for the older engineering professions were established while electricity was of small service. Through human inertia these courses have tended to continue on their old lines. The present time, therefore, finds training in electricity far from satisfactory in engineering courses other than electrical.

The work usually assigned is the electricity and magnetism of the general college physics course, with possibly one term on its applications. No time is given to a vigorous advanced treatment of the subject from an engineering standpoint. The college physics course might as well be depended upon to give the requisite training in applied mechanics or thermodynamics.

In addition to the work now usually scheduled, a thorough training in the laws of direct and alternating currents, as they apply to the practical utilization of electricity, should be added. This should be taught by an engineer, and should be assigned time comparable to that given the steam engine, hydraulics and hydraulic machinery, etc. This time could be obtained with advantage by cutting out special work. An outline of such a course is included in the paper.

As scientific knowledge increases, engineering courses must give more time to fundamental principles at the expense of mere technical practice. Hence such courses tend to converge.

If electrical engineering studies are to be satisfactory they must be under the supervision of an engineering department, and should not be taught by instructors in the departments of physics.

The Mechanicville-Schenectady Power-Transmission Plant.

At a point on the upper Hudson River, near Mechanicville, N. Y., there has been under construction during the past year an admirably designed plant for the development of the water power there available and its transmission electrically to distant points.* The site is only 2 miles from Mechanicville, 11 miles from Troy and 18 miles from Albany, in each of which places large quantities of power will without doubt find a market. But most important of all, it is only 17 miles from Schenectady, where, covering not less than 130 acres of ground, the largest electrical works in the world are operated from an extensive steam plant with which the electrical power from the Mechanicville cataract can readily compete.

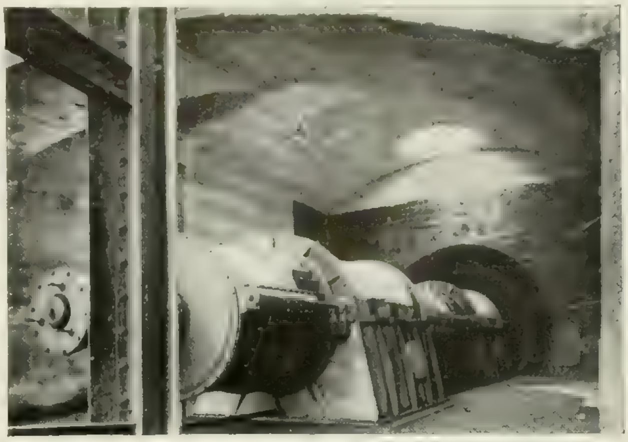
A point was chosen for the hydraulic development where the physical conditions were ideal for a dam and power house. The banks and bottom of the river are of rock, as is Bluff Island, which divides the Hudson into two channels, and here during the greater part of the year is water sufficient to produce from 7000 to 10,000 horse-power.

The island is about one-third of the distance across the river from the western bank, the combined width of the two channels being about 1200 feet. The western channel is used for the head and tail races.

DAMS.

The power house starts from the west bank and extends out into the river about 215 feet and is connected with Bluff Island by a concrete dam, 26 feet high above the bed of the river, 10 feet wide on top and 18 feet wide at the base. The upstream face is vertical and the downstream face sloping. The top of this dam is at an elevation considerably above the spillway; thus no provision is made to take care of falling water on the downstream side, but the dam is provided with four arched waste gates 4 feet wide and 6 feet 9 inches high, operated in the same manner as those in the main dam.

The Main Dam and Waste Gates



One of the Flumes.

Power House from Upstream Side.

The main dam is on the eastern side of the island. It is built entirely of concrete, as indeed is the entire construction with the exception of the upper walls of the power house. The upstream face is vertical; the downstream face is curved and provided with a horizontal apron 14 feet wide, which throws the falling water off horizontally, and thus effectually prevents wash or scour of the toe of the dam. The dam is 16 feet high above the river bed, 8 feet thick immediately below the crest, 16 feet thick through the base and 30 feet thick through base and apron. The dam is set between massive abutments anchored to the rock sides of the river bank and island. The length of the spillway between abutments is 800 feet. In the western abutment are twelve arched waste gates, each 4 feet wide and 6 feet high, opened and closed by a hoist operated by a hand gear. The eastern dam is practically a solid rock wall, capable of safely resisting any flood. It was severely tested in the spring of 1898, when a flood of extraordinary proportion came against it, yet, notwithstanding the fact that the dam was green, the flood in no manner injured it. To prevent any floating rubbish, ice, or logs reaching the rocks or choking the waste gates, a floating wooden boom stretches from the western end of the spillway diagonally for a distance of 400 feet to the edge of the normal river bank, and then for a distance of 1000 feet to the main embankment of the Mechanicville highway. It is anchored to a line of stone-filled cribs.

THE POWER HOUSE.

The power house lies between the west bank and the short concrete dam, nearly filling the space between the island and the west bank of the river. It is practically a continuation of the dam, and like the latter is of concrete, with the exception of the upper walls. The foundations are carried down to bedrock, and the house is carried on heavy steel box web girders resting upon steel I beam columns. The latter are imbedded in concrete walls carrying arches spanning the tail races and forming the floor of the generator room and the wheel flumes. The division walls form a separate and distinct tail race, 22 feet wide, for each set of turbines, from which the water may be shut out at will. The house is divided into two parts by a thick head wall. The upstream part [illegible] wheel chambers for seven 1000-hp wheels, of which five are at present occupied, and also for two exciter wheels. The downstream portion contains the wheel governors and the electrical apparatus. The length of the power house proper is 257 feet, the width of the forebay space between head wall and [illegible] [illegible] [illegible] feet, and the width of the wheel chamber portion [illegible] feet. At the upstream end an [illegible] [illegible] of brick runs up stream [illegible] [illegible] feet, [illegible] [illegible] [illegible] down stream from the power house along the [illegible] a distance of [illegible] feet. The [illegible] the power house.

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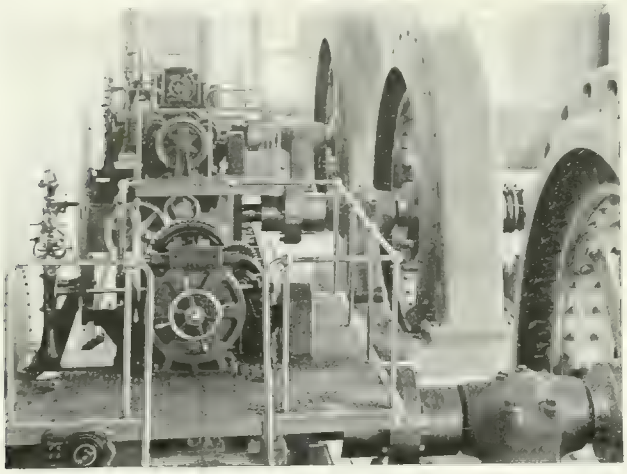
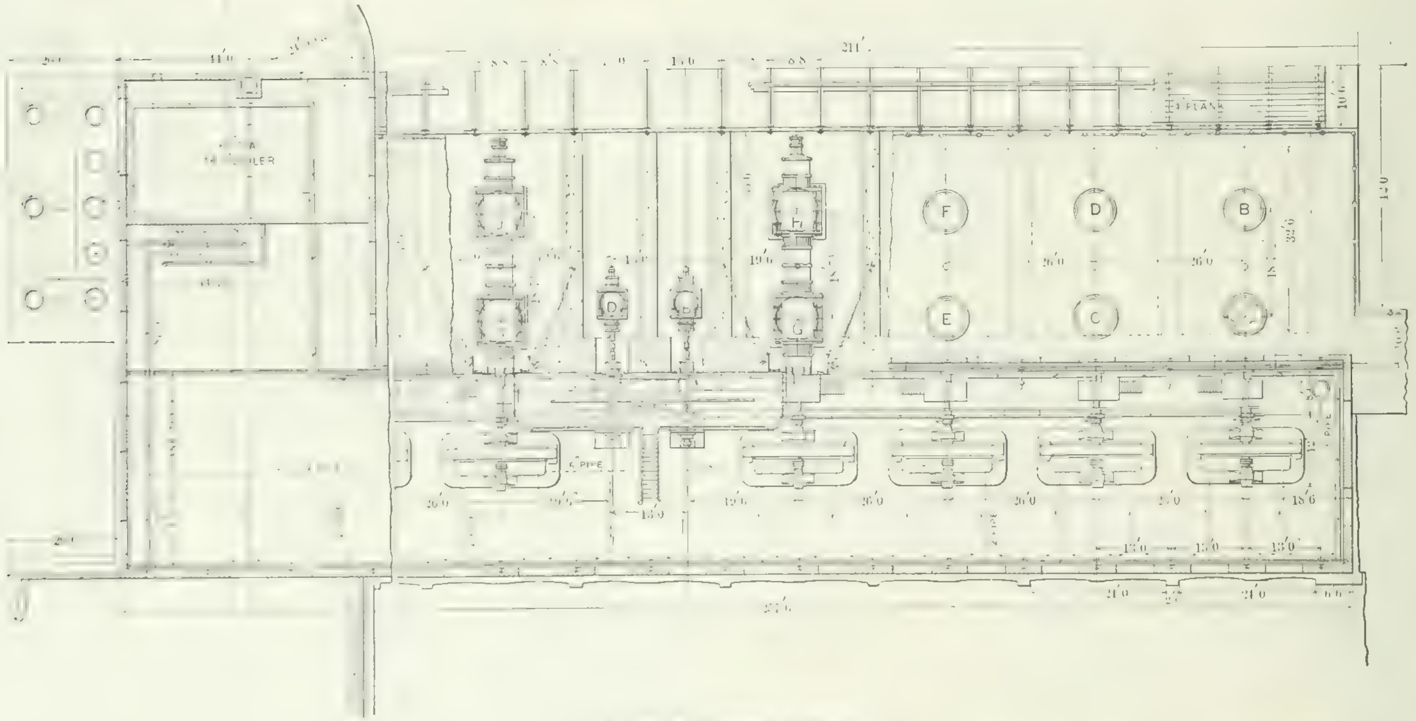
*See also The Electrical World, November 13, 1897.

A [illegible] crane spans the entire length of the dynamo room.



The Wheel Governors.



Plan of Power House.

In front of the wheel chambers and running the entire length of the power house is a [illegible] [illegible] of [illegible] [illegible] supported on I beams [illegible] [illegible] [illegible] [illegible] and I beams.

WATER WHEELS.

Each main turbine consists of two pairs of [illegible] horizontal Victor turbines, built by the Stilwell-Bierce & Smith-Vaile Company, of Dayton, Ohio. The rating of each set of four wheels under a [illegible] head is [illegible] horse-power.

The turbines for each exciter consist of three [illegible] Victor cylinder gate wheels (arranged as one pair with a central discharge and one single wheel), having at 259 revolutions per minute a total of 300 horse-power. The quarter-turn draft tubes of the single wheels are brought through the wall beneath the station switchboard.

Two draft tubes lead from each main turbine, each pair of wheels having a common central discharge, the forward tube descending straight into the tail race beneath the flume, the upstream tube curving downstream and flaring outward.

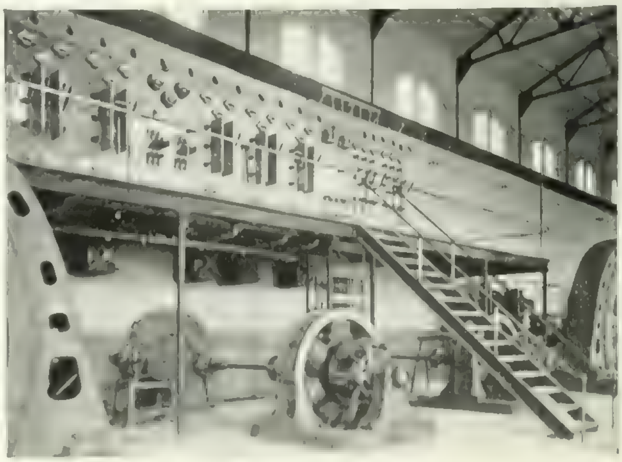
WHEEL GOVERNORS.

The speed of each set of main wheels is regulated by a Geisler electro-mechanical governor, mounted on a platform directly over the turbine shaft, and between the head wall and the generator. The gates can be moved through their full travel, should the full current be thrown on or off, in six seconds.

The governors controlling the exciter-wheel gates are improved "Snow" governors, which rapidly bring the speed to normal when changes are neither frequent nor heavy.

GENERATORS.

The generators are unitooth, three-phase, forty-pole, 750-kw General Electric Company machines, having internal revolving fields and stationary armatures, and wound to deliver 36 amperes of current at a periodicity of 38 cycles and a pressure of 12,000 volts to the transmission lines when running at 114 r. p. m.



Switchboard and Exciters.

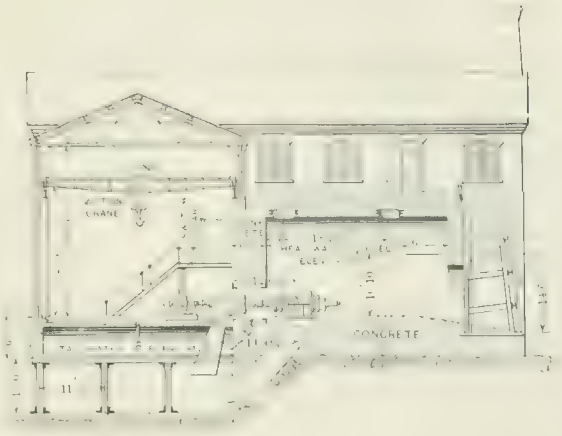
The generators are similar in their main characteristics to those successfully used in the development of the power of the Lachine Rapids at Montreal.* The armature frame or ring is of the box

* See The Electrical World, October [illegible], [illegible].

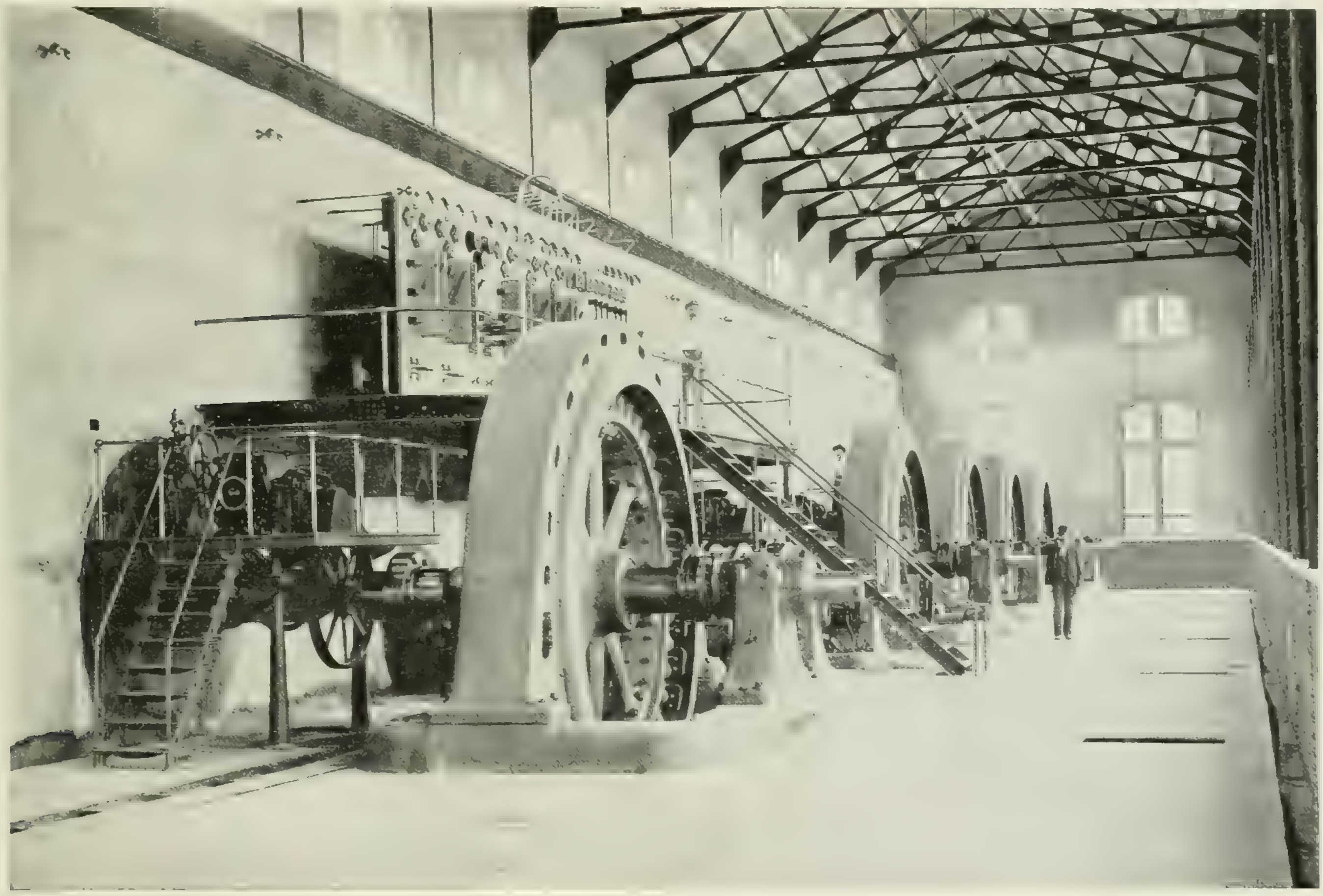
type, 15 feet 4 inches in diameter and 36 inches wide. It is bolted to a base, along which it may be moved parallel with the shaft, in order that the revolving field spider and poles may be uncovered should occasion arise. The armature winding is protected on each side by iron shields.

The field ring carries forty poles and revolves on a shaft 15 inches in diameter, coupled rigidly to the turbine shaft. The dynamo shaft is extended at the other end for coupling to a vertical steam engine in case of necessity.

The following reasons for selecting this type of alternator have been given by Mr. C. P. Steinmetz, of the General Electric Company. In addition to the advantage which the stationary armature type has over the stationary field type in allowing a high-transmission voltage to be taken directly from the armatures, it allows of a fairly low saturation of the magnetic circuit, giving an almost straight saturation curve. This is preferable in power transmission, since a considerable increase in the voltage may be obtained if needed to cover excessive drop in the lines due to heavy loads, and the voltage may be maintained even if the speed remains low.



Sectional Elevation Through Power House, Showing Exciter and Wheels.



The Dynamo Room.

The exciters are placed one on each side of the stairway leading to the switchboard gallery. They are six-pole, 100-kw, 125-volt standard General Electric machines, with ribbed field frame and toothed core armatures.

SWITCHBOARD.

The switchboard, erected on a gallery along the north wall of the dynamo room, is built up of nine panels of blue Vermont marble. Of these nine panels, five are used for the generators and two for the feeders, one is the total output panel and the ninth is fitted for the control of the exciters. The generator panels occupy the left end of the board, and room on the gallery is left for two additional panels. The feeder panels are on the right end; the total output panel is between these and the generator panels and the exciter panel is the third panel from the left-hand end of the board.

Each generator panel is equipped with the following instruments: one inclined coil alternating ammeter reading to 75 amperes for the main current, and one direct-current ammeter reading to 150 amperes for the field exciting current. Above each of these is a pilot lamp and between the pilot lamps is a synchronizing lamp. Beneath the two ammeters is an inclined coil voltmeter reading to 15,000 volts, and beneath this instrument are three single-blade, double-throw, quick-break, high-tension switches, each mounted upon corrugated cones of hard rubber. Similar studs support the bus bars. The corrugations give a total distance of about 8 inches between the metal and the surface of the marble on each side. As these switches are to break current of 12,000 volts they are tested by opening circuits carrying 21,000 volts. The switches are without handles. An eye is made in the end of each blade into which a hook at the end of a stick may be inserted and the switch opened by the attendant from a safe distance. Further, to prevent any jumping from blade to blade marble barriers are placed between them. On the back of the panels are the high-tension fuse blocks, which, designed for 20,000 volts, are of the snap-break expulsion type. These blocks are removable as a whole, and are fitted with blades which connect them with terminal clips supported from the panel by hard-rubber studs, 3½ inches high. The aluminum fuse is held tightly in the block between two pivoted arms attached to springs which put a strong tension on the fuse. As soon as the fuse melts its two halves are pulled apart, and thus the duration of the arc is minimized.

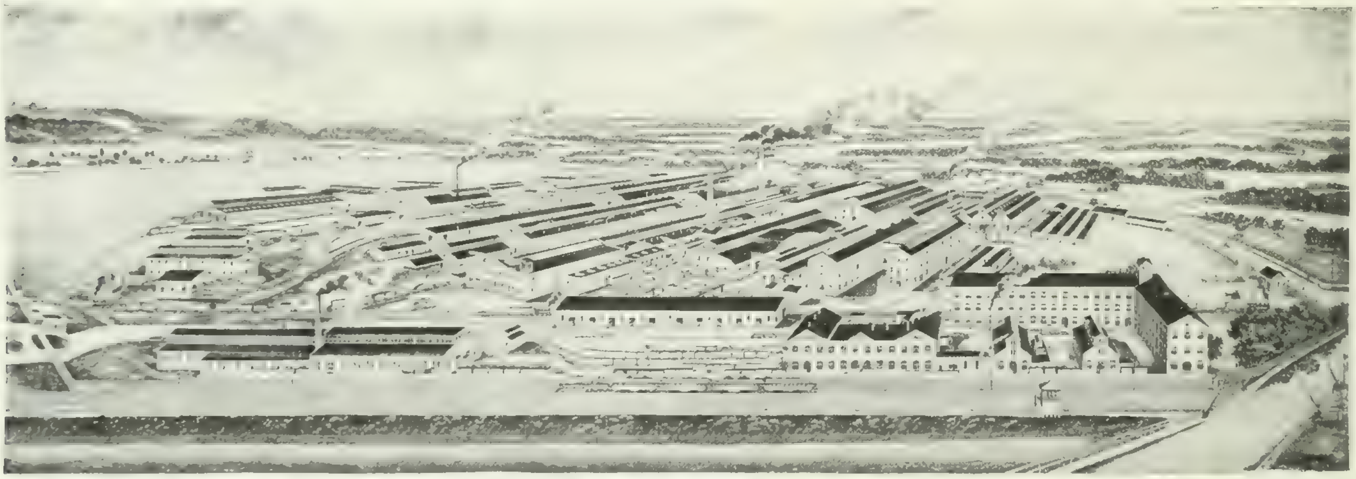
The field rheostats are hung beneath the gallery and are operated through gears. The panel for the two exciters carries two pilot lamps, two circular dial, 1000-ampere ammeters, one voltmeter reading to 150 volts, one four-position voltmeter switch, one synchronizing switch, two 800-ampere, triple-pole, double-throw main switches and two packed card rheostats.

The two feeder panels are similar to each other in every respect. Each outgoing line is provided with an independent ammeter reading to 150 amperes and a quick-break, double-throw, high-tension switch, similar to those on the generator panels, and similarly mounted on the board. Mounted also on corrugated hard-rubber supports are the six circuit breakers or automatic plunger switches. These consist simply of long copper rods capable of sliding lengthwise in vertical rubber tubes. Each is held by a trigger and forced downward suddenly, when released, by a strong helical spring, opening the circuit at its upper end. The triggers are actuated by a rock arm, so that all three poles may be opened simultaneously.

On the upper part of each feeder panel are also two single-phase integrating wattmeters and the current and potential transformers therefor.

On the front of the output panel are two Thomson integrating wattmeters for balanced three-phase circuits, each reading to 300 amperes and 12,000 volts, and twelve triple-pole, single-throw, 100-ampere switches with fuses for the lighting and heating circuits of the power house.

The line is protected by double-pole, 2000-volt, short-gap lightning arresters, connected six in series to give the necessary number of spark gaps, which are each one-thirty-second inch long. They are placed in a small house, 15 feet square, near the first pole, the line running underground from the power station to the arrester house.



The Works of the General Electric Company at Schenectady.

The lead-covered cables from the generators are laid in ducts in the floor. Rubber-covered wire is used for the field connections. The cables rise on a frame from the duct to the door of the gallery through which they rise to the board. From the back of the [illegible] support bolted to the I beam on the north wall, which supports one of the crane runways.

The line from Mechanicville to Schenectady is the only one at present laid down. It consists of three No. 000 B & S gauge [illegible] poles [illegible] to 60 feet long, and all 8 inches in diameter at the top. Each pole carries one cross arm, on one side of which are two porcelain insulators of the [illegible] on the other end. For lightning protection a barbed wire, frequently grounded, runs along the [illegible]

[illegible] the Mohawk River [illegible] ground and connected [illegible] quarter-inch rubber and three-thirty-seconds lead sheet, laid in [illegible]

The introduction of this transmitted electrical power into the [illegible]

550-volt motors in the testing department are supplied from an engine-driven, multipolar generator, of 500-kw capacity, while a smaller engine drives a number of exciters, which allow of independent control of the excitation of all machines in this department. The factory is operated by a number of 250-volt motors running on the same circuit as the factory lights. These motors will not be changed and the steam plant which supplies them will be retained as a reserve in case the power from Mechanicville should fail.

The large engine driving the 500-kw multipolar generator will be replaced by a 500-kw synchronous motor coupled to a direct-current generator. This motor is a twelve-pole, 400-revolution machine of the revolving field type, wound to take 10,000 volts direct. The small engine driving the exciters is to be replaced by a 100-kw synchronous motor—an eight-pole, 600 r. p. m. revolving field machine similarly wound. This disposition renders this department independent of everything but the speed of the Mechanicville generators, which will be kept as nearly as possible constant.

The three rotaries supplying 250-volt current to the factory motors are ten-pole, 400-kw, 480 r. p. m. machines, having two commutators and two sets of collector rings connected to two independent windings on the armature. The commutators at each end are, of course, inside the main bearings, but the collector rings overhang the latter. They receive the three-phase current from independent secondary coils of the same set of air blast transformers. When the two commutators are connected in multiple they furnish direct current at a normal pressure of 250 volts, but as they may be called upon to furnish current to the testing department in case the demand exceeds the supply from the synchronous motor driven machine, they may be connected in series to give 500-volt current, operating in parallel with the railway generator, driven by the synchronous motor in the testing department.

The rotaries will normally be operated in parallel at 250 volts, and all the factory motors, the factory railway and all the factory lighting will be operated from the same direct-current circuit, the latter on the three-wire system, the neutral of the three-wire system being secured by connecting the secondaries of the step-down transformers feeding the rotaries in Y, the common point of which gives a balanced voltage between the direct-current terminals.

The entire construction of the dams, power house and lines has been carried out by the National Contracting Company, of which G. M. Furman is general manager, E. A. Mathews superintendent, and J. A. Leonard constructing engineer. The electrical equipment is furnished by the General Electric Company and the hydraulic equipment by the Stilwell-Bierce & Smith-Vaile Company, of Dayton, Ohio, to which company was confided the entire development contract. It took the Hudson River in its natural condition and turned over to the operating company the plant in running order.

The officers of the Hudson River Power Transmission Company are: Gen. Edmund Hayes, of Buffalo, N.Y., president; R. N. King, president of Stilwell-Bierce & Smith-Vaile Company, of Dayton, Ohio, vice-president; G. M. Furman, Newark, N. J., treasurer; Mr. [illegible], Boston, Mass., superintendent; J. S. O'Shea, manager.

The Meter's Relation to the Dividend.*

BY CARYL D. HASKINS.

The meter's relation to the dividend is partly, of course, a very obvious relation, but I have been surprised in going from plant to plant and from place to place to find how many central stations throughout the country have overlooked the fact that in the mere matter of the careful disposition and management of meters lies all of the difference between financial success and failure.

A good many central stations in the past have confined themselves to the question of accuracy on what they deemed would be the average load of the meter. While no doubt that test is better that none, it really means very little. The next step has been the testing of the meter, to see on what load it will start. The load on which a meter will start to rotate is of almost no importance. A meter may start on 2 per cent. of its rated capacity, and yet may be running 90 per cent. slow, and is not as good a meter as the one which won't start until it gets within 3 or 4 per cent. of its rated capacity, but when once started will run with approximate accuracy.

I have come to appreciate that the most important thing of all to look for, the thing which will make the treasurer look happiest at the end of the year, is the proper action on overload. A great error that central station managements have made in the past is the use of meters too big for the work. If a meter is used which is good on overloads, and is accurate until it burns up, phenomenal accuracy on low loads is not essential. The meter which is extremely accurate on low loads is not to-day a hard meter to find, but a rather hard meter to maintain. The low load is the load that friction, dust, dirt, wear and age affect; and what is wanted to-day in every installation is that meter which will carry the load, frequently working on an overload perhaps, and seldom working on a very low load.

When possible it is a good thing to avoid working meters at much less than 10 per cent. of their rated capacity. Of course this is not always possible; but more often possible than one would think at first sight, or upon hasty investigation. I admit that next in importance to overload accuracy in a meter comes the light-load accuracy; for the simple reason that light loads cannot always be avoided.

The third feature to investigate with care is the inductive-load accuracy.

These three factors are perhaps being looked into pretty carefully now by 75 per cent. of our stations. Almost every station, however, stops at that point. Very few stations investigate accuracy on changes of frequency, accuracy on changes of wave form. Almost every one has to face a change in frequency sooner or later; and the bulk of meters to-day are weak at that point. A meter which must be changed if the frequency of the system is altered, or a meter which cannot be changed from a 60-cycle machine to a 125-cycle machine, or vice versa, is not a profitable piece of apparatus to have, and ought to be avoided. The wave-form question is one which has not been appreciated very long; but obviously it is not a good thing to have meters which will run within 1 per cent. of accuracy on a smooth-core armature and a different percentage on a toothed-core armature; yet many meters vary materially between these conditions.

I have placed all of these technical considerations before another, which perhaps has also been passed over too lightly in the past; and that is the mechanical construction of the meter and its ability to withstand punishment. I can class with that portion of the treatment of the subject the question of damping magnets. The speed of the meter changes as the square of any change in the damping magnet strength; in other words, a slight change in the strength of the damping magnet will change the speed of the meter as the square of that change in the magnet. That emphasizes immediately the importance of having really permanent damping magnets. If they are exposed to unusually high or fluctuating temperatures, as in an attic under a tin roof, their strength falls, as it does also under severe vibration.

The jewel is also a point which should be looked into with care. Sapphire jewels are the commonest bearing to-day. The sapphire is really the only substance which is fit for a meter bearing; it is next to the diamond in hardness, and yet is peculiarly smooth on its polished surface, and in that respect differs from diamond, which is apt to be gritty and rough. The sapphire which comes from Arizona is not more than one-half as hard as the sapphire which comes from Ceylon.

Generally speaking, lighter colored and whiter sapphires make the best bearings. A rigid mount is not the best for jewels, since they are worn away not so much by the rotation of the shaft as by its reciprocating motion. Imperceptible though it may be, it is always there; and it is this hammering motion which breaks up the surface of the jewel and establishes that gritty foundation which means death to the bearing. The moment the outer skin of the polish on a jewel is broken the jewel is on the road to destruction.

Low speed is much better than high for a meter. A jewel will wear a good deal longer proportionately on a low-speed than a fast; in other words, the jewel which will wear on an average 2,000,000 revolutions at a speed of 40 revolutions per minute will not wear for 2,000,000 revolutions at a speed two or three times greater. About 2,000,000 revolutions is the life that can be looked for from a good grade of sapphire meter jewel. This is true unless the meter is placed in position where there is a good deal of vibration, when it will have a shorter life. A good rigid point of installation in a basement, with no moving machinery, will show more; yet 2,000,000 is a fair average.

This leads me to the question of the installation of the meter. Many central station managers will take out and test their meters with the greatest of care, and use expert knowledge in determining what is the best meter to meet their conditions and yet sacrifice from 1 to 2 per cent. of their stockholders' money annually on the altar of improper installation. As I said before, most meters are too large for their work. It is better to put in too small a meter, even if one is occasionally lost by a burn-out, than it is to put it in one big enough for the maximum load, and lose revenue constantly on minimum loads.

It is, of course, a greater loss to have a meter running an hour on one hundred lamps at a speed of one-half of 1 per cent. slow than it is to have that same meter run for an hour on one lamp 25 per cent. slow. The accuracy on overloads, therefore, must be greater than that on the light loads. That is a point that is often missed. A good many people think that 5 per cent. is 5 per cent., forgetting that while 5 per cent. may not be at all serious on light load, it is death to dividends on high load or an overload.

In installing meters in theatres, hotels, and big installations generally, there has been in the past a very common error made in putting in only one meter. When that is done a lot of revenue is lost, owing to the theatre corridor or office lights, which are burning when the bulk of the house is idle. If the meter is big enough to carry the whole theatre or hotel installation on an ordinary overload, when ten, twelve or even twenty lights are run on that meter for a good many hours a day, a considerable percentage of that proportionately light load is lost. In all installations of that kind—theatres, hotels, halls—it is well to split up the circuits.

In installing meters avoid vibration. I have been in office buildings where every meter in the building was on a wooden partition, and where 50 per cent. of them were on partitions with banging doors. That means death to the jewels. It destroys light-load accuracy, because the jewels speedily become rough. If the meter has brushes it causes sparking at the commutator, which in turn increases the friction.

Considerable sacrifices in the wiring are justified to secure a suitable point of installation for the meter. A brick wall is good; the nearer the foundation the better. All kinds of pounding should be avoided, especially the vibration from moving machinery, which is the worst form of vibration to which a meter can be exposed. The price of a jewel is a small matter as compared with the loss which the company has to undergo from running meters on rough jewels. Much energy cannot be spared to make the meter a high-torque device, and friction must of necessity always be a considerable portion of the load which the meter carries in the work it does. This can be doubled, trebled or quadrupled by leaving a rough jewel beneath the lower bearing.

Places subject to high temperatures, or to sudden changes of temperature, ought to be avoided. Like very hard glass, jewels are liable to crack and break and flaw when the temperature changes; and it is probable that meters installed in garrets where the temperature sometimes goes as low as zero, and again as high as 100°, will not show anything like the accuracy at the end of a year as will meters installed in situations where the temperature seldom goes below freezing point or rises above 90°. Again, the places where the temperature is constantly high are dangerous and hurtful, because by just so much do they lower the ability of your meter to carry overloads.

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*Abstract of paper read before the Ohio Electric Light Association, August, 1898.

Another common error made in installing meters in connection with motors—and sometimes in connection with lights too—is the placing of the meter on the load side of the main switch. I suppose that is done with motives of economy, because when the main switch is open the energy which traverses the shunt coil of the meter is cut off. All meters which have shunt field coils must of necessity be wound with extremely fine wire. Every time the main switch is opened that fine wire cools off and contracts; every time that the main switch is closed that fine wire heats up and expands, and speedily the meter is open-circuited in the shunt field coil.

Until they have tried it, very few appreciate how easy it is to keep meters clean. With the average installation a visit to the meter for the purpose of cleaning twice a year is ample—sometimes three times a year where the point of installation is not a clean one. With a bellows all the loose dust which is liable to work into the bearings and enter the brushes and clock-train can be blown out. With a piece of tape a commutator meter can be cleaned in about a minute and a half. Altogether, the operation of cleaning out the meter should not consume more time at the meter itself than five minutes per visit—ten minutes a year! This is a very small sacrifice in wages to make for the return obtained owing to light-load accuracy. Sometimes people say to me, "but since we begun to clean our meters we began to get a lot of kicks." I think that tells the story at once. They began to get a lot of kicks because they had been running a long time with dirty meters.

As to testing meters, many stations have a practice of removing a meter to test it. They change their meters once a year. I don't believe it is necessary, except under very rare conditions, to remove a meter from the point of installation to test it. There are a good many simple and accurate ways of testing a meter at the point of installation which do not involve creating distrust in the mind of your customers. On direct-current service and also on alternating-current service where there are no inductive loads the method with ammeter and voltmeter is not to be despised; it is accurate, but is sometimes cumbersome. Better than that is the use of an indicating wattmeter, which when cut in with series coil in the field of the meter and potential coil in multiple with the armature of the meter gives an immediate indication of the watts in use. But even that method, I think, is inferior to one which is just beginning to come into favor, and which has proved a great success. That is nothing more than the use of a box of calibrated lamps. With a calibration card showing the consumption at various voltages and a voltmeter this gives good results. The lamps, if they are selected for a potential higher than that to which they are to be exposed, will retain their wattage for a surprisingly long time. It is also a method which appeals to the consumer. He knows what a lamp is. I have come to be a great believer in teaching the customer how to read and how to test his own meter. Meters are made pretty well to-day, and I think it is a good thing in the long run to have the customer so well armed with a very little simple information that he can turn on a number of lights in his house, and go down and watch the meter and satisfy himself that it is right.

Lately two entirely new propositions in connection with the meter problem have developed; and they have grown, I believe, up to a point where they will soon become the strongest kind of modifying influence on the earning capacity of the central station. I refer to the rate-modifying systems, such systems as the two-rate and the Wright demand.

The two-rate system is just what its name indicates. It is a clock which between certain hours of the day changes the record of your meter from dial No. 1 to dial No. 2; and your customer pays on his high-rate dial one price for the current that he uses during the peak and on his low-rate dial another and much lower price for the current that he uses at other times than that of the peak. The determining of those two rates is strictly a local issue. Theoretically they should be determined by charging the peak customer the low rate plus his proportion, according to the amount he uses, of the interest, depreciation, and investment charges on the apparatus maintained for the purpose of carrying the peak alone. Some central stations have found it a possible and profitable basis to make the low rate about one-third of the high-rate or peak charge. It has been pointed out that after the system was established for a time the peak would change. That is just what is wanted. That hump should extend until the valleys are filled out, like grading a piece of ground.

There is a large class of customers who use light almost exclusively in the valley periods and who to-day, to a large extent, cannot be reached at all by electric light, for the simple reason that the rate is too high; but with the two-rate system gas rates can be met and strong inducements offered them.

It seems to me it is essential to the success of any multiple-rate system that the factor which changes the rate should be purely dependent on the occurrence of the station peak. There are systems which, instead of making the change of rate dependent upon the station peak, make it depend upon the local peak. If the local peak and station peak are coincident, this would be perfect, because it is somewhat a simpler system than the other; but the local peak is more commonly not coincident with the station peak than coincident with it. If the rate system makes the modifications depend upon the occurrence of a local peak, it seems to me that it punishes a class of customers who should be encouraged and not punished. If a very heavy load between 11 in the forenoon and 3 o'clock in the afternoon can be obtained, even though that load be a local peak, it is a profitable one. If a lot of distributed peaks can be obtained, overlapping one another and filling out the valley of the curve, it realizes what all central stations want to accomplish—a load curve which enables them to run as nearly as possible with the whole equipment at a fair load twenty-four hours a day.

The prepayment system is now being adopted in some cities, and will, I believe, be very widely used. It merely consists in a meter into which the customer drops his money in payment of his bill before he can get his light. It is simple, and in the large cities it seems destined to accomplish quite a revolution in electric light. It lets the illuminating company into whole sections of cities which to-day are closed from the mere fact that the people who take the light in those districts have no credit. They move every two weeks; and yet those people are the very ones who are the most extravagant in the expenditure of their money. They pay a high price for everything; and it has been proved quite conclusively in Europe that those people will use light in large quantities provided they pay for it in small installments. Such meters open up the slums of the larger cities, and even in smaller cities of the manufacturing class they open up great districts which to-day are either not available or not profitable, by reason of the great number of defaulted bills.

A Comparison of the Single-Phase and Multiphase System.

In the abstract of a paper on this subject by Mr. Ernst J. Berg in the last issue of The Electrical World, and also in the editorial comment thereon, there is an opportunity for a misunderstanding of Mr. Berg's attitude on this subject. The subject of the paper, which was requested by the officers of the Ohio Electric Light Association, was "Long Distance Transmission of Power," but Mr. Berg specifically limited himself, on account of the nature of the association, to the transmission of power for lighting or lighting and incidental motor use, and this limitation unfortunately was lost sight of in the abstract and comment in these columns. Mr. Berg recognizes the advantages of multiphase systems over the single phase for the transmission or distribution of electrical energy to motors or to loads consisting mainly of motors with incidental lighting, but reasons that these advantages diminish as the motor load diminishes and are more than outweighed by the disadvantages of poor regulation and the difficulties of balancing when the load consists, as do most central station loads, largely of lamps with an occasional motor. It would appear from the statements published in the last issue of The Electrical World that Mr. Berg did not consider the use of multiphase systems advisable except for transmission to extremely great distances or for the supply of rotary converters. This is the case when and only when the load is largely a lighting load. Cases where the load consists almost entirely of motors form another exception.

Some Tests with an Induction Generator.*

BY A. F. M'KISSICK.

It has been pointed out by several engineers, especially by Mr. Charles P. Steinmetz, that an induction motor, driven mechanically at a speed above synchronism, will act as a generator, and that for its operation as a generator there must be connected to it either an alternator or a synchronous motor.

In an article published in THE ELECTRICAL WORLD January 21, 1893, by Mr. E. Danielson, the following experiment is described: "A three-phaser *A* of 50 volts (as measured from the neutral point to each of the brushes), and with a current capacity of about 60 amperes, sent current to a motor *B*, with inductive winding of about the same capacity. The motor, by means of a belt, ran a continuous-current dynamo, *C*, of 330 volts and 16 amperes. The matters were reversed so that dynamo *C*, fed from a 330-volt circuit, ran the motor *B* as a generator, sending a rotary current to the three-phaser *A*, which then became a motor. The belt was then thrown off of *A*, and trials were made to break it out of step with the current, but without success."

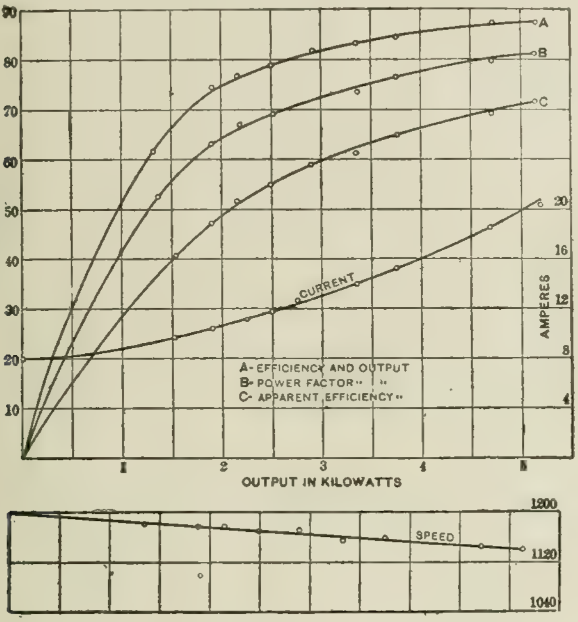

FIG. 1.

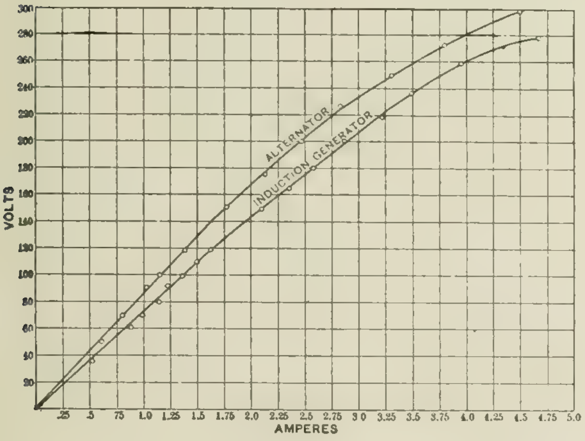

FIG 2.

Again in the excellent paper of Mr. Charles P. Steinmetz on "Induction Motors," presented before the American Institute of Electrical Engineers on July 26, 1897, the use of an induction motor as a generator was referred to as follows: "As generator the induction machine differs from the synchronous alternating-current generator, or generator with constantly excited field, in so far as the latter can yield current and output at any power factor—that is, any phase displacement corresponding to the load—while in the induction generator at given terminal voltage to every value of current output a certain power factor of load corresponds. That is, to derive a certain value of current from the induction generator, the total load put on it must have the particular power factor corresponding to this current, and besides leading current, or if the power factor of the load changes, current and voltage of the induction generator will change accordingly. In consequence thereof, in general the induction generator is stable only if at least a part of the load consists of synchronous motors."

In the discussion that followed this paper Mr. Steinmetz speaks further of the induction generator as follows: "The induction generator is a very important piece of apparatus, I believe. It is, however, somewhat restricted in its application, due to the necessity of having as load a circuit-leading current. But whenever the conditions are such that it can be used, as for operating synchronous motors or rotary converters, this type of machine has the great advantage of the absolute absence of continuous current-exciting circuits, collector rings, or any other parts requiring attention. The voltage is generated in a stationary structure, and the revolving part is a solid structure of iron and copper bars. Furthermore, as soon as the circuit is opened or short circuited, the power is gone and the machine is dead, so that you get here a type of alternator requiring no attention whatever. Besides you can run it at different speeds and still get the same frequency out of it. There is another interesting feature noticeable when comparing the induction motor curves and the induction generator curves. The same machine as induction generator gives a considerably larger output electrically than as induction motor mechanically. In a future paper I shall dwell more particularly on the induction generator, and may mention here only that I have operated synchronous motors from an induction generator; the mechanical output from the synchronous motor driven by the induction generator was larger than the maximum mechanical output which could be derived from the same induction machine as induction motor."

The results of the tests made show close agreement with the theory as given by Mr. Steinmetz.

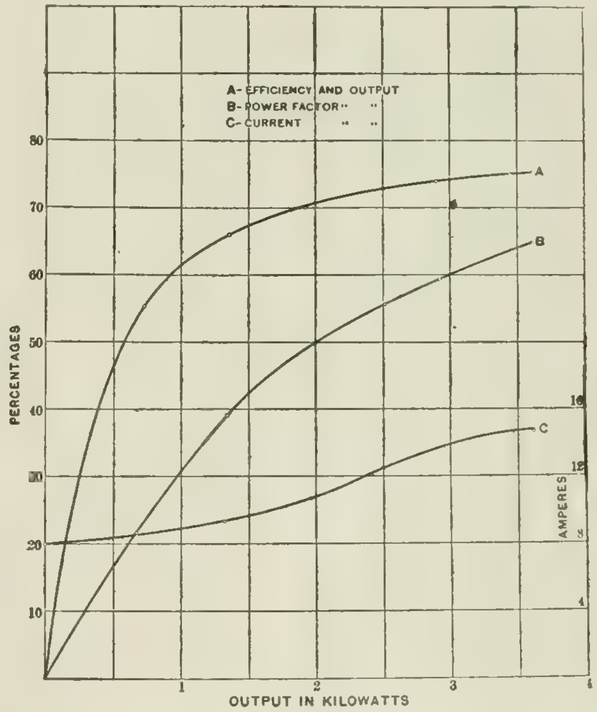

FIG. 3.

The tests described in this paper were made with a General Electric 5-hp, three-phase, 220-volt, six-pole, 60-cycle induction motor (with starting resistance in secondary rotating element), driven by a 10-hp. 110-volt Thomson-Houston direct-current motor.

The machine used as an alternator and synchronous motor in the tests was an "Ideal" 5-kw, three-phase, 60-cycle, 10-pole, 220-volt machine, and could be belted either to a jack-shaft or to a three-kw Edison 125-volt dynamo.

The curves in Fig. 1 show the operation of the induction machine as a motor with varying output.

In the tests under this head the belt connecting the Ideal alternator to the jack-shaft was in each case thrown off after starting and the alternator run as a synchronous motor, either empty or driving the 3-kw Edison dynamo.

CURVE OF MAGNETIZATION.

The method of making this test is as follows: Start induction motor from Ideal alternator, the 10-hp direct-current motor being belted to the induction machine when up to speed, supply current to 10-hp direct-current motor, driving induction machine near synchronism, and throw off belt connecting alternator to jack-shaft. This alternator will then run as a synchronous motor, receiving its current from the induction machine, which is now being driven as a generator by the 10-hp, direct-current motor belted to it.

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*A paper presented at the general meeting of the American Institute of Electrical Engineers, Omaha, June, 1898.

By varying the exciting field current of the synchronous motor the voltage of the induction generator is varied, and from the readings of field current in synchronous motor and voltage at terminals of induction generator, the curve marked "Induction generator" in Fig. 2 is obtained.

The magnetization of the Ideal alternator is also given in Fig. 2, which is almost identical with the magnetization curve of the induction generator.

TEST WITH INDUCTION GENERATOR DRIVING SYNCHRONOUS MOTOR LOADED.

In this test the alternator was made to run as a synchronous motor by the induction generator as before, and then belted to the 3-kw Edison, driving this machine as a dynamo.

The results of this test are shown in Fig. 3.

In making the calculations for efficiency the energy required for the excitation of the synchronous motor fields was charged up against the synchronous motor.

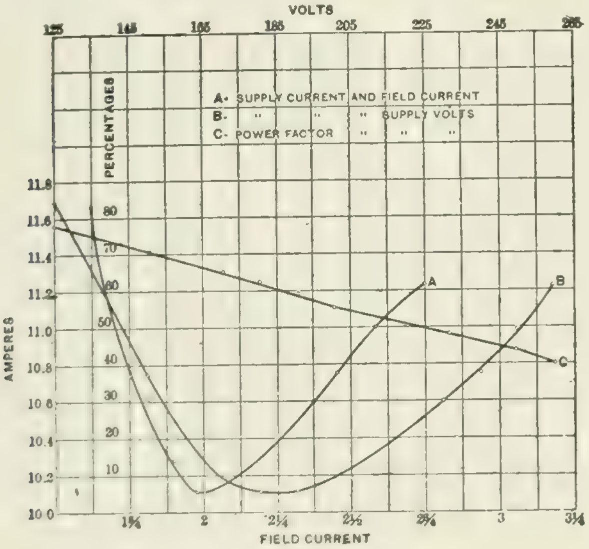


Fig. 4.

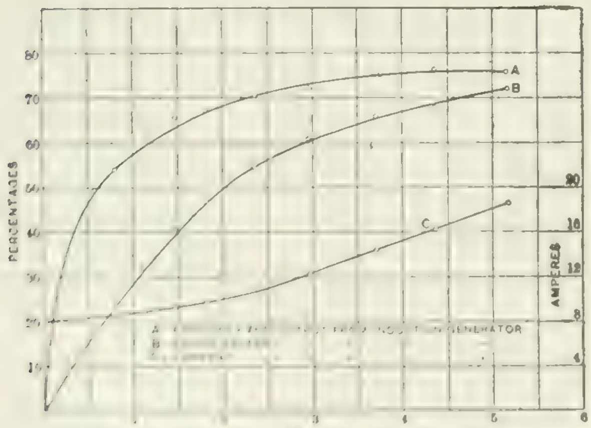


Fig. 6

Fig. 4 gives the results of the following test: With the connections the same as in the preceding test, and the load on the 3-kw Edison maintained constant, the voltage of the induction generator was varied and corresponding current, watt and speed readings recorded.

The voltage was varied from 265 to 125, the synchronous motor falling out of step in attempting to lower the voltage to 100.

Curve *A* gives the variation of supply current with field current, curve *B* variation of supply current with voltage of supply, and curve *C* is plotted between power factor and voltage of supply.

It is interesting to note the similarity between the general shape of curve *B* and the curve plotted between the same coordinate known as curve V, obtained from a synchronous motor with constant load, supplied with alternating current at a constant pressure, and also the similarity between the curves in Fig. 4 and those in Fig. 5, which were taken with the induction machine run as a motor, the load being kept constant on the motor, but the supply voltage varied.

It will also be noted that in both tests the power factor increased uniformly with decrease of voltage.

TEST OF INDUCTION GENERATOR WITH LAMP LOAD.

The induction generator was started as before, and a lamp load that could be varied put on, it, of course, being necessary to run the synchronous motor empty.

The load in lamps was varied from zero to the full load of the induction generator, with the results as shown in Figs. 6 and 7.

In calculating the results shown in Fig. 6 the watts supplied to the alternator running as a motor, and to the lamps, were taken as the output of the induction generator, the efficiency being this output divided by the input to the induction generator, and the power factor this output divided by the total apparent watts from the induction generator.

In Fig. 7 the fact that the energy delivered to the alternator and that required for the excitation of the alternator fields do no useful work is taken into account. So, in calculating the results in Fig. 7, the watts supplied to the lamps were considered as the output, the efficiency being this output divided by the input, and the power factor this output divided by the total apparent watts from the induction generator.

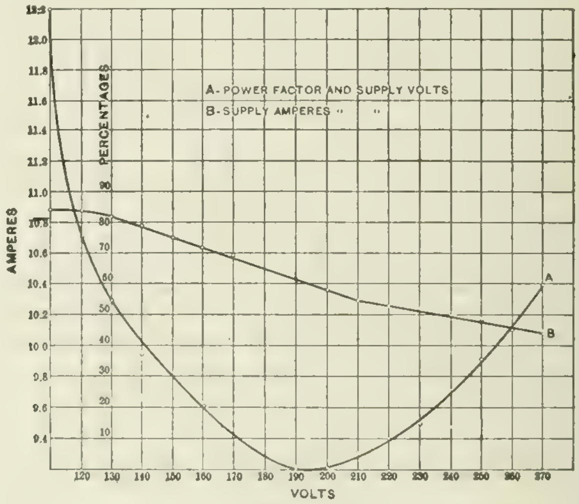


Fig. 5.

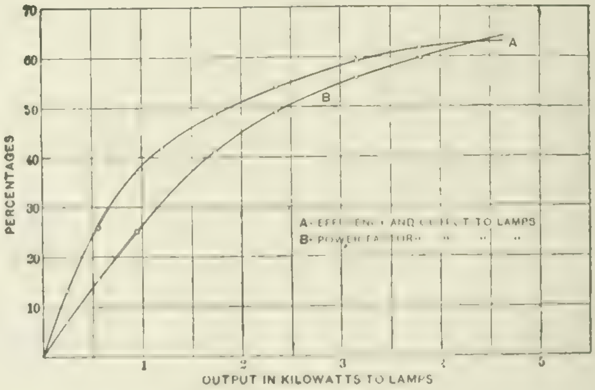


Fig. 7

SYNCHRONOUS OPERATION OF ALTERNATOR.

The speed of the induction generator was varied, the voltage of supply being maintained constant, and corresponding readings of speed taken on alternator running as a synchronous motor, which showed that motor ran in synchronism with induction generator. The results are shown in Fig. 8, the full line representing the synchronous speed line, the small circles the points found from readings.

In all preceding tests the belt connecting alternator to jack-shaft was thrown off, after the starting up of the induction generator. In the tests below the belt connecting the Ideal alternator to the jack-shaft was not removed.

TEST OF INDUCTION GENERATOR, FURNISHING CURRENT TO ALTERNATOR.

The induction generator was started up as usual, and its speed gradually increased from below synchronism to about 6 per cent.

above synchronism, readings taken as usual. The alternator was therefore run as a motor and helped to drive the jack-shaft.

The results are plotted in Fig. 9, which will be found by comparison to resemble the curves constructed by Mr. Steinmetz.

It is interesting to note in connection with this test the readings on the two wattmeters, as shown in Fig. 10.

At the beginning of the test, before the induction motor was speeded up, readings were taken on the two wattmeters, and as the power factor was below 50 per cent. the reading on one wattmeter (No. 2) was negative, hence its connections had to be reversed, and while its connections were reversed the difference of the two wattmeter readings represented the total true watts. As soon as current was turned on the shunt motor (insufficient, however, to make this machine act as a motor and drive the induction machine) the load on the induction motor was decreased, the power factor decreased, and the corresponding wattmeter readings are shown in Fig. 10.

On furnishing sufficient potential to the shunt motor to make it act as a motor, and drive the induction motor as a generator, the readings on wattmeter No. 1 diminished and finally became negative (necessitating a changing of its connections), while the readings on wattmeter No. 2 continue to increase as shown, and always negative. Under these conditions, the total watts will be the sum of the two wattmeter readings, and as the sum is negative, the induction generator is supplying energy to the Ideal alternator.

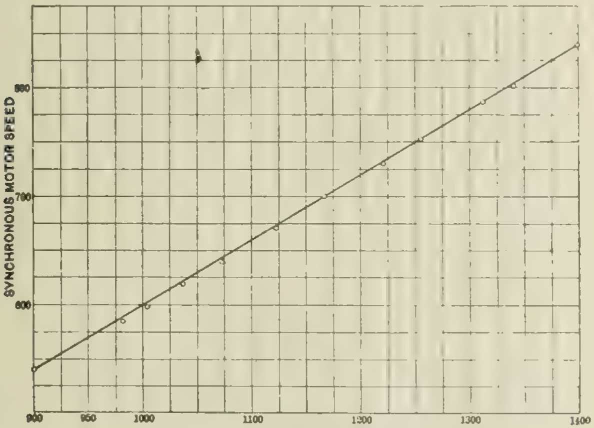


FIG. 8.

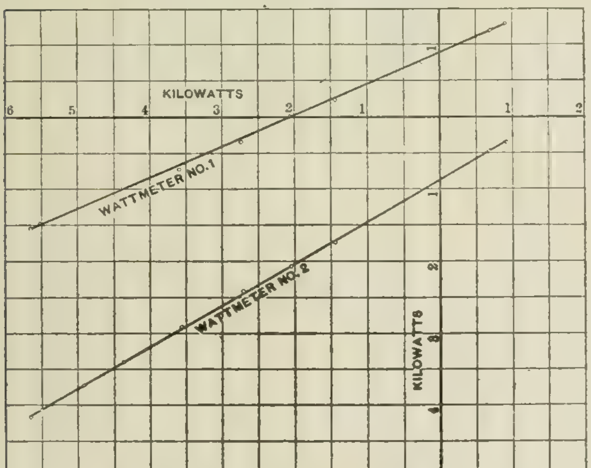


FIG. 10.

TEST WITH INDUCTION GENERATOR FURNISHING CURRENT TO IDEAL ALTERNATOR AND TO A BANK OF LAMPS.

This test is the same as the preceding one, except that a bank of lamps is connected to the three-phase terminals. At the beginning of the test the alternator furnished current to both induction motor and lamps, when on speeding up the induction motor, now running as a generator, supplied current to both lamps and alternator, which acts as a motor helping to drive the jack-shaft.

The results of these tests are shown in Fig. 11.

Curve *B* is plotted with induction motor output as ordinates and number of revolutions per minute above synchronism as abscissæ. At first the output is negative, which indicates that the motor is receiving energy from the alternator; at 11 revolutions per minute above synchronism it commences to act as a generator, and at 22 revolutions it is furnishing energy to both alternator and lamps.

As pointed out by Mr. Steinmetz, the induction generator can be run at different speeds and still the same frequency obtained from it. For proof of this a small induction motor was connected in the above test to the three-phase mains and run with no load. Variation of the speed of the induction generator from synchronism to 20 per cent. above synchronism did not in any way affect the speed of the little induction motor, its speed remaining constant, which was almost synchronous with the Ideal alternator.

Of course the above will not hold true when the conditions are as described in Fig. 8.

On attempting to make some tests with this induction generator as a single-phase instead of a three-phase machine it was found that the current required by the motor when running as a synchronous motor (with belt connecting alternator to jack-shaft thrown off) was excessive, so that this test had to be abandoned.

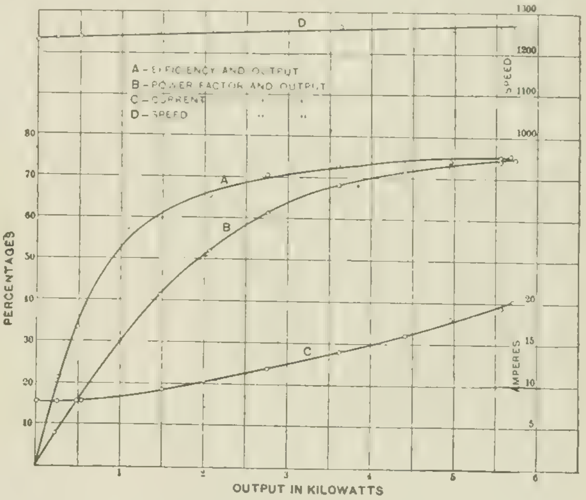


FIG. 9.

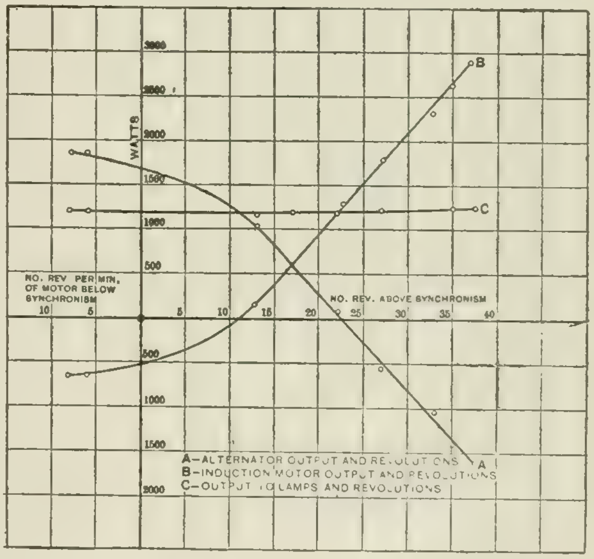


FIG. 11

USES OF INDUCTION GENERATOR.

The most probable use of the induction generator will be for boosting. Mr. Kelly has discovered (ELECTRICAL WORLD, March 20, 1897) that an induction generator, having its field coils in series with the mains, will act as a booster or feeder regulator, and that this action as a booster at any particular speed above synchronism will depend upon the amount of current supplied to the field magnets.

In order to use an induction generator as a booster the fields are connected in series with the main line, and the induction generator driven above synchronism. With no current flowing there will be no boosting action, but as soon as current flows the boosting action commences, its amount depending upon the current flowing in the mains, and this amount for a given current may be varied by varying the speed of the induction generator. So that by the use of an induction generator as a booster, we get a machine with no brushes, collector rings or commutator.

In case the induction motor should ever be used for the propulsion of street cars, its action as an induction generator, when driven above synchronism, could be taken advantage of in descending grades, thus pumping back energy into the line, doing away with braking to a great extent.

TEST OF INDUCTION GENERATOR AS A BOOSTER.

The induction generator and alternator used in the above experiments were connected in series as single-phase machines, with a bank of lamps and readings taken to determine its boosting action.

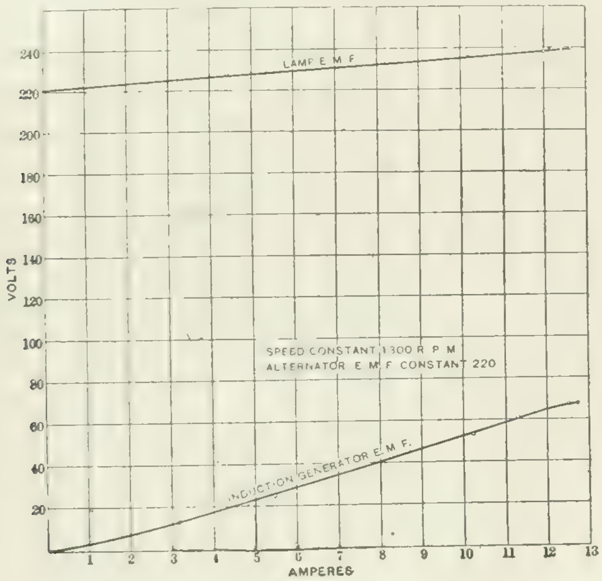


Fig. 12.

In the first test as a booster the speed was maintained constant at 1300 revolutions per minute (synchronous speed 1230), and the current flowing in the mains varied from zero to the full load current of alternator, by adding lamps in lamp board. The results obtained are shown in Fig. 12.

In the second test the speed of the induction generator was varied [illegible] the alternator E. M. F. being maintained constant, and also the number of lamps connected in series with [illegible]

The results are shown in Figs. 13, 14 and 15.

In Fig. 13 the results show that the potential difference around the induction generator terminals increased from 45 volts at rest to any value [illegible] of 1225 revolutions per minute, and that a slight increase in speed caused the machine to supply e. m. f., in equal amounts [illegible] generator. This change, it will be noticed, is very sudden, going from a negative maximum to a positive maximum in about ten revolutions. Several attempts were made to get intermediate points between these two maxima, but without success.

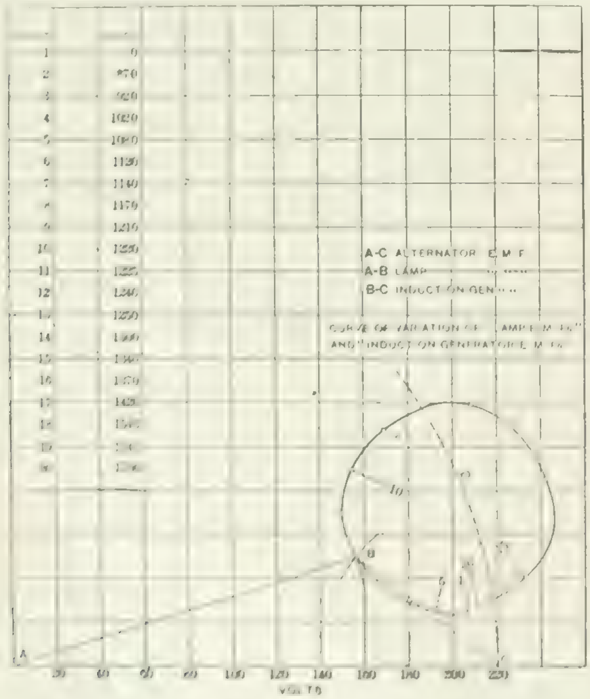


Fig 15

Fig. 14 gives the curves of amperes and "lamp e. m. fs.," this last expression being the potential difference around the lamp terminals.

Fig. 15 shows the variation of the "lamp" and "induction generator e. m. fs.," polar co-ordinates being used. For all points within the dotted arc, *D*, the induction generator causes a drop in potential, and for all points without this arc the induction generator supplies potential to the system. The method of construction of the curve is simply the location of the vertices of the different triangles of e. m. fs. In the figure the points of the curve are numbered and the corresponding speed readings given in table.

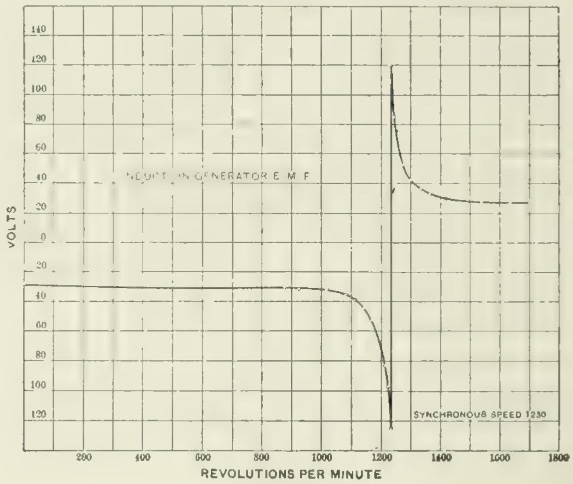


Fig 13

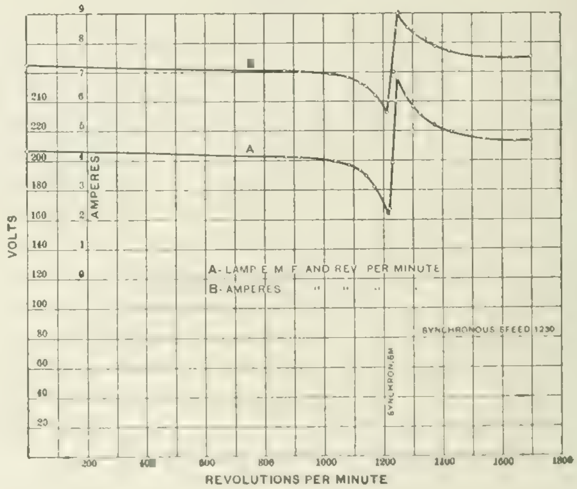


Fig 14

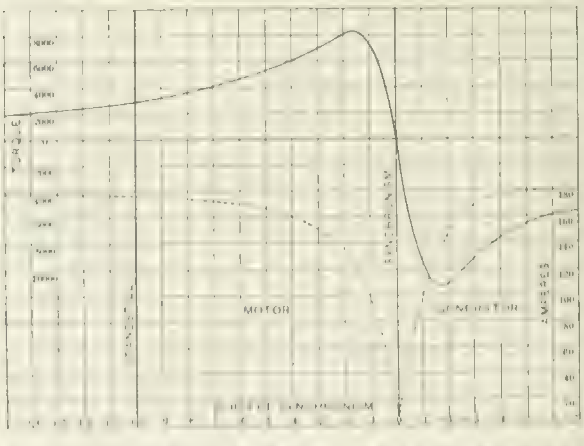


Fig. 16. Induction Motor Speed Curves. Z = 1 – 8 j Y — 01 + 1 j

It is interesting to note the similarity between the curves in Figs. 13 and 14 and the one for torque and slip, given in Fig. 16, taken from Mr. Steinmetz's paper on "Induction Motors." While the results, shown in these curves, were taken under somewhat different conditions, still the action, when the motor is driven near synchronism, is strikingly similar.

The Death of Dr. John Hopkinson.

The announcement came from Berne, Switzerland, on August 29, that Dr. John Hopkinson, the well-known English electrical engineer, together with his son and two daughters, was killed while ascending one of the high Alps without a guide. It is reported that the unfortunate persons fell over a precipice to their death. The dispatch does not give the date of the occurrence of the sad accident, but it presumably happened within a day or two of the date of the Berne information.

Dr. John Hopkinson was the eldest son of Mr. Alderman Hopkinson, of Manchester, and was born in the year 1849. In the year 1870 he graduated as Doctor of Science in the University of London, and in the following year he graduated at Cambridge with honors rarely obtained by one man.

Early in the year 1872 Dr. Hopkinson accepted the appointment of engineer to Messrs. Chance Brothers & Company's lighthouse works, near Birmingham, at which town he lived until 1878, when he moved to London, and began practice as an engineer on his own account—without, however, giving up his connection with the firm, a connection which resulted in many improvements in lighthouse work; notably what is known as the group flashing apparatus. After his removal to London he became widely known as an expert in patent cases.

Dr. John Hopkinson.

In the year 1877 Sir William Thomson communicated Dr. Hopkinson's first electrical paper to the Royal Society, and it was published in the "Philosophical Transactions." The paper dealt experimentally with the residual charge of the Leyden jar and the dielectric properties of different kinds of glass. In the course of this investigation he showed that the more highly conducting kinds of glass conduct electrolytically even at low temperatures. His next paper, published in the "Philosophical Transactions" of the same year, "On the Electrostatic Capacity of Glass," contained the results of an investigation carried out in order to test the truth of the conclusion deduced by Maxwell from his electromagnetic theory of light, that the product of the electrostatic capacity and the magnetic permeability of a transparent substance should be equal to the square of the refractive index for long waves.

During the years 1879 and 1880 Dr. Hopkinson read two papers of very exceptional importance, "On Electric Lighting," before the Institution of Mechanical Engineers. In the first of these he described a number of experiments made with a Siemens dynamo to determine its efficiency under varying conditions, and mapped out the relations between e. m. f. and current by means of curves, since called "characteristic curves." It was the nature of these curves which led the author to the discovery of the now well-known magnetic lag or hysteresis. Early in the year 1883 Dr. Hopkinson made some improvements in the Edison dynamo, which proved to be of exceptional importance in dynamo machinery. In the same year he was appointed to deliver before the Institution of Civil Engineers one of a series of lectures on "The Practical Applications of Electricity." His lecture was entitled "Some Points in Electric Lighting," and in addition to a most masterly general exposition of the subject he developed in it some very important points, such as the possibility of running two or more alternating machines in parallel. The theory of alternating dynamos was further developed in a paper on "The Theory of Alternating Currents," read before the Society of Telegraph Engineers in 1884.

Dr. Hopkinson received $90,000 from the Westinghouse Company, Ltd., for his British patents on the three-wire system of distribution, which he invented simultaneously with Edison in this country. These patents expired on July 27, 1896, a strong effort having been made to have them extended on the ground that special acts of Parliament had curtailed the life of the patents by six years. The application for extension was denied, however, on the ground that the benefits would be derived by the Westinghouse Company, and not by the inventor.

Dr. Hopkinson was elected as a Fellow of the Royal Society in 1878, and was also a member of the Senate of the London University. He was made president of the Institution of Electrical Engineers in 1890 and again in 1895. In his consulting engineering work he designed and superintended the construction of electric lighting installations in Manchester, Whitehaven and Stafford, and electric railway plants in Leeds and Liverpool. It is stated that Dr. Hopkinson had intended to sail for New York on September 28, on business in connection with a syndicate which was forming for the purpose of developing his inventions.

Not All Engines Are American.

To the Editor of The Electrical World:

Sir—In a recent issue of one of your contemporaries there is a very chatty and interesting article on electric traction in Paris. The description of the plant and its accessories is brilliant and catchy, and gives the reader a pleasant impression of the truthfulness and accuracy both of the writer's kodak and powers of observation. The half-tone illustrations are also well executed, but a "dead give away" on the writer, for one of my engineering friends was nearly paralyzed on coming to the description, which states emphatically: "I refer to the engine room. Three high-speed Armington & Sims engines are at present in use, but two more are shortly to be added." On turning to the cut, one glance showed why the engineer so nearly fainted, for it shows clearly that the station is equipped with three Willans engines, built by Willans & Robinson, of Rugby, England. As soon as the engineer recovered his breath he gave vent to his feelings as follows:

"What in the name of fair play and square dealing caused a reputable paper to publish an article like that. Apparently it is intended to give interesting data, which the average reader will accept as facts, and it then deliberately gives an American engine company credit for supplying engines which were built by a well-known firm of English manufacturers. Is this another case of American brag run wild in claiming 'everything in sight,' or is it simply a case of another American abroad trying to do 'Europe in fifteen minutes,' or had the correspondent remained so long in France that he had forgotten to read plain English and so could not decipher the English name plate on an English-made engine, or still worse, has the lively correspondent become so wholly absorbed 'in the study of electrical matters that he has neglected to post himself on steam engine construction sufficiently to enable him to distinguish between an English vertical, triple-expansion, transfer, high-speed engine and an American horizontal high-speed engine?' The query is, which?

An English Reader.

An Odd Improvement in Telephone Repeaters.

In the specifications of patent No. 609,374, issued August 16 to J. S. Stone, of the American Bell Telephone Company, it is claimed that telephone repeaters consisting of a receiver actuating a microphonic transmitter work much better when inclosed in a vacuum. Under this circumstance, to quote the specification, "the messages automatically transferred from one circuit to another are reproduced in the receiving telephone of the second circuit with a well-defined gain in volume or loudness and without any substantial distortion or offsetting loss in clearness or articulation."

DIGEST OF CURRENT ELECTRICAL LITERATURE
AMERICAN AND FOREIGN
By Carl Hering.

Dynamos, Motors and Transformers.

EXCITATION FROM HALF THE DYNAMO VOLTAGE. Sengel. "Elek. Zeit.," August 11.—A reprint of the complete paper of which a brief abstract was noticed in the "Digest" July 16 (some statements in that abstract were not correct). If any one point of a continuous-current armature winding be connected to a slide ring contact, then between this third brush and either one of the others there will flow a current which is always in the same direction, but whose voltage varies between the total voltage of the machine and zero; it will thus be a pulsating direct current whose mean voltage is half that of the voltage between the two main brushes. He gives a curve of this current and discusses it analytically, showing that it may be assumed to be the sum of a continuous current and of an alternating current. A self-induction placed in this circuit would have no effect on the continuous current element, but would tend to choke off the alternating current element; the insertion of a self-induction in that circuit, therefore, will afford a means of obtaining a practically continuous current. He then describes some applications of such a system, which enables a current of half the voltage to be obtained from a dynamo. It may be used, for instance, for a three-wire system by connecting the neutral wire to this third brush through a choking coil. The pulsations might be completely neutralized independently of the choking action of a self-induction coil, if a second alternating current equal to the alternating element in the main current be added to the main current, but shifted through 180°; this may be accomplished by a second slide-ring contact connected to a diametrically opposite point of the winding; this resolves itself to the well-known system of Dobrowolsky, in which two opposite points of a winding are connected through a choking coil, the middle of which is then connected to the neutral wire. It may also be done by similarly connecting three symmetrical points to the common point through choking coils, and this will give three alternating currents, differing by 120°. The system suggested by Ettingshausen is also quite similar to this one; in it there are two auxiliary windings connected to two diametrically opposite points of the armature, and thence to a slide ring on which the third brush rests; each of these windings embraces half the armature and half the number of windings as compared with the similar part of the main winding; the present author shows that a single auxiliary winding would accomplish the same purpose. A useful application of this method of obtaining half the voltage of the machine is to excite the shunt field between this brush and one of the others; it has the advantage that the wire of the magnet coil then has double the cross-section, and this is of importance with shunt machines for high voltages, especially for smaller machines; it diminishes the cost of material and construction of the field windings and utilizes the coil space to greater advantage. In the same way the system can be used to advantage for shunt motors; here it has the additional advantage that in starting the motor there will be the full voltage at the terminals of the field magnet, which means double the normal excitation, thus increasing greatly the starting torque; the voltage at the terminals of the field will vary from the full voltage to half of this as the normal speed is reached; the regulation from the double excitation to the normal is thus accomplished quite automatically without the need of resistances; moreover, this current also flows through more or less of the armature, and thus increases the armature current. Tests made confirmed the theories; a more detailed discussion is promised. The question arises whether the pulsating currents will be sufficiently dampened by the self-induction of the shunt field coil, so that there will be no appreciable variation in the magnetism, which involves losses in the iron. A test showed that about 5 per cent. of the energy was lost in this way; this loss will increase with the frequency.

ELECTRIC GENERATORS. Parshall and Hobart. Lond. "Engineering," August 12.—In this continuation of their long serial they describe the calculation of the magnetic circuit of a dynamo; this is shown very briefly by an example of a simple case; they prefer to calculate the ampere turns separately for each portion of the whole magnetic circuit and add these together, instead of making the laborious calculation of finding the total reluctance [illegible] the following [illegible] the number of pounds of [illegible] is also given, showing experimentally determined, no no-load sat- [illegible]

THREE-PHASE MOTORS WITH SHORT-CIRCUITED ARMATURES. [illegible] "Elek. Zeit.," August [illegible]

lustrated description of the Boucherot system referred to in the "Digest" February 19, 26, April 16, June 11, 18.

ROTARY TRANSFORMERS. Marchena. "L'Ind. Elec.," August 10.—The first part of an article in which he intends to discuss in as simple a manner as possible and without involved mathematics the properties of rotary converters with special reference to electric traction. The present portion is introductory, comparing the relative advantages of three-phase transmission direct to the cars for long-distance lines, and the system in which the three-phase current is transformed at substations into continuous current; he shows that the advantages are in favor of the latter method, the former being of advantage only on long lines carrying light trains at frequent intervals, when the power house can be a single station at which the energy is developed cheaply—that is, if the question of efficiency is not important, but where the attendance is to be minimized; but in nearly all other cases it will be more advantageous to use the second method—that is, to transmit the energy in the form of three-phase current and use it as continuous current. In this system the present tendency is to use rotary converters combined with static transformers, as distinguished from a synchronous motor coupled to a generator; it reduces the cost of the sub-station and the efficiency is higher, while the cost of operation is lower.

MAGNETIC LEAKAGE IN TRANSFORMERS. Kapp. "L'Ind. Elec.," August 10.—A long abstract of the article noticed in the "Digest" May 7.

TRANSFORMER PATENT.—Lond. "Elec. Eng.," August 12.—A reprint in full of the Zipernowski-Deri British patent, which is claimed to be the fundamental transformer patent and is about to be used to extract royalties from those using transformers in England.

Lights and Lighting.

ILLUMINATION OF INTERIORS. Thompson. "Zeit. f. Beleucht.," August 10.—An article somewhat similar to the one by the same author noticed in the "Digest" May 28; it contains more curves. He gives the results of measurements made of the illumination in a closed room with different kinds of shades around the incandescent lamps; the results are given in curves, together with the theoretical curve. He seems to have obtained good results with the inverted conical shades, reflecting the light onto a white ceiling; these shades should intercept all direct light from the filament; the less the difference in the illumination of the different parts of the room, the more agreeable was the illumination; the light through ground glass is not as pleasant as through opal glass; large spherical globes completely inclosing the lamp gave very good results, and admit of artistic effects. The best distribution was obtained with the inverted conical shades of an angle of 90° and made of frosted glass in preference to opal glass. A light of 16 candle power, which can be raised or lowered, is quite sufficient to light a table with 2.6-feet candles and the room with 0.5-feet candles, if a spherical frosted glass shade is used; ground glass pear-shaped globes give much light, but are too intense—the diffusion is not sufficient.

ECONOMICAL CARBONING OF ARC LAMPS. Clarke. "Elec. Eng.," August 25.—A note stating that lamps may be so carboned that a double lamp will run two nights of fourteen hours each, thus reducing the number of trimmers to one-half; he claims that for some unaccountable reason few lighting stations are aware of this fact. It is accomplished by using five-eighths-inch plain carbons in the upper holders and half-inch copper-coated carbons in the lower, and then reducing the current from 9.5 to 9 amperes. It will necessitate slight alterations in the adjustments of the lamps.

WELSBACH LAMP FILAMENT.—"Elec. Eng.," August 25.—A brief account of the osmium filament invented by Welsbach, descriptions of which were noticed in the "Digest" some months ago.

Power.

SINGLE-PHASE MOTOR PLANT. Geist. "Elek. Zeit.," August 11.—A short article describing the plant at the wharves at Cologne. All the trains, lifts, etc., in the municipal docks are run with hydraulic power, the water for which is pumped by means of single-phase motors of 70 horse power, the power for which is obtained from the central lighting station in the form of a 2000-volt single-phase alternating current; this is transformed down to 220 volts, at which it is used in the motors. The 70-hp motors consist of a chief motor and a starting motor on the same shaft, between which there is also a fast and loose pulley; the starting motor is wound as a two-phase motor and appears to develop about [illegible] horse power, which brings the main motor up to speed in about [illegible] minutes; its armature is short-circuited and the motor is on the end of the shaft which projects beyond the bearing. Only a single switch is necessary for the large motor; its armature is also short-circuited; at its best power—namely, 50 horse-power—it has an efficiency of 87 per cent. The method of operation is described; the pumps are driven through a countershaft; the motor is started without load; the action is automatic, the motors being regulated by a device operated by the hydraulic accumulators; the power is applied gradually, and produces no objectionable effects on the central station net work. He thinks there is no question that there is economy in thus obtaining the power from a large central station.

MACHINE TOOLS.—"L'Ind. Elec.," August 10.—A short, illustrated description of several direct-driven machine tools, as used in the Siemens & Halske factory.

SMALL INDIVIDUAL MOTORS.—"Elec. Eng.," August 25.—A short article describing briefly the application of very small motors in a factory where telephone coils are wound; the installation is of interest on account of the fineness of the sub-division of the power. Each operator has a small motor and the coil to be wound is placed directly on the shaft; the operators can be placed where light is good instead of having the place selected in reference to the shafting; the speed is more perfectly under control and consequently better work can be done.

NIAGARA POWER.—"West Elec.," August 20, and "Elec. Eng.," August 25.—A short note on recent progress at this station, the first named journal containing a number of illustrations.

Traction.

CONTACT BAR. Stobrawa. "L'Elec.," August 13.—A French translation, with the illustrations, of the article noticed in the "Digest" June 12; see also July 30.

MIDDLESBROUGH.—Lond. "Elec. Rev.," August 12.—A well-illustrated description of the electric railway plant extending to Stockton and Thornaby. (See also The Electrical World of August 6, page 137, for a full, illustrated description of this plant.)

CORK. Griffin. Lond. "Elec. Eng.," August 12.—A reprint of a recent paper giving an illustrated description of the railways.

HIGH-SPEED MAIL SERVICE.—"Elec. Eng.," August 25.—A brief description of the McGurty electric mail and express railroad system, of which a series of tests were made at Jersey City Heights during the past three weeks on a model circular track 0.25 miles in length. There is to be no attendant on the car, the control being automatic and from the stations. It is proposed to run 120 miles per hour, but in the model the speed attained was only 18 miles per hour; the car is intended to be 30 feet in length and have a capacity of 40,000 pounds; it appears that alternating-current motors are to be used.

ACCUMULATOR TRACTION IN PARIS.—"Sc. Am. Sup.," August 20.—A translation of a short, illustrated article from "La Nature," describing the combined trolley and accumulator line in Paris.

RAILWAY LINES AND RETURNS. Pepper. "El'ty," August 24.—A reprint of the paper noticed in the "Digest" July 23.

Installations, Systems and Appliances.

THREE-PHASE EXTENSIONS OF CONTINUOUS-CURRENT PLANTS.—Lond. "Elec.," August 12.—A note stating that at Manchester the system advocated by Wordingham is about to be tried on a small scale. Some of the outlying districts of the present continuous current station are to be supplied with low-pressure continuous current for distribution on a three-wire system at 400 volts between the outers; the continuous current from the central station bus bars will be transformed by rotary and stationary transformers into a 5000-volt three-phase current, which will be converted back to a low-pressure continuous current at the sub-stations; the present extension is for 600 kilowatts.

DISTRIBUTION FROM CENTRAL STATIONS.—"West. Elec.," August 20.—A reprint in full of the discussion of Wagner's and Ferguson's papers read before the National Electric Light Association in June.

DAY LOAD. Economy. "Can. Elec. News," August.—A short article, in which he advocates a combination with the city water works, so that the spare power during the day could be used for pumping water.

Wires, Wiring and Conduits.

RULES AND REGULATIONS FOR HIGH-PRESSURE INSTALLATIONS.—Lond. "Elec.," August 12.—A reprint in abstract of the German rules noticed in the "Digest" August 20. (In that abstract the word "insulators" should read "installations.") In an editorial some criticisms are made; the rules allow the frames of generators to be insulated from the earth if precautions to insulate the attendant are also taken; this is not approved editorially, and it is thought that it would involve very little hardship if it were required that the frames of all machines and transformers should be earthed; another rule goes to the other extreme and requires that unless the floor in front of the switchboard is uninsulated the switch itself must earth the outside circuit on its disconnection. To specify that all overhead wires are to be bare is a new departure, but is probably intended to do away with any false sense of security given with the light insulated covering often used on such wires, especially in America. Regarding the conventional symbols hope is expressed that they will be ignored in favor of those now in use.

INSULATOR.—Lond. "Elec. Eng.," August 12.—An answer to a request to describe an insulator for out-door use which will stand a pressure of 2000 volts and carry 50 pounds.

INSULATED WIRE SPECIFICATIONS.—"Ind. Rub. World," August 1.—A reprint of the general specifications issued by the United States Navy and in force since March, 1897, for all classes of insulated wire required for the ships of the navy.

WIRING OFFICE BUILDINGS.—"Can. Elec. News," August.—An illustrated description of a system devised by Strickland by means of which a suite of offices can be interchanged from one meter to separate meters, or the reverse.

ALUMINUM VS. COPPER AND BRASS FOR ELECTRICAL CONDUCTORS. Hunt. "Sc. Am. Sup.," August 20; reprinted from the "Aluminum World."—An article pointing out the advantages of aluminum as compared with brass and copper, for conductors.

Electro-Physics and Magnetism.

EFFECT OF TEMPERATURE ON THE RESISTANCE OF STEEL. Chatelier. "L'Ind. Elec.," August 10.—An Academy paper giving the results of investigations of the effect of temperature on the electric resistance of steels. The effects of the temperature of the tempering process are shown by a table of figures; when the temperature of the tempering was 950° C. the resistance was tripled; 750° C. is the temperature at which tool steels are usually tempered. The results show that the tempering alters the resistance only if the temperature has exceeded that of recalescence, namely 710° C.; this temperature is that which is required to change the mechanical properties; the resistance then increases with the temperature of the tempering to a value which is higher the richer the steel is in carbon; the increase of specific resistance in iron due to the presence of carbon is about 45 microhms-cm for 1 per cent. of carbon, or 7 microhms-cm for 1 atom in 100; this is the same increase which he noticed previously for silicon. The effect of the presence of other bodies than carbon was then investigated, notably tungsten and chromium; their effects are quite different, for at high temperatures chromium increases the rate of increase of resistance due to the tempering of carbon steels, while tungsten diminishes this; this leads him to believe that chromium, after the tempering, remains, in part at least, as a mixture like nickel or manganese, while tungsten remains isolated in the mass of iron.

LONGEST HEAT RAYS. Rubens and Aschkinass. "Wied. Ann.," No. 6; abstracted in the Lond. "Elec.," August 12.—They entered a step further into the region where the spectrum joins the Hertzian wave system and attained a wave length of 0.067 mm, which is 100 times the wave length of red light and 60 or 70 times smaller than the smallest electromagnetic waves yet produced—namely, 4 mm; the gap between these, therefore, remains to be bridged. The property of these long heat rays is more closely akin to those of electromagnetic waves than to waves of light.

POLARIZED ELECTROMAGNETIC WAVES. Latrille. "Wied. Ann.," No. 6; abstracted in Lond. "Elec.," August 12.—He considers an analogy between the electromagnetic and light waves in the transmission through slits. A slit exerts a polarizing action on the electromagnetic wave and transmits most easily the component perpendicular to itself; more energy is transmitted as the slit is increased in length, but not in proportion to the length; when the width is increased from 5 mm upward the energy increases slowly at first and then more rapidly up to a certain limit. A coherer responds more readily to vibrations parallel to its axis than to those perpendicular to it.

THEORY OF THE ETHER. Larmor. "Proc. Roy. Soc.," No. 398; abstracted briefly in the Lond. "Elec.," August 12.—An article in the form of a supplement to his third memoir on the electrical theory of the ether, in which he deals with the a priori difficulties encountered in the conception of orbital systems of electrons moving through a practically stagnant ether.

RADIOGRAPH TUBES. Bonetti. "L'Ind. Elec.," August 10.—A very short Academy note. By varying the state of the gas in the interior of the bulb he succeeded in obtaining a lower resistance and thereby was enabled to use tubes which had become "hard" and were no longer of use. The method he used was to maintain a platinum wire at a red heat inside of the tube; the current was 2 to 3 amperes at 4 volts, and with this he obtained excellent results.

X-RAYS. Kalischer. "Elek. Zeit.," June 30, July 7 and 14, August 4 and 11.—The continuation and conclusion of his long series (see "Digest" July 9).

TANGENTIAL SCREENING. Du Bois. "Wied. Ann.," No. 6; abstracted from the Lond. "Elec.," August 12.—He discusses the possible type of screening action in which the lines of force are parallel to the surface of the screen, as distinguished from the case previously considered, in which they are perpendicular to the screen. The simplest case is that of a straight wire carrying a current and surrounded by an iron tube. He uses the toroid of revolution as the typical body. If such a screening action existed a perpetual-motion machine might theoretically be constructed by introducing the pole of an infinitely thin magnet into the magnetized toroid through the narrow, equatorial section, where it would revolve in a circle forever.

TERRESTRIAL MAGNETISM IN AUSTRIA. Trabert. "Zeit. f. Elek.," August 7.—A review and discussion of the report of Lizner on the new observations of the earth's magnetism in Austria-Hungary, under the auspices of the Imperial Academy of Science, which supplied the funds.

HYDRAULIC ILLUSTRATION OF WHEATSTONE BRIDGE. Hallock. "Science," August 19.—An illustrated description of a hydraulic analogy to illustrate the action of the bridge. The resistances are introduced in the form of clamps around a rubber hose; a capacity is represented by an aspirator bottle connected to the tubes; a self-induction, by coiled rubber tube; the galvanometer, by two vertical parallel manometer tubes; the apparatus is horizontal and a stream of water passes through it.

RADIOGRAPHIC APPARATUS.—"Sc. Am. Sup.," August 20.—A reprint from a German paper of an article giving an illustrated description of some improved apparatus made in Germany.

Electro-Chemistry and Batteries.

CALCIUM. Moissan. "L'Ind. Elec.," August 10.—An abstract of an Academy note in which he shows that metallic calcium may be obtained in the form of crystals or melted globules by electrolyzing fused iodide of calcium at a dull red heat; this salt conducts quite well at that temperature. The negative electrode is pure nickel, while the positive consists of a cylinder of graphite in the centre of a porous cup; the temperature is maintained by the current at about the fusion point of this salt.

ELECTROLYSIS OF ZINC SOLUTIONS. E. A. "L'Elec.," August 13.—An abstract and discussion of a long paper by Ashcroft read before the English Society of Mining and Metallurgy, describing his extended experience with his process on a large scale for a number of months, at the Broken Hill mines in Australia. This process was finally abandoned.

ACCUMULATOR CONSTRUCTION. FitzGerald. Lond. "Elec. Eng.," July 22 and August 12.—In this continuation of his long serial he continues the discussion of the cell mentioned in the last section (see "Digest" August 6), which, in some respects, is a new departure and some of the details of which are still kept secret. He then contrasts some striking points of the traction cell recently described and some English cells, with special reference to the weight of the electrolyte. He holds that a density of 1.264 is perfectly safe in the case of a traction battery, but that a lower density is preferable for a battery which remains at rest for comparatively long periods; by using less acid at a greater density there will be an enormous reduction in weight of the transportable battery, and this saving in weight is much more important than the conductivity of the electrolyte. He then discusses the calculation of the bulk of a cell of a given capacity.

ELECTROLYTIC THEORIES. Edser. Lond. "Elec. Eng.," August 12.—In this continuation of his serial he discusses reversible cells.

STORAGE BATTERY DEVELOPMENT AND APPLICATIONS. Appleton. "Proc. Eng. Club" of Philadelphia; a long abstract is given in the "Elec. Rev.," August 24.—A paper read before that society; it is general in character, describing briefly recent large plants installed by a certain company and pointing out briefly the advantages of an auxiliary accumulator plant under various circumstances. The main portion of the paper refers to electric vehicles. The paper is descriptive in character, and contains very little data.

UTILITY OF PRIMARY BATTERIES.—"Elec. Rev.," August 24.—A reprint of the editorial noticed in the "Digest" last week.

CARBORUNDUM.—"Amer. Mach.," August 11.—An illustrated description of the method of manufacturing this material.

TREATMENT OF ORES CONTAINING PRECIOUS METALS. Webber. "El'ty," August 24.—The beginning of a reprint of the paper noticed in the "Digest" February 19, 26, March [illegible]

Units, Measurements and Instruments.

SUBMARINE CABLE TESTS. Murphy. Lond. "Elec.," August 12.—An article on the interpretation and correction for leakage of conductor resistance tests of submarine cables. He shows that the normal observed conductor resistance of even a perfect cable may differ materially from the true resistance, and that the conductor resistances cannot be properly compared until they have been corrected for leakage as well as temperature. He deduces [illegible]

PRIMARY BATTERY TESTS. [illegible]

VALUE OF A RESISTANCE. Ayrton. "Sc. Am. Sup.," August 27.—A reprint of his article noticed in the "Digest" December 18, 1897, on "Our Knowledge of the Value of a Resistance."

ELECTRICAL RESISTANCES. Atkinson. "El'ty," August 24.—The beginning of a reprint of the paper noticed in the "Digest" May 14; see also May 28.

Telegraphy, Telephony and Signals.

TELEPHONE DISTRIBUTING SYSTEMS. Baumann. "Elek. Zeit.," August 4 and 11.—A long article in which he calls attention to the insignificantly small number of connections which a subscriber makes, as compared with the possible number of connections which he could make with all the other subscribers, and he then shows how greatly the work at the central station may be diminished by various modifications in the distributing system of wires. There are, for instance, many cases in which two subscribers have very frequent communication with each other, and if this were accomplished by direct wires connecting them it would save the central station all those calls; moreover there are many local groups of subscribers who hold many of their communications between each other; these might be directly connected each with the other, and besides have facilities for connecting to a common wire station; in some cases it would suffice to connect only one of two subscribers to the central and have a separate connection from that subscriber to the other; moreover a number of the groups might be connected with each other directly; some subscribers would rarely, if ever, have any need of being connected with the central station; a subscriber might also be connected directly with a number of these groups. A number of such groupings are discussed and illustrated. With such modifications as these the construction and operation of the central station would become very much simpler and cheaper.

AUTOMATIC EXCHANGE SYSTEM.—Lond. "Elec.," August 12.—A brief, illustrated description of a modification in the form of an extension of the system referred to in the "Digest" June 4, so that it will now accommodate up to 10,000 subscribers; it is provided with what is termed the bridging system.

HERTZIAN TELEGRAPHY.—Lond. "Elec. Rev.," August 12; reprinted without the illustrations in "El'ty," N. Y., August 24.—A well-illustrated description of the Ducretet apparatus recently described before the International Society at Paris and referred to in the "Digest" June 25 and July 9.

HERTZIAN WAVE TELEGRAPHY.—Lond. "Elec. Rev.," August 12.—A reprint in abstract of the English Lodge and Muirhead patent, No. 18,644, 1897.

TIMING TELEPHONE CALLS. Abbott. "Elec. Eng.," August 25.—A long article discussing the relative merits of the different methods and appliances used in the United States; these are divided under six heads, the one which he appears to consider the best being the calculagraph system, to which the greater part of the article is devoted. The calculagraph is an instrument which makes a printed record of the time elapsed, mechanically subtracting the time of connection from the time of disconnection, and printing the result on a ticket; the operator has merely to pull a lever at the start and the finish. He points out the advantages of this instrument; it is in use at a number of exchanges and is admitted to be a decided improvement; it is accompanied by a reform in the operating methods, and this is its chief element of value; it has been introduced quite generally into the exchanges of the Bell companies in the past two years.

PARTY TELEPHONE LINES. Miller. "Elec. Eng'ing," August.—The beginning of an illustrated article on the general subject of party lines—that is, those running to more than one subscriber; the various systems are classified, described and discussed.

TELEPHONY IN SWEDEN.—"West. Elec.," August 20.—A note, with some illustrations, showing the systems of ducts used by the Stockholm Company, which is rebuilding its system and consolidating three exchanges into one.

EFFECT OF TELEGRAPHIC WORK ON HEALTH.—"Elec. Rev.," August 24; reprinted from the Lond. "Lancet."—An abstract of a paper by Hull, giving an unfavorable account of the effect of telegraphic work on the health of the operators; he thinks this work is responsible for many bodily ailments. The prevalence of phthisis among telegraphers is shown in a table by Garland, which was given as evidence before a royal commission; it shows the comparative percentage of mortality from respiratory diseases; the average for all adult males, deaths after fifty-five years not included, is 24.4; for telegraphers, 50.5; and for cutlery grinders, 57.3.

RELAY RESISTANCE. Hewett. "Teleg. Age," August 16.—A discussion of the question of the relay resistance, the energy expended and the static condition of the line. He concludes that in order to improve the working efficiency of a heavily loaded line more energy must be expended where it will do most good, and that place is in the line; with high resistance relays the expenditure of additional energy will usually make the matter worse.

MANILA CABLE. "West. Elec.," August 20.—A chart and a table of distances of the system of cables connecting Hong Kong and Washington.

BLOCK SYSTEM. Hope. "Teleg. Age," August 16.—A brief, general review of the block system as applied to railroads.

Miscellaneous.

PARIS EXPOSITION.—"L'Ind. Elec.," August 10.—A reprint of the official documents concerning the conditions governing the installation and operation of electrical exhibits at that exhibition. Editorially, attention is called to the limitations of the voltage and frequency; if the installation is complete in itself—that is, includes all the wiring and receptive devices—then no limit is placed on the voltage or frequency. The administration contributes but little toward the expenses of the installations; a group for 1500 horse-power, for instance, will receive $1,800, which is about one-tenth of the cost of the installation; the proportion is about the same for the cost of operation.

RESISTANCE OF THE HUMAN BODY. Dubois. Lond. "Elec. Eng.," August 12; reprinted in "El'ty," N. Y., August 24.—An abstract of his recent French Academy paper, referred to in the "Digest" August 20. He described experiments on the duration of the variable period of current flow when the difference of potential is applied to the human body. He concludes that during the period of variable current the body presents a reactance much smaller than the ohmic resistance; its capacity partially annuls the resistance; the resistance, however, during the variable period of the current is constant; it increases with the length of the parts of the body in circuit and depends on the surface of the electrodes; the body acts as a condenser with a liquid dielectric having a capacity equal to about 0.165 microfarads.

SMALL ELECTRIC FURNACE. Hopkins. "Sc. Am. Sup.," August 27.—A well-illustrated description of a small laboratory furnace adapted to be connected to a 110-volt circuit; he gives detailed instructions for the production of calcium carbide and other directions for the construction and operation of such a furnace. One of the main features is that three arcs are used in series in the same furnace, there being three carbons opposite three others, and by this means only a short length of resistance wire is required. Very successful results were obtained with this furnace, and many metallurgical processes were carried on. A 12-ampere fuse in each leg of the current is sufficient; the carbon electrodes may be separated 3.5 inches without extinguishing the triple arc. It appears that the furnace is easily constructed.

CONVENTIONAL DIAGRAMS. Van Orden. "Teleg. Age," August 16.—A short discussion of the diagrams suggested by the Chicago Elec. Assn. as far as they apply to telegraphy. He does not favor them, claiming that they are too simple and depend upon a key for their interpretation, therefore failing of their purpose. He reproduces what he calls the old methods in a parallel column (these, however, require a comparatively large amount of draughting).

"ELECTRICAL ENGINEERING."—This journal, published in Chicago, has changed hands, and is now called "Electrical Engineering and Telephone Magazine." It is published on the 15th day of every month. Its policy has been radically changed, as one of the principal objects will be to give, in an impartial and unbiased manner, accurate information of the progress made in the independent telephone field throughout the United States. The new editor is C. E. Kammeyer.

A Line of Presses for the Manufacture of Armature Discs.

The requirements of armature work for electric motors and dynamos have led to the construction of presses which differ in essential points from those used for other styles of sheet metal work, and the representative group of such presses, built by the E. W. Bliss Company, 12 Adams Street, Brooklyn, N. Y., shown below, is of particular interest as embodying the types of many of the machines used in the manufacture of armature discs.

The press shown in Fig. 1 is specially designed for simultaneously cutting the inside and outside of plain rings, with or without key notches, such as is shown on the floor in the illustration. It will do work of this class up to 21 inches in diameter. The rings or discs as they come from this press are ready for notching by means of the machine shown in Fig. 3. The press may be also used for simultaneously punching the notches on discs up to 10 inches outside diameter or more, if the developed cutting edge does not become too great. The press is supplied with an automatic knockout.

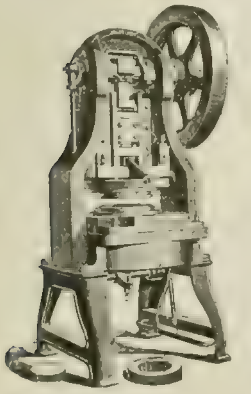


Fig. 1.

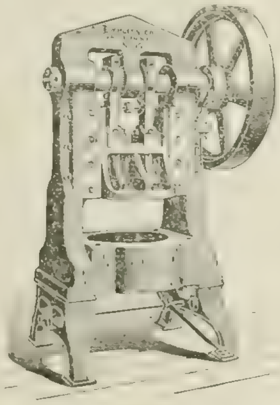


Fig. 2.

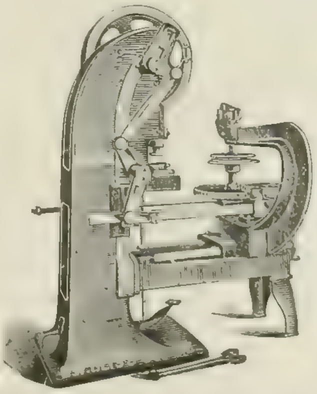


Fig. 3.

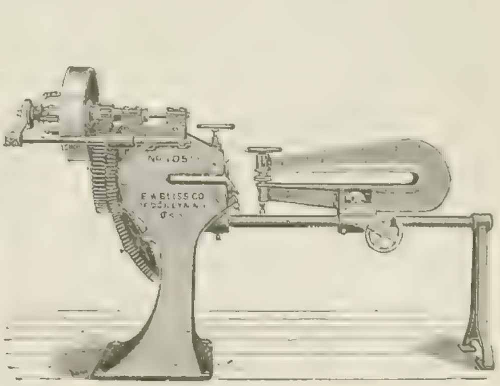
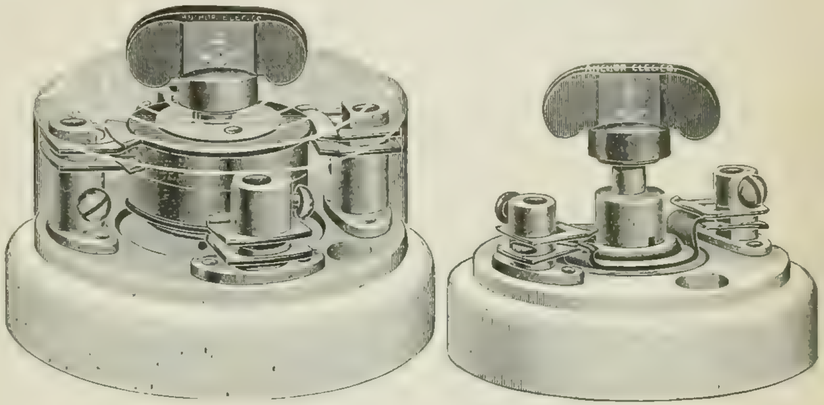


Fig. 4.

The "Stiles" double-crank power press, Fig. 2, is extensively used in the manufacture of armature sections, and embodies a number of special features which have not heretofore been used in connection with presses of this class. It is made in a number of sizes weighing from 1600 to 25,000 pounds. It is sometimes supplied with a positive knockout for punch and die, making the press specially adapted for cutting the entire armature disc (outside, inside and notches) in one blow, and for that class of work is employed on discs up to 11 or 12 inches in diameter. Beyond that size it is usually furnished with back gearing and sometimes with a body of cast steel instead of cast iron. It may, however, also be used for plain rings, and in that case is designed to take in up to 24 inches diameter. It is also a useful machine for cutting the smaller sections for armatures for large generators, in which case the outside of the sections and holes in same are mostly punched in one operation.

The "Bliss" automatic notching press is illustrated in Fig 3. This machine is of entirely new design, and offers several important advantages over other machines of this class. It is made in three sizes, with or without clamping arm, weighing from 1500 to 3000 pounds, and is adapted for automatically notching with great accuracy discs of from 3 to 60 inches in diameter.

The shear shown in Fig. 4 is specially designed for cutting the inside and outside of armature discs. It is very carefully built throughout, so as to meet the demand for a tool of greater accuracy and strength than the ordinary cheaply built shears in the market. The angular position of the lower cutter permits of making as clean a cut on the inside as on the outside of the discs. It will cut circles up to 60 or 72 inches in diameter.



Some Improved Snap Switches.

The "Stiles" power punching press is also much used for electrical work, being adapted for nearly every kind of blank cutting, punching, perforating, forming, bending, etc.

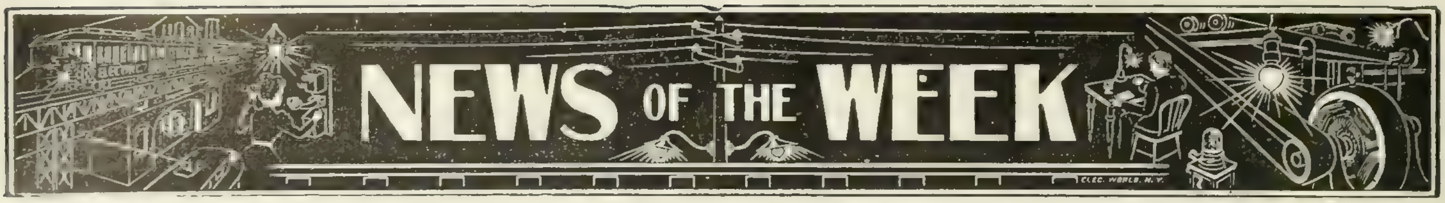
If a more detailed description is wanted of any of these machines the Bliss Company will take pleasure in giving any further information that may be required. This company has had almost unlimited experience in the manufacture of tools for producing armature discs and other sheet-metal electrical parts and fittings, and will be pleased to correspond with any one interested.

Improved Snap Switches.

The new designs of Anchor snap switches, one size of which is illustrated in the cuts shown above, and which are being manufactured by the Anchor Electric Company, of Boston, possess several noticeable improvements in this class of circuit breakers.

The covers are completely insulated on the inside by heavy bristol board, which extends below the edge, preventing the possibility of arcs or short circuits through the cover. Another common difficulty, the stripping of threads in the binding posts, is overcome by drilling the wire holes eccentrically, which gives abundant threads for the binding screws.

In the single-pole switch the spring is covered with a dome, which, at the same time, serves as a long bearing on the spindle for the moving contact. In the double-pole switch, the insulating separator, composed of a new heat-resisting and strong material, completely envelops the moving contacts (which are loose and move to accommodate themselves to the knife contacts on the binding posts), preventing all chance for the arc following along the edge, a fault common in many styles of snap switches. Long life in the mechanism is insured by constructing all the working and non-current-carrying parts of nickeled steel. These switches have been approved by the National Board of Fire Underwriters, after exhaustive tests.


ELEC. WORLD, N. Y.

NEWS OF THE WEEK

Financial Intelligence.

THE METROPOLITAN STREET RAILWAY COMPANY, of New York, has declared a dividend of 1¼ per cent. on the present capital stock, payable October 25.

OPPOSITION TO THE GENERAL ELECTRIC CAPITAL REDUCTION.—The owners of about 10,000 shares of the preferred stock of the General Electric Company have taken steps to prevent if possible the carrying out of the plans recently approved by the joint action of the preferred and common stockholders to cut down the capitalization. It is claimed that this is a direct spoliation of the interests of the preferred stockholders in favor of the interests of the common stockholders. The next step in the proceedings will be the filing of the answer to the bill brought by counsel for the committee, after which the court will set a date for a hearing, probably in November.

BROOKLYN RAPID TRANSIT.—It has been announced that this company has total fixed charges to the amount of $2,045,000 annually. For the year ending June 30, 1898, during which time it had been operating over the Brooklyn Bridge but four months, the company earned over and above the operating expenses $2,112,500, or $67,000 more than the present fixed charges. Since the end of the fiscal year the increases are stated to have averaged from $2500 to $3000 per day gross. Estimating an average daily gross increase for the year of $1500, of which two-thirds may be assumed to be net, this would give a net return of something over $430,000 for Brooklyn Rapid Transit stock, which would be equal to a little over 2 per cent. on the par valuation.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
9 Murray St., NEW YORK, August 28, 1898.

THE KINGSBRIDGE EXTENSION.—The ditch excavated in the Kingsbridge road on the upper part of Manhattan Island in December, 1896, for the construction of a street railroad is at last to be filled in. Judge McAdam has directed the commissioner of highways to commence work within thirty days. The trench was excavated by the Third Avenue Railroad Company, but the franchise was objected to by the Metropolitan Street Railway Company, and litigation has been carried on in the courts ever since. Abutting property owners have attempted again and again to get the matter settled, but hitherto without success.

THE SECOND ANNUAL OUTING of the employees of the Conduit Wiring Company, New York, Davis & Brussel, successors, was held August 21 at Donnelly's Grove, College Point, L. I. A most enjoyable day was spent in bowling, land and water races, etc. Among the visitors were Messrs. Olson and Harrington, of the Habirshaw Wire Company; Mr. Scribner, of the Bryant Electric Company; Mr. Kirkland, of the American Circular Loom Company, in addition to representatives of most of the large supply houses in New York. Mr. Davis, of the firm, was also present, and took an active interest in the games and other diversions. Messrs. Fenton, Koehler and Bennett were the committee in charge of the affair.

NEW ENGLAND NOTE.

Branch Office of THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
Boston, Mass., August 26, 1898.

THE TUNNEL TO EAST BOSTON.—The Boston Transit Commissioners gave a public hearing on August 23 on the question of routes for a tunnel or tunnels to East Boston. The appropriations which have been made for this purpose are insufficient to construct a tunnel connected with the subway, as many had hoped could be done, and are barely sufficient to run from Maverick [illegible]

PHILADELPHIA NOTE.

[illegible]

[illegible]

BUFFALO AND NIAGARA FALLS NOTES.

[illegible]

[illegible]

[illegible] asked to bid on the furnishing of the cables, which will cost from $25,000 to $30,000 before they are laid.

A MONSTER TRAVELING CRANE for carrying steel vessel plates from the forge to the dock is now in service in the yard of the Union Dry Dock Company. It is operated by Westinghouse type C induction motors. The use of electricity in the plant is to be extended further by the substitution of electrically driven pumps for the present steam pumps, for discharging the docks.

A BALL-BEARING RUNNING GEAR for street cars has been invented by Harvey Hoag, of Buffalo, who has interested the Buffalo company so much in its merits that a car on one of the lines has been equipped with it, and is running apparently with entire success. There are forty-six half-inch balls used to the bearing. The inventor claims that more than half the power is saved by the invention, and that it requires next to no oil.

THE BUFFALO GENERAL ELECTRIC COMPANY has under consideration the adoption of the Thomson recording two-rate wattmeter, one of which has been received and is undergoing test. By means of this meter it will be possible to give a cheaper rate to customers who use electricity, but who can take it at off hours of the day. The great demand for lights is from 4 to 9 P. M., which adds to the actual cost of furnishing the current. The meter is made to record on one or the other dial by self-winding clockwork.

THE NEWLY OPENED LOCKPORT TROLLEY LINE is a great success. Manager Van Horn reports that he has made the trip of about 28 miles in an hour and thirteen minutes, half an hour of which has to be taken up inside of Buffalo. The road now owns the Kenmore line, having bought it this week on a mortgage foreclosure. Though the railroad commissioners refused to permit the road to take in the Kenmore line by forcing a way across the steam roads in the northern part of the city it will yet be used in some way as part of the entire system. The passenger cars of the Lockport line are the largest in use, and are equipped with 200-hp motors, the line to Niagara Falls owned by the same company having only 120-hp motors. A speed of 50 miles an hour has been developed between Tonawanda and Lockport. The freight motors, which are similar to those used by the Baltimore & Ohio road, are four to a car of 100 horse-power each.

MILWAUKEE NOTES.

MILWAUKEE, Wis., August 26, 1898.

THE BADGER STATE LONG-DISTANCE TELEPHONE COMPANY of Baraboo has extended its line to Kilbourn, a distance of 14 miles.

A FRANCHISE was granted by the Council of Durand, Mich., to the Long Lake, Durand & Corunna Street Railway Company. The power house and car stables will be located at Durand. The road will run from Corunna to Detroit.

ST. LOUIS NOTES.

ST. LOUIS, Mo., August 25, 1898.

SHOOTING HOLES IN CABLES.—Vandals have been shooting holes in the lead casings of the Kinlock Telephone Company's overhead wires. The Bell Telephone Company has also suffered. Efforts are being made by both companies to locate the miscreants.

THE STRIKE OF THE LINEMEN of the Missouri-Edison Electric Light Company is still on, but many of the striking linemen are weakening. About forty went to work last Monday, and more will very likely soon follow. The strikers, however, say they will not give in.

CITY LINES TO GO UNDER GROUND AT ONCE.—The lighting committee of the board of public improvements has decided to go ahead with the work of burying the wires despite the fact that the specific ordinance providing for their burial has not been passed, though the money has been appropriated to pay for the work.

THE PRESIDENT OF THE LINEMEN visited the managers early this week and was received courteously by each one. In each instance he was informed that no men were needed, and that work was slack. The managers seemed willing to talk the matter over, and a conference may be held. The linemen say the firms are being crowded with orders, and that they attempt to hire all men who apply for work.

PACIFIC COAST NOTES.

SAN FRANCISCO, Cal., August 21, 1898.

THE SUNSET TELEPHONE & TELEGRAPH COMPANY recently received 685,000 pounds of copper wire, the greater part of which will be [illegible] the telephone circuit in Sacramento, Cal., under ground. [illegible] rapidly, and probably in less [illegible] California, Oregon, Washington and Idaho will be joined by one long-distance system. Conversations can then be carried [illegible] Idaho, a distance of [illegible] miles.

THE SAN FRANCISCO GAS & ELECTRIC COMPANY was finally awarded the city street lighting contract for the term of two years from Au[illegible] both gas and electric services [illegible] The [illegible] company was the only one that could comply with such terms. There will be a large increase in the number of arc lights for street illumination and a corresponding decrease in the number of [illegible] The San Francisco Gas & Electric Company, in anticipation of the increased demand for electric lighting, has installed four additional 100-kw direct-current generators on its three-wire system, and six additional 150-light arc machines at the arc lighting station. Additional overhead wires are being strung for the use of the street service.

THE SNOQUALMIE FALLS POWER COMPANY, which recently let contracts for four 1500-kw generators to the Westinghouse Electric & Manufacturing Company, intends to keep the details of the "Snoqualmie Impeller Type" wheels, which are being constructed, a secret until they are put into operation. They are said to be neither turbine nor impact wheels, and their aggregate capacity is to be 12,000 horse-power. The head of water is 270 feet. Included among the supplies and apparatus, for which contracts amounting to $350,000 have been let, are 22,000 Imperial porcelain insulators for 25,000-volt circuit, 5000 barrels of cement and 150,000 pounds of aluminum-copper wire. There will be 1½ per cent. of pure Lake copper in the 500 miles of circuits, which will supply Seattle, Tacoma and way points with electric power. It is reported that the Knight Water Wheel Works, of Sutter Creek, Cal., are to build ten large wheels for a Western electric installation.

CANADIAN NOTES.

OTTAWA, Ont., August 26, 1898.

THE WEST KOOTENAY POWER & LIGHT COMPANY is now delivering 1000 horse-power in Rossland, B. C., from its generators at Bonnington Falls, 30 miles away.

THE PROPOSED ELECTRIC RAILWAY between the towns of Lanark and Perth, Ont., is being revived. The subscribed capital is now said to be sufficient to build the road, and the company undertakes to complete it by April 1 next.

THE TOWN OF DUNDAS, Ont., will give a franchise for fifteen years to an electric lighting company, of which George H. Harper is managing director, the town to have 150 incandescent lamps and four arc lights. The lights will cost the town $1100 per annum.

AN ELECTRIC RAILWAY FROM MONTREAL TO ST. BRUNO will be built by a number of Montreal gentlemen, who have purchased a mountain at St. Bruno, in the Chambly district, about 10 miles from Montreal, and propose spending a large sum in improvements.

THE ELECTRIC RAILWAY SYSTEM will not be extended from Quebec to Montmorency this year, but everything will be got in readiness during the winter to change the motive power of the entire railway from Quebec to Cap Tourment from steam to electricity next spring.

ANOTHER HEAVY TRANSACTION IN ELECTRIC PROPERTY is on foot in the Province of Quebec. Following the absorption of the Quebec District Railway Company by the Quebec, Montmorency & Charlevoix Company, the latter is about to acquire the property of the Montmorency Power Company, which furnishes the city with electric light and the street railway cars with their motive power. It is understood that the purchase price is $1,250,000. A meeting of the Quebec, Montmorency & Charlevoix Electric Railway Company will be held on September 13 to ratify the purchase. The shareholders of the power company will receive a handsome premium on their stock, which will be 25 per cent. of its value in cash, while they will also raise in the stock of the Quebec, Montmorency & Charlevoix Railway an amount equal to their stock in the Montmorency Power Company.

ELECTRIC TRANSMISSION FROM THE WELLAND CANAL TO TORONTO.—Mr. Henry Symons, Q. C., has recently returned from England, where he had estimates prepared for the construction of the proposed works of the Welland Power & Supply Canal Company. This project involves the construction of a canal from the Welland River to the brow of the mountain at Thorold, Ont., a distance of 8 miles; the construction at Thorold of a power house, and from Thorold to Lake Ontario a raceway by which to carry water into the lake. In addition to these different works estimates were obtained for the construction of a transmission line from Thorold to Toronto by way of Burlington Beach. The estimates obtained by Mr. Symons were prepared by Dr. Hopkinson, one of the leading electricians of Great Britain; Sir Douglas Fox, Edmund Wragge, late of Toronto, and W. C. Unwin. The estimate for the machinery to generate 100,000 horse-power is £125,000; for transmission line to Toronto at a voltage of 10,000 and delivery of 50,000 horse-power, £801,600; for excavation and other work connected with the undertaking, £1,525,062. The total estimate therefore amounts to £2,452,162, or roughly speaking, $12,000,000. If the amount to be delivered in Toronto is reduced to 20,000 horse-power the project would cost $1,000,000 less. S. Pearson & Son, contractors, state that if the contract could be secured from the cities of Toronto and Hamilton for a considerable quantity of power, for a definite term, there would be little difficulty in raising money for the project by bonds and shares in Great Britain.

ENGLISH NOTES.

(From Our Own Correspondent.)

LONDON, August 17, 1898.

THREATENED TRANSFORMER PATENT LITIGATION.—Mr. Martin D. Rucker, who has made a name for himself in the flotation of cycle companies, has brought up the famous Zipernowsky-Déri patent, which has now only one year to run, and he threatens to proceed against all the alternating current supply stations for infringement, and to enforce the payment of certain royalties to him. Proceedings are already being commenced against the London Electric Supply Corporation, and the municipalities which have alternating plants have decided to combine with this company and some of the other supply companies to resist the claim, and if necessary to fight the matter on appeal to the House of Lords. In electrical circles it seems to be the general opinion that Mr. Rucker will have very little success in his new speculation.

THREE-PHASE EXTENSIONS AT MANCHESTER.—A system of three-phase high pressure generation and transmission, combined with low pressure distribution, is to be used in Manchester on some extensions which are being made. The system at Manchester is a continuous current five-wire system at 400 volts between the outers, and in parts a three-wire system at 400 volts between the outers. Continuous current from the central station bus-bars will be transformed by means of rotary and stationary transformers into a 5000-volt three-phase current, and then will be conveyed to sub-stations in the new district in question by means of three-core cables. There it will be converted back into low pressure continuous current for distribution on the three-wire system at 400 volts between the outers. The initial plant will only be of 600-kw capacity.

CONDUIT EXPLOSIONS.—Two serious conduit explosions occurred last week, one in Regent's Park, London, and the other on the circuits of the Oldham Corporation electric lighting undertaking. Both were due to the leakage of gas into the ducts from broken gas pipes. In Regent's Park, which is on the circuit of the St. Pancras Vestry's electric light station, three heavy manhole covers were blown out, and a length of 200 yards of bare strip conduit was seriously damaged. In this case it is especially remarkable that such a serious explosion should have occurred, as there are no less than four ventilating shafts in the 200 yards of conduit, and the matter can only be explained by the gas having accumulated with great rapidity just previous to the explosion. The faulty gas pipe crossed the conduit at a point 70 yards distant from where the explosion occurred, and at this point there were workmen engaged in searching for the leakage. It is possible that it was here that the ignition took place, in which case the flame must either have run along the conduit or else along the surface of the road. It will be remembered that a few years ago similar explosions occurred on the St. Pancras mains, the cause of these having been traced to insufficient ventilation of the ducts and the formation of sodium on the surface of the insulators, which caused the ignition of the accumulated gas. Now, however, the mains are laid on a much better principle, highly glazed three-lipped insulators are used, and no traces of sodium were found after the explosion. At Oldham 50 yards of pavement were torn up, and here the ignition was caused by the turning off of the switch in the base of an arc lamp-post. The only damage to person was at Oldham, where a woman was injured on the knee.

THE TELEPHONE QUESTION.—The committee of the House of Commons which was appointed to inquire into the telephone question with a view to recommending whether municipalities should be granted licenses on a similar footing to that granted to the National Telephone Company has issued its report. Although it appears there was a sort of understanding between the National Telephone Company and the Post Office that no competition with the former should be instituted, except in such districts where the telephone service was proved to be inefficient, the committee reports that there is no legal reason why new licenses should not be conceded for a term equal to that originally conceded to the company. It recommends that licenses should be given under certain conditions to municipalities, but that these should lapse to the Post-Office in 1911, at the time when the National Telephone Company's license lapses. Among the conditions to be imposed are that all new systems are to have double wires and to be erected in accordance with the regulations of the Post Office. The committee recommends that the Post Office should insist upon complete uniformity of systems so far as the differing conditions of the different localities permit, and that both a maximum and minimum rate should be imposed, so that on the one hand the municipalities should have no inducement to carry on the service at a profit, and on the other hand the Post Office may be protected against a reduction of rates to a point that would involve an unremunerative service after 1911. A royalty of 10 per cent. of the gross profits is to be paid to the Post Office; the same royalty that the National Telephone Company now pays. The Post Office itself will now probably start active competition in some districts, the main object, it appears, being to lessen the value of the National Telephone Company's business by the time its license expires. The disadvantages of a competing telephone service, which have been felt in the States for some time past, will now be experienced in this country, it seems for the next twelve years, until the Post Office has acquired the whole system of telephones, as it should have done nearly twenty years ago.

General News.

NEW INCORPORATIONS.

THE KEYSTONE ELECTRIC CONSTRUCTION COMPANY, Tunkhannock, Pa., has been formed with a capital stock of $10,000.

THE MOUNTAIN HOME & WEST PLAINS TELEPHONE COMPANY, of Arkansas, has filed articles of incorporation in Missouri. The capital stock is $5000.

THE NEW ROCHELLE TELEPHONE COMPANY, New Rochelle, N. Y., has been organized for the purpose of dealing in telephones and telephone supplies.

THE MIDLAND TELEPHONE COMPANY, Adrian, Minn., has been formed with a capital stock of $50,000. Daniel Shell, of Worthington, is one of the incorporators.

THE WINCHESTER & LEXINGTON TELEPHONE COMPANY, Vine Grove, Ky., has been incorporated, with a capital stock of $1650, and the chief incorporator is T. C. Vanmeter.

THE PERRY TELEPHONE COMPANY, Duquoin, Ill., has been incorporated with a capital stock of $12,000. Among those interested are C. L. Downey, Robery O. Lehn and J. J. Dewey.

THE MORROW ELECTRIC LIGHT & POWER COMPANY was incorporated by the same persons and with the same amount of capital as the Loveland Power & Electric Light Company.

THE NORTH PARK TELEPHONE COMPANY, Walden, Col., has been incorporated by Montie Blevins, J. O. Mosman, George F. Scott, C. E. Mosman and M. C. Ward. The capital stock is $5000.

THE CITIZENS' TELEPHONE COMPANY, of Spartanburg, S. C., has been incorporated with a capital stock of $8000. The officers are: W. H. Clark, president; C. E. Fleming, manager and treasurer.

THE CENTRAL DAKOTA TELEPHONE COMPANY, Aberdeen, S. Dak., has been incorporated with a capital stock of $50,000. The incorporators are J. L. W. Zeitlow, E. G. Porter and W. H. Anderson.

THE DUNKIRK & REDNEY TRACTION COMPANY, Dunkirk, N. Y., has been incorporated with a capital stock of $75,000. Among those interested are Henry C. Bittingsley, C. A. Hanable and R. H. Hasbrouck.

THE SAGINAW & FRANKENMUTH RAILWAY COMPANY, Saginaw, Mich., has been incorporated with a capital stock of $50,000. The new company will build an electric road between Frankenmuth and Saginaw.

THE AMERICAN TELEGRAPH & TELEPHONE COMPANY, Little Rock, Ark., has been incorporated with a capital stock of $10,000. The incorporators are Clifford H. Strong, Gray Carroll and Thomas S. Busbee.

THE LOVELAND POWER & ELECTRIC LIGHT COMPANY has been incorporated at Columbus, Ohio, with a capital stock of $10,000. The incorporators are I. W. Newcomer, C. C. Stickelman, W. H. Stubbs, H. A. Coyne and R. B. Corwin.

THE PEOPLE'S TELEPHONE EXCHANGE has been organized at New Richmond, Wis. The officers for the first year are: President, Charles N. Gorham; vice-president and manager, A. J. Presson; secretary, William Hughes; treasurer, Dr. Epley.

THE PERRY ELECTRIC LIGHT, HEAT & POWER COMPANY, Newport, Pa., has been formed with a capital stock of $13,000. The incorporators are A. D. Van Dyke and S. S. Lelby, Marysville; J. K. Van Dyke and L. H. Smith, Philadelphia, and J. S. Lelby, Newport.

THE MARYLAND TELEPHONE & TELEGRAPH COMPANY, Baltimore, Md., has been incorporated with a capital stock of $30,000. It is said to be the intention of the company to purchase the interest of the Interstate Telephone Company, which now conducts the principal telephone system in Frederick.

THE KEESEVILLE ELECTRIC COMPANY, Chesterfield, Essex County, N. Y., has filed articles of incorporation with the Secretary of State. The directors are Orville S. Morse, Henry K. Prime and A. W. Boynton, Keeseville; George F. Morse, of Peru, and Henry E. Barnard, of Plattsburg. Capital stock, $30,000.

THE BROCKTON & WHITMAN STREET RAILWAY COMPANY, Brockton, Mass., has been incorporated for the purpose of connecting, the two places named by an electric railway. The directors are Col. J. J. Whipple, Albert Davis, Whitman; Benjamin S. Atwood, C. Waldo Dyer, F. C. Kingman, Horace Kingman and William Jones.

THE ROCHESTER & SODUS BAY RAILWAY COMPANY, Rochester, N. Y., has been organized for the purpose of operating an electric railroad to Sodus Bay. The officers of the new company are: President, T. J. Nicholl; vice-presidents, first, J. C. Tone, second, Walter B. Duffy; treasurer, John H. Gregory; secretary, Charles Van Voorhis. Capital stock, $1,000,000.

THE TELEGRAPH AND TELEPHONE.

INDIANAPOLIS, IND.—The New Telephone Company has certified to an increase of capital stock to $400,000.

PEORIA, ILL.—A new telephone line is to be put in between Peoria and Springfield, via Petersburg and Delavan.

LANCASTER, WIS.—The Wisconsin Telephone Company has been granted a franchise to establish an exchange in this place.

POLO, MO.—The Bell Telephone Company has purchased the Kingston and Hamilton telephone line, and will put it in first-class shape.

ROBY, TEX.—The Roby & Sweetwater telephone line has been purchased by Hughey, Green & McCrea, who will at once make a connection with Abilene and other outside points.

TIFFIN, OHIO.—The Ohio Telephone Company has begun the work of stringing its line to Bettsville to connect with the Home Telephone Company of this city. Connection will be made with Fort Seneca.

[illegible], N. Y.—A new metallic circuit telephone line between this place and Gibsons has just been completed. It is intended to extend the line to Wayne, Tyrone and other points in Yates and Schuyler counties.

MANKATO, MINN.—The Mankato Citizens Telephone Company has [illegible] for [illegible] a telephone plant in this city to H. M. [illegible]. The contract is to be completed within ninety days.

SPRINGFIELD, [illegible].—The Cumberland Telephone & Telegraph Company [illegible] and White House. The completion of this line gives Springfield telephonic communication with every [illegible]

LUBEC, ME.—An exchange has been recently opened at this place and [illegible] and Whiting. [illegible] Eastport and [illegible]

SPOKANE, WASH.—The Inland Telephone & Telegraph Company has [illegible]

ELECTRIC LIGHT AND POWER.

[illegible] & Co., of Reading, Pa., have been granted a franchise to construct and operate an electric light plant [illegible]

[illegible].—The City Council has passed an ordinance granting to the Helena Water & Electric Power Company a franchise allowing it to deliver electric power in the city.

KOKOMO, IND.—Three applications for receivership have been filed against the Citizens Electric Light & Power Co., with claims aggregating $12,800. The company is capitalized at $40,000.

WHEATON, ILL.—The city of Wheaton is considering the purchase of the local electric light plant. The city now pays $3000 per year for electric light, and has been offered the plant for $20,000.

NEWPORT NEWS, VA.—The City Council has granted to the Newport News & Old Point Railway & Electric Company a franchise to operate an electric light plant here for a period of fifty years.

COHOES, N. Y.—By the terms of the new contract for lighting the streets of Cohoes, which will go into effect on September 1, the rate will be $33 per light less per year, making a saving of $4,752 per year.

HACKENSACK, N. J.—The Hackensack Gas & Electric Company has received a franchise to wire the borough of Delford, the Delford Electric Light Company having surrendered the franchise recently granted to it.

CHICAGO, ILL.—The Commonwealth Electric Company has purchased from the Calumet Gas Company the latter's electric plant at Garfield Boulevard and Wallace Street, and the part of the plant at Ninety-sixth Street and Erie Avenue, South Chicago, for $500,000.

SEDALIA, MO.—The property of the Sedalia Water & Light Company was sold to a syndicate composed of H. C. Warren, of New Haven, Conn.; E. Burr, Jr., and H. M. Knapp, of Bridgeport, Conn, and four local capitalists. The consideration is said to have been $400,000.

ST. LOUIS, MICH.—Sealed proposals for the construction of a dam and power house and the installation of water power and steam power apparatus and an electric light plant will be received by the board of public works of St. Louis, Mich., up to 8:30 P. M. September 9, and then publicly opened and read. Mr. E. Z. Burns is the consulting engineer.

WESTERVILLE, OHIO.—The Westerville Electric Company has been incorporated and has secured the contract with the town for ten arc lights and fifty 32-cp incandescent lights for five years. Also about 500 private lights will be put in to start with. The 220-volt system will be put in with a 40-kw dynamo. Mr. E. S. Aldrich, No. 11 Wesley Block, Columbus, Ohio, will be elctrical engineer in charge, and wishes prices on a 40-kw generator, ten 220-volt lamps, 6000 pounds waterproof wire and all supplies necessary to complete the plant. Lights are to be burning before November 1, 1898.

THE ELECTRIC RAILWAY.

WALTON, N. Y.—The right of way for an electric road from Margaretville to Andes has been secured.

CORUNNA, MICH.—The Long Lake, Durand & Corunna Electric Street Railway Company has been granted a franchise to operate an electric road in Durand.

CLEVELAND, OHIO.—The County Commissioners have granted a franchise for the extension of the Euclid Avenue line through Euclid Heights Boulevard.

SPRINGFIELD, OHIO.—Work has been commenced on the Springfield and Dayton electric line, and it is expected that the road can be completed within ninety days.

BROCKTON, MASS.—It is proposed to connect Brockton and Whitman by an electric railway, the Brockton & Whitman Street Railway Company having been formed for this purpose.

CATSKILL, N. Y.—The Catskill Electric Railway Company has at last been granted permission to increase its capital stock from $30,000 to $400,000. This increased stock was asked for in order to enable the company to construct an electric road from Catskill to Cairo.

ELIZABETH, N. J.—The Union County Chosen Board of Freeholders, in consideration of $250,000, has granted a franchise to John Kean, to build an electric road from this city to Plainfield, a distance of 12 miles. The term of the franchise is seventy-five years.

BLOOMINGTON, ILL.—The Bloomington & Normal Railway Company, as successor to the Bloomington City Railway Company, has negotiated a mortgage with the Illinois Trust & Savings Bank of Chicago, as trustee, to secure an issue of $250,000 first mortgage 5 per cent. bonds.

SAGINAW, MICH.—Judge Snow has filed an order authorizing the sale of the Consolidated Street Railway property to satisfy a claim held by the Boston Safe Deposit & Trust Company, in trust, amounting to $253,719, exclusive of all prior claim on account of receivers' certificates, amounting to $30,000.

HUDSON, N. Y.—The Hudson street railway has been purchased by Charles Cooper, of Brooklyn, who represents the Brooklyn Traction Company. He also secured a controlling interest in the Kinderhook & Hudson Steam railroad, running between Hudson and Niverville, a distance of 18 miles. It is said that the latter will be converted into an electric line and run in connection with the Hudson city road, which will be extended to Philmont. The consideration for the property and franchise is placed at $500,000.

BROOKLYN, N. Y.—Negotiations are in progress between the Brooklyn Elevated Railroad Company and the Brooklyn Heights Railroad Company, looking to a traffic arrangement by which the former will be able to operate its new trolley routes to Bensonhurst and Bath Beach. The plan is to have the Heights road continue its Avenue C route across the Ocean Parkway and down Sixteenth street to the Eighty-sixth Street line, and thence through to Bath Beach and Bensonhurst, the elevated road making a connection by means of an inclined plant at Thirty-sixth Street.

BROOKLYN, N. Y.—The work of stringing the electric wires on the old elevated railroad structure at Coney Island is rapidly nearing completion, and it is expected that everything will be in readiness by September 1. The Brooklyn Heights Railroad Company secured control of the property formerly belonging to the Sea View Elevated Railroad Company last July, and immediately commenced work on the structure in order to make it secure for the heavy trolley cars. The Sea View Company went out of business a few years ago, and until last June nothing in the way of any business had been done on the line.

NEW YORK, N. Y.—Judge Cohen, of the Supreme Court, has appointed a receiver for the New Paltz & Walkill Valley Railroad Company, on the application of the directors for the voluntary dissolution of the corporation. The bond of the receiver was fixed at $50,000, and the order to show cause was set down for December 1 next. The road extends from the tracks of the West Shore Railroad at Highland, N. Y., to the village of New Paltz. The company was incorporated January 16, 1897, with a capital stock of $150,000. The total liabilities are said to be $185,730, and the nominal assets $154,196.

LEGAL NOTE.

THE CONDICT CONTROLLER PATENT.—Judge Lacombe, of the United States Circuit Court for the Southern District of New York, on August 25 issued preliminary injunctions on the Condict patent controlled by the General Electric Company against the Nassau Electric Railroad of Brooklyn, enjoining the further use of the electric car controllers, which were made by the Steel Motor Company, and against the Walker Company, enjoining its manufacture of the several types of series parallel car controllers made by it. The operation of this injunction is suspended until the next session of the Court of Appeals to give the defendants an opportunity for appeal. This is the same patent recently sustained at final hearing by Judge Townsend in a suit against a user of Walker controllers.

PERSONAL NOTE.

MR. F. E. DRAKE, of the Walker Company, has been selected as electrical adviser to Commissioner General Ferdinand Peck of the United States to the Paris exposition of 1900. Mr. Drake sails for France with the commissioner general and party on the steamer La Touraine from New York on September 3. He expects to return to this country about the middle of October, and will then resume his duties with the Walker Company.

Trade and Industrial Notes.

THE AMERICAN CIRCULAR LOOM COMPANY has moved its New York office and storeroom to the Hamilton Building, corner Thames and Greenwich Streets, where the New York agent, Mr. H. B. Kirkland, will carry a full stock of electroduct.

THE ILLINOIS ELECTRIC COMPANY states that it is now in a position to furnish an incandescent arc lamp for direct or alternating current. The company guarantees these lamps in every respect, and asks the trade to secure its prices before placing orders elsewhere.

MR. V. C. GILPIN, 120 Liberty Street, New York, metropolitan representative of the Cutter Electrical & Manufacturing Company, of Philadelphia, states that the C. S. and I-T-E specialties, manufactured by his company, continue to grow in popular favor with the electrical trade.

MESSRS. CHARLES WHITE AND ARTHUR R. MIDDLETON have purchased from Mr. Louis S. Houghton his interest in the business carried on under the style of the White & Middleton Gas Engine Company, of Baltimore, Md., and will continue the manufacture of gas engines under the same firm name.

THE BEACON LAMP COMPANY, New Brunswick, N. J., guarantees that its 3.5-watt lamps will maintain their average initial candle power for 300 hours or more. A free sample lamp may be obtained by any station manager by addressing the company. Such samples can be tested scientifically, or, in the absence of photometric instruments, a dozen Beacon lamps may be placed in service, and run 300 hours; at the end of this time, half of the lamps may be taken off and replaced by new lamps of Beacon or other makes. It will then be found, the company states, that the remaining lamps which have been in service will give as much light as, if not more than, the new lamps.

WHILE IRON OR STEEL ARMORED CONDUIT is being used to the exclusion of almost everything else in new conduit work, there is nevertheless some work where iron armored conduit can not be used. The most satisfactory substitute under such circumstances is Canvasite flexible conduit. This is particularly useful in wiring or rewiring old buildings, and in difficult and out-of-the-way places in new buildings. The Electric Appliance Company, of Chicago, is carrying Canvasite flexible conduit in all sizes, from one-fourth inch to 1¼ inches, and finds that it has a ready sale for the above mentioned uses.

THE C & C BRUSH HOLDER.—In an article in THE ELECTRICAL WORLD of July 23, 1898, entitled, "Some Modern Brush Holders," the reaction brush holders as designed by Mr. R. N. Baylis and various modifications of the same were described. The form of this holder used by the C & C Electric Company was one of these modifications, and the C & C Company, fearing that it might be understood that this was used under license from Mr. Baylis, wishes it stated that it is used by proprietary right, Mr. Baylis being at the time he developed this brush holder the chief engineer of the C & C Company, and materially assisted by that company in making experiments necessary to the perfection of this holder. On this account also the C & C Company was the first to adopt this improvement.

AT THE RECENT MEETING of the National Association of Fire and Police Telegraph Superintendents and Municipal Electricians a committee consisting of William Brophy, inspector of wires, Boston, Mass.; M. W. Mead, superintendent bureau of electricity, Pittsburg, Pa.; George F. MacDonald, superintendent fire alarm, Ottawa, Canada; F. C. Mason, superintendent police telegraph, Brooklyn, N. Y., and W. N. Thompson, superintendent fire telegraph, Richmond, Va., made the following creditable report on the exhibit of the Montauk multiphase cable: "We find properly located and connected up one fire-alarm box, arranged so as to be operated from an auxiliary sub-station; also the proper arrangements and connections for automatically sending in an alarm of fire by means of multiphase cable, a fusible wire being burned through or cross connected by contact with a slight blaze or fire such as a match might cause. On the application of a very slight fire from a match the multiphase cable was cross connected, thus throwing on an additional current of electricity, the composite wire was melted, thus opening properly another line, relieving a light current, which had previously been in operation. By these simple means, the main box was pulled, the alarm struck on a local gong attached to the circuit, a warning bell rung to indicate that the line was in operation, and the instantaneous sounding of its alarm showed that all claims as to the merits of the purpose and operations of the apparatus had been fulfilled. It is simple in action, and reliable as a fire alarm adjunct. The Montauk multiphase cable is practically a substitute for a thermostat, and this cable being run in out-of-the-way places, or in dangerous localities in buildings where fire is liable to occur, really makes a continuous thermostat, ready at all times for action in case of fire or dangerous heat at any point where the cable runs."

THE AMERICAN EXHIBITORS' AGENCY COMPANY for the Paris Exposition of 1900 has been incorporated under the laws of the State of New Jersey with a capital stock of $500,000, and has established general offices in the Commercial Cable Building, 20 and 22 Broad Street, New York, with a branch office in Paris. The purpose of the company's existence is indicated briefly in its title and explained more completely by the following statements of what the company proposes to do: 1st, To take the entire charge of exhibits from the moment they are ready for shipment until they are returned to their owners after the close of the exposition. 2d, To make all the preliminary arrangements, secure appropriate space, pay all charges for freight, insurance, customs, etc., and meet all other necessary expenses upon exhibits. 3d, To put exhibits in place with all necessary appliances, properly display them, care for them, bring their merits duly to the attention of visitors and juries of award, carefully repack and reship them at the close of the exposition, and give them in all respects the same personal care and attention they would receive from the exhibitors themselves. 4th, To act as agents for the sale of the various wares at the exposition, and to take orders for both the purchase and sale of all kinds of goods, wares and merchandise for its patrons. As this company will, in the execution of its functions, combine the representation of a large number of exhibitors, all outlays for salaries and expenses of separate special agents of individual exhibitors will be avoided. By its having always in its employ in Paris a regularly salaried corps of skilled artisans, mechanics and laborers capable of installing, arranging, and caring for all kinds of exhibits in a satisfactory and expeditious manner, the cost of special labor to each exhibitor will, through its medium, be saved, and the scarcity, unskillfulness, or exorbitant demands of labor guarded against; and by means of the combination of shipments and general charters ocean freight rates and other transportation charges will be greatly reduced, as will also insurance premiums and various incidental expenses. In addition to these considerations of economy, it may be stated that, through the employment of this company, exhibitors will be relieved of many costly and vexatious delays and annoyances resulting from unfamiliarity with the French language had French methods of doing business. Competition for the company's service will be a fixed charge, the amount of which will be duly contracted for with the exhibitor in advance.

Directory of Scientific Societies, Associations, Etc., and Meetings of the Same.

FRANKLIN INSTITUTE (Electrical Section), Philadelphia, Pa.—Secretary, William H. Wahl.

THE NEW YORK ELECTRICAL SOCIETY.—President, Gano S. Dunn; secretary, George H. Guy, New York.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.—F. W. Putnam, secretary, Salem, Mass.

ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA, Pittsburg, Pa.—Meetings, third Tuesday of each month.

CANADIAN ELECTRICAL ASSOCIATION.—President, William H. Browne, Montreal; secretary, C. H. Mortimer, Toronto, Ont.

CHICAGO ELECTRICAL ASSOCIATION.—Meetings, first and third Fridays of each month, from October 1 to June 1; J. R. Cravath, secretary.

NORTHWESTERN ELECTRICAL ASSOCIATION.—President, F. A. Copeland, La Crosse, Wis.; secretary, Thomas R. Mercein, Milwaukee, Wis.

MASSACHUSETTS CHARITABLE MECHANIC ASSOCIATION, Boston, Mass.—Exhibition of Motor Carriages, October 10 to December 3, 1898.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK.—President, G. Tracy Rogers, Binghamton, N. Y. Next meeting, Manhattan Beach, September 13 and 14, 1898.

NATIONAL ELECTRIC LIGHT ASSOCIATION.—President, A. M. Young, Waterbury, Conn; secretary, George F. Porter, New York. Next meeting, New York, May or June, 1899.

AMERICAN STREET RAILWAY ASSOCIATION.—President, A. E. Lang, Toledo, Ohio; secretary, T. C. Penington, Chicago, Ill. Next meeting, Boston, Mass., September 6, 7, 8 and 9, 1898.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS.—President, W. W. Ryder, Chicago; secretary, P. W. Drew, Milwaukee, Wis. Next meeting, Wilmington, N. C., June 19, 1899.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, New York.—President, Dr. A. E. Kennelly; secretary, Ralph W. Pope. Meeting, third Wednesday of each month, from September 1 to June 1.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES.—President, Samuel Insull, Chicago; secretary, Wilson S. Howell, Harrison, N. J. Next meeting, Sault Ste. Marie, Mich., September 12 and 13, 1898.

THE PACIFIC COAST ELECTRIC TRANSMISSION ASSOCIATION. President, W. F. Pierce; secretary, George P. Low, 427 Tenth Avenue, San Francisco, Cal.

THE OHIO ELECTRIC LIGHT ASSOCIATION.—President, Emil C. Schmidt, Sandusky; secretary and treasurer, Samuel Scovil, Cleveland. Next meeting place, Cleveland, 1899.

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION.—Dr. C. R. Dickson, Toronto, Can., president; Dr. John Gerin, Auburn, N. Y., secretary. Next meeting, Buffalo, N. Y., September 13, 14 and 15, 1898.

PENNSYLVANIA STATE STREET RAILWAY ASSOCIATION.—President, Robert E. Wright, Allentown; secretary, S. P. Light, Lebanon. Next meeting, Scranton, Pa., September 7-8, 1898.

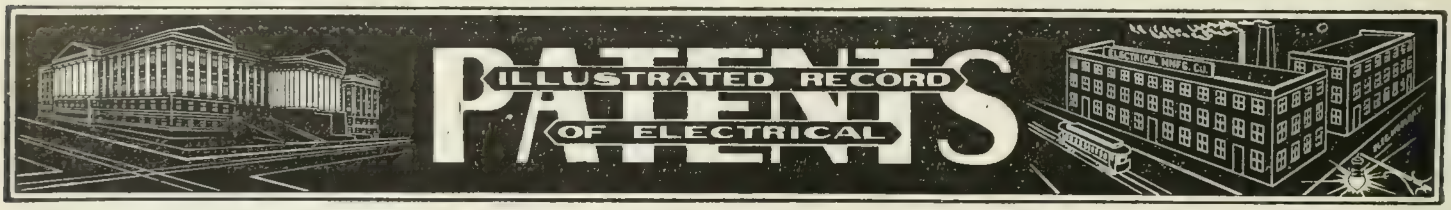
ASSOCIATION OF FIRE AND POLICE TELEGRAPH SUPERINTENDENTS AND MUNICIPAL ELECTRICIANS.—President, J. W. Aydon, Wilmington, Del.; secretary, H. T. Blackwell, Jr., New York. Next meeting, Wilmington, Del.

THE SOUTHWESTERN GAS, ELECTRIC AND STREET RAILWAY ASSOCIATION.—President, Carl F. Drake, Austin, Tex; secretary, E. L. Wells, Jr., Marshall, Tex. Next meeting, Austin, Tex., April 19, 1899.

INDEPENDENT TELEPHONE ASSOCIATION OF THE UNITED STATES.—President, Judge James M. Thomas, Chillicothe, Ohio; secretary, W. J. Vesey, Fort Wayne, Ind. Next meeting, June, 1899. Place to be named hereafter.

Business Notice.

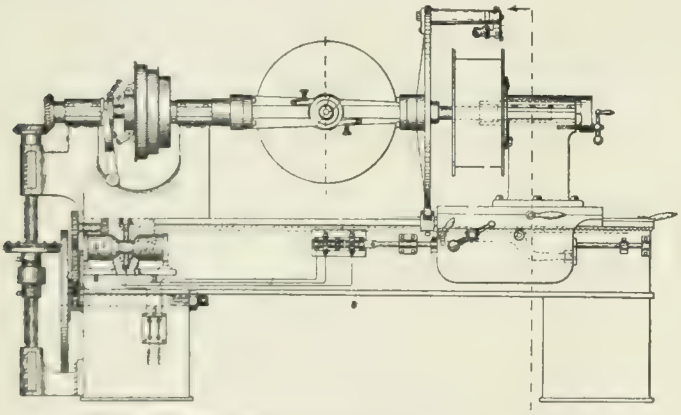
THE ILLUSTRATIONS in this issue were made by the Photo-Engraving Company, 9-15 Murray Street, New York City.



UNITED STATES PATENTS ISSUED AUGUST 23, 1898.

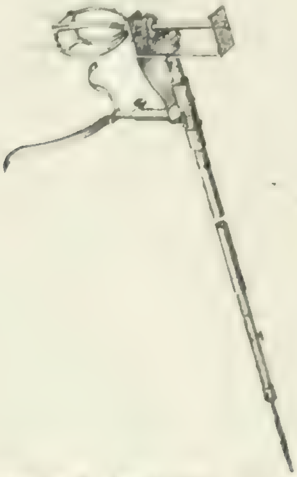
[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

609,421. DEVICE FOR ATTACHING OR DETACHING ELECTRIC LAMP BULBS; C. G. Edwards, of Albert Lea, Minn. App. filed Jan. 24, 1898. A device for attaching and detaching the bulbs of electric lamps, consisting of a rotatable handle and grasp or holder adapted for engagement with the bulb, and connecting with the handle, and an adjustable and removable spring guard extending out from said handle.



No. 609,620.—Field Spool Winding Machine.

609,614. ELECTRICAL APPLIANCE FOR ASSISTING ANATOMICAL ORGANS; J. Doty, of Syracuse, N. Y. App. filed March 22, 1898. An appliance for assisting the male generative organ in the natural performance of its functions, consisting of a wholly elastic loop and means to stretch it [illegible] to produce [illegible] and regulated pressure upon the [illegible] [illegible] and [illegible] of the [illegible] [illegible].



No. 609,421.—Device for Attaching or Detaching Electric Lamp Bulbs.

609,620. FIELD SPOOL WINDING MACHINE; [illegible] Lentz, of New [illegible]. App. filed Aug. 13, 1897. In a field spool winder, the combination of a support, a frame rotatively mounted thereon, a reciprocally moving carriage on the frame, reversible mechanism for moving the carriage, a manually operated mechanism for moving the carriage, and means for simultaneously throwing one of said carriage moving mechanisms out of and the other mechanism into operation.

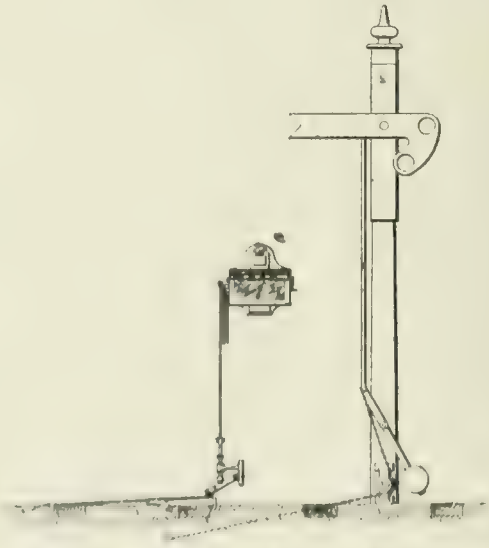
609,639. ELECTRO-MEDICAL APPARATUS; R. H. Wappler, of New York, N. Y. App. filed Nov. 2, 1897. The combination with the rheostat coil, of two sliders, a shaft, cranks and connections for moving the sliders in opposite directions, a hand upon the crank shaft and a dial for indicating the action of the rheostat in the electric circuit.

609,640. BURGLAR ALARM; D. L. Wartzenlift, of Kutztown, Pa. App. filed Nov. 16, 1897. A burglar alarm, comprising an electric circuit, the wires of which are extended across a window or the like, an alarm in the circuit, and a circuit closer mounted to swing on one of the wires and adapted to close the circuit when swung out of its normal engagement with the window or the like.

609,702. MANUFACTURE OF FLUIDS FOR IMPREGNATING FIBRES FOR INCANDESCENT LIGHTING; G. B. Puchmuller, of Schoneberg, Germany. App. filed March 21, 1898. A fluid composed of a solution of oxids of strontium, zirconium, barium and aluminum.

609,732. APPARATUS FOR SIGNALING ON LOCOMOTIVES; F. A. Cheetham, of Rastrick, and R. Bostock, of Brighouse, England. App. filed Jan. 18, 1898. In an apparatus for signaling in locomotives, the combination with a weighted faller and a semaphore connected thereto, carried by the locomotive; of means for supporting said faller; a shaft and connections for releasing said faller, a pivoted lever carried by the locomotive, connections between said lever and said shaft for operating the latter; a plate situated between the tracks, and means for operating same to bring it into contact with the pivoted lever during the travel of the locomotive, so that through the said shaft the faller is released and the semaphore operated; and means for raising the faller.

609,745. DIAPHRAGM FOR ELECTROLYTIC PURPOSES; William G. Luxton, of Liverpool, England. App. filed April 9, 1898. A diaphragm made of a composition of cement, sand and a porous material mixed with water and allowed to dry, or set, said diaphragm having pores through the substance of the porous material and interstices between the cement and the other constituent particles.



No. 609,732. Apparatus for Signaling on Locomotives.

The Electrical World.

VOL. XXXII. NEW YORK. SEPTEMBER 10. 1898. No. 11.

PUBLISHED EVERY SATURDAY BY

THE W. J. JOHNSTON COMPANY,

9 Murray Street, New York.

Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York.

New England Office, 620 Atlantic Ave., Boston.
Western Office, 936 Monadnock Block, Chicago.
Philadelphia Office, 929 Chestnut Street.

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THE ELECTRICAL WORLD,

9 Murray Street, New York.

VOL. XXXII. NEW YORK, SEPTEMBER 10, 1898. NO. 11.

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ELEVATED RAILROADS AND GEARS.

The elevated railroads of this country have largely changed over of late to electric traction or made preparations for such change. One of the chief advantages to the public often pointed out in this connection is the reduction of the noise due to the elimination of the cylinder exhaust. A close comparison between the elevated roads now running in New York City by steam power and in Chicago by electric power shows that this advantage of the electric is nullified, or even more than nullified, by another source of noise, namely, the gears. Noise from this source has been pretty well eliminated from surface equipments, but the conditions on an elevated structure are entirely different. The structure itself forms a huge resonator which responds at once to any vibrations in parts as intimately connected with it as are the trucks running upon its roadbed. The electrically operated trucks seem also to pound much more seriously over frogs and crossings than do trailer trucks or even steam locomotives. This may be due to the greater amount of dead weight not supported by springs in the electrical equipment.

It is to be hoped that the manufacturers of traction motors may see their way clear to the construction of gearless motors for this service. Such motors have been tried and found unsuitable for surface traction, largely on account of the comparatively low speed of the car wheels and consequently high gear ratio needed to obtain a peripheral velocity at the air gap sufficient for proper motor output without too great a weight of motor. As the car speed increases, however, the gear ratio can come down proportionately with the same armature speed. With suburban and elevated service the speeds are considerably higher than can be maintained on public highways, and sufficiently so for a gear ratio approximately one to one.

The gearless motor is not, however, as easy to design as a geared motor with a ratio of one to one, for the reason that with the gearing the motor centre can be raised above the wheel centre and with the same clearance between the motor shell and track considerably more room can be obtained for armature and field magnets. When the motor is mounted directly upon the wheel axle the parts are very much cramped, and particularly is this the case if the wheels are small. The larger the wheels the greater is the capacity of the motor that can be mounted direct and the greater the ratio of the speed at the armature periphery to the speed of the car or train, giving a double increment of the power of the motor. Large wheels mean high trucks, and much higher trucks than now used in elevated service would necessitate some modification in the construction of the cars. Some English roads using gearless motors, notably the London underground lines, construct the car floors higher at the ends over the trucks than throughout the rest of the car, sufficient head room being left, however, over these raised portions of the floor for seats for passengers, the cars themselves being entered through side doors instead of at end platforms. Such a disposition as this gives an opportunity for a ready enlargement of the wheels by a considerable extent. Even so, however, it is difficult to get in a truck as much power as can be obtained with gearing, but plenty of power can be installed under the car for its own propulsion and by means of a multiple unit system trains can be readily propelled.

THE SUCCESS OF THE OPEN CONDUIT IN NEW YORK CITY.

About one year ago the Metropolitan Street Railway Company started the active construction work of a complete open conduit electric traction system to be extended eventually over all of its routes. Rather than delay the operation of the lines electrically until a power generating and distributing system of the enormous magnitude necessary for driving such a load could be constructed, the company installed two temporary power stations, the interesting points of which will be found on other pages of this issue. The apparatus in these temporary stations, aggregating a generating capacity of almost 10,000 horse-power, will only be in service about a year and then discarded, and its place occupied by rotary converters taking power from the high-tension alternating system. The temporary equipment is of the most thorough and reliable type, no cheap work being allowed even in this case where, if anywhere, economy of first cost might be considered advisable. The most interesting feature of it all is that the company should see fit to install such an expensive equipment, against a large part of which depreciation of 100 per cent. must be charged and a very large percentage even on what can be sold, its only return being the increased business for one year over that obtained with the former equipment of horse-power, and to a certain extent the good will of the public.

The increased business due to the improved nature of the service has been most astonishing in its magnitude, even to the officials of the company themselves, although they have had previous experience in the re-equipment of horse car lines with cable apparatus. Where small horse cars jogged along with a fair patronage, double-truck electric cars of twice the capacity, twice the speed and one-third the headway are crowded to their very limit. The company has met the public's demands by constantly adding to the service, putting on cars as fast as they could be built and equipped and loading up every new generator to its limit as soon as it was ready to run. The improvement in service is so great that the public has insistently demanded the change on other lines and two such lines reaching the shopping districts are now about ready to go into service. The mammoth units of the permanent power station will not be ready for service in time to carry the heaviest winter load and two 850-kw generators are now being hastily erected in a temporary location to help the temporary stations, but even with them it is apparent that little electrical car heating can be done during the rush hours of the winter and the generating stations are going to be pretty well overloaded from dawn till midnight. The traffic has largely come, of course, from the Manhattan elevated, the accessibility of the surface lines, the extensive transfer privileges and the perfection of the service generally taking from the overhead system practically all of the short-haul business, leaving it only the long-distance traffic, in which its higher speed is of greater value.

Mechanically and electrically the conduit system on these lines has been proven an unqualified success. Troubles with the plows and underground rails are much less frequent than with the overhead pole and trolley wire. The nuisance of the trolley slipping [illegible] the plow of which requires no attention whatever on the road. It [illegible] do occur to conduit apparatus they are likely to be more disastrous than cases of [illegible] water or snow and apparently but little trouble from spreading of the conductor rails or failure to make contact from any cause. An incidental advantage of the conduit system of no little importance is the solidity of the roadbed, due to the depth and massive nature of the concrete conduit walls, which with the yokes form a most perfect foundation for the track. A feature of the switches and crossings from which some trouble might have been anticipated is the necessary break in the continuity of the conductors, cutting off power from the car for short distances at these points. To be sure this is somewhat of a nuisance at night to passengers who are reading, as the lights go out with annoying frequency on a complicated crossing. The attention of the motorman is also distracted to a certain extent from his other cares at these points by the necessity of turning off the power before his plow reaches each such break and turning it on immediately after leaving the break, and of preventing his car from stopping in the open circuit position, in which case it could not again be started. This requirement, however, seems to give no trouble in practice.

COMBINED STREET AND PRIVATE RIGHT OF WAY TRACTION.

One of the most notable features of the instances in which electric power has been up to the present adopted for traction purposes on private rights of way is the fact that through service is, as a rule, given from the streets either at one or the other terminal or both, the same cars running on the public highways and the private right of way. This is notably the case in two such installations described in other columns of this paper, one operating between Buffalo and Lockport, N. Y., and the other between Brooklyn and the seashore. In both instances the existing street railway systems serve as a distributing network, over which the cars spread to various destinations after leaving the high speed through line.

In general it may be stated that in all interurban traffic but a small percentage of the passengers comes from the immediate neighborhood of any one terminal station, and the ideal service is one that will give a passenger an opportunity to ride without a change of cars from the street corner nearest to his point of departure to the street corner nearest his destination in the other city. The majority of the run should be covered at high speed, and if so the slow speed incident to the terminal collection and distribution of passengers is not a serious objection. Steam railroads are unfitted for this service owing to the impossibility of manipulating their rolling stock through the public streets, and street railway systems other than electric are also unfitted owing to their inability to operate economically and satisfactorily over private rights of way. The electric service combining street-railway lines as sort of terminal feeders and the routes over private right of way as intermediate express trunk lines approaches most nearly to this ideal desideratum.

CIRCUIT BREAKERS VERSUS FUSES.

It is becoming customary to use circuit breakers instead of switches to open and close main circuits, this probably being due to the fact that it is easier to trip the trigger of a circuit breaker than to pull out a heavy switch. This practice, although prompted by laziness, is to be commended, as the carbon brake of the circuit breaker removes the arc from the main contacts to a point where it does no harm. Double pole circuit breakers, made up in such a way that the two sides can be independently closed, require no switches in series with them, since the first pole restored acts as a safety when the second is closed, unless double-throw or change-over connections have to be made in the circuit. Even in this case the circuit breaker can always be opened in ahead of the switch, eliminating the arc from the switch contacts. It might be well for the manufacturers of this type of apparatus to get up double-throw, single, double or triple pole circuit breakers, which could be used in place of the present circuit breakers and switches.

The Feeding of the New York & Sea Beach Railway.

One of the most popular routes to Coney Island is a road which has been in service a great many years, with trains drawn by steam locomotives, and known as the New York & Sea Beach Railway. The road is 6 miles in length, starting from the water front near Sixty-fifth Street, Brooklyn. Last winter the Brooklyn Heights Railroad Company obtained control of this road and decided to equip it electrically and give a through service over its street lines and the Sea Beach route to the island. The problem of feeding currents for this road was a rather difficult one, and was rendered more so by the necessary haste in the construction of the apparatus. The nearest station of the Brooklyn Heights system was the Southern Station, situated at the foot of Fifty-second Street, Brooklyn, and equipped with twelve four-pole generators belted in pairs to Corliss engines. It was proposed at first to supply the new line and one other long route to the seashore by means of a high-tension multiphase and rotary system, and complete designs were worked out with this end in view. The poles even were erected for carrying the overhead high-tension lines. The scheme contemplated the use of the alternating system for supplying another load in winter, the sub-station apparatus to be made portable for this purpose; but the plan had to be abandoned for two reasons—one, the inability to obtain franchises for the transmission line, and the other the difficulty in obtaining the equipment in the short time allowable, since such apparatus is not as yet thoroughly standardized, and the manufacturing companies are not able to give prompt deliveries. The booster system was then adopted as the only alternative, and the method of connecting up the lines, feeders and boosters constitutes rather a novelty in electric railway practice.

It was anticipated that the traffic would be limited only by the capacity of the line, the service to be rendered by twelve-bench open double-truck cars, weighing about 10 tons each, running at about 30 miles per hour, and operated without trailers, with a minimum headway of 20 seconds. It was calculated that this would call for a maximum load of about 2200 amperes. The closeness with which such estimates can be made is well illustrated in this case by the fact that the loads at the maximum periods vary from 2000 to 2300 amperes. Three hundred and fifty cars are in service over this route, the cars leaving the private right of way at the Brooklyn end and spreading to various terminals, such as the New York end of the bridge, various ferries, etc. The headway has reached a minimum of 14 seconds, but without dangerous overcrowding, owing to the nature of the road and its consequent absence of interference from other traffic.

The two trolley wires of 00 cross-section are continued through from one end of the line to the other without a break, and are reinforced by what is known as a "side feeder" of 0000 cross-section, tapped into them at various points, this 0000 line being more properly called—in conformity with the terminology of lighting systems--a main than a feeder. Its purpose in conjunction with the trolley wires is to distribute any local load over the various feeders proper, which are tapped into the line at several points. For the two miles of the line nearest the station the size of the so-called "side feeder" is increased to 500,000 cm, and it becomes a feeder connected directly with the station bus bars and supplying some 300 amperes from the latter. The rest of the line is supplied by means of one 0000 and three 500,000-cm feeders tapped into the "side feeders" and trolley lines at four points. At times of light loads all these feeders are directly connected with the station bus bars, on which the voltage rises to about 580 volts above ground, but on Sundays, holidays and other times of especially heavy loads two special engine-driven boosters are started in the station, the two shorter feeders being fed through one of these boosters and the two longer feeders through the other. Economy of power is of little importance in this service, owing to the short duration of the heavy loads during the year, and hence the feeders were proportioned, not to keep the drop within any predetermined limit, but only of sufficient size to safely carry the currents which it was estimated would be thrown upon them. The boosters, then, were specified of sufficient voltage to overcome the feeder drop with this maximum current, the one requirement of the whole system being the maintenance of 500 volts at all points on the line for speed considerations. The two boosters, which are of a capacity of 1000 amperes each, can build up about 350 volts at full load. Owing to the nature of the distribution described above, there being no section insulators and the boosters, with their respective feeders, being, so to speak, in multiple with each other on a bus bar consisting of the trolley wires and "side feeder," it was considered advisable not to wind the boosters with plain series fields, in which case one machine might happen to back current through and reverse the other. They are, therefore, compound wound, the series ampere turns, however, being somewhat greater than the shunt ampere turns. The shunt winding is supplied with current taken betweeen the bus bar and ground, so as not to be affected by the rise and fall of the booster voltage. The two machines are eight-polar, rated at 350 kilowatts, run at 250 r. p. m., and were built by the General Electric Company. One of them is direct-coupled to a Westinghouse compound 500-hp engine, and the other is belted to a similar engine, the latter arrangement being due to the fact that a machine suited for direct coupling could not be supplied in time to start the line. The plans were only approved in March, the machines were ordered about the first of April and the line was running May 29. Two other boosters are also in use in the same station for long feeders at times of heavy load, the machines being standard 500-volt dynamos and used in multiple with the rest of the equipment at other times.

The arrangement of the feeders described above differs from that ordinarily used with boosters in that each booster does not drive its own load separated from the rest of the system by section insulators, but the two boosters work not only in multiple with each other but with a direct feeder from the main bus bar. This arrangement helps greatly in the distribution of the load and the equalization of concentrated heavy loads over the whole equipment of the station. The same principle is applied so far as possible to the whole system of the Brooklyn Heights Railway, the overhead lines being tied together to an extent limited only by the capacity of the main generators—that is to say, the capacity of all the circuit breakers supplying the feeders, which are tied together in one section, should be less than the capacity of the machines, otherwise the machine breakers will come out on short circuit, shutting down the whole system supplied from that station. Even these large sections are now to be cross connected by the use of fused or circuit-breaker junctions.

The hasty but satisfactory equipment of the Sea Beach line reflects no little credit on the chief engineer of the line, Mr. J. C. Brackenridge, and also upon the electrical engineer, Mr. R. P. Brown.

Overhead Switches on the Brooklyn Bridge.

The four loops forming the New York terminus of the trolley lines coming across the New York and Brooklyn Bridge have given no little trouble in the trolley switches. The trolley lines are necessarily low, owing to the structure under which the cars run, and the trolley poles are consequently pressed down until almost horizontal. The sharp curves necessary to enter between the columns supporting the structure overhead bring sharp bends into the overhead wire, and twist the wheel flanges at many points considerably out of the general direction of the wire which they must follow. The trolleys continually run off at these curves and miss the switches to the various loops.

An ingenious remedy for this is now being tried on one of the incoming switches and curves. The arrangement consists simply of a shallow, inverted metal trough, about 1 foot in width, with downwardly projecting flanges to keep the trolley from running off at the sides, against which the flanges of the trolley wheel can run and from which they can collect current. The trough narrows at its ends in a V shape, which guides the trolley wheel onto the wire, starting from the point of the V. At switches the trough is full width, so that if the trolley wheel follows the car with any accuracy at all it cannot go wrong at these points. The arrangement is not unsightly in this particular instance, owing to the fact that it is under cover. Its operation appears to be very satisfactory.

The Output of the Calumet and Hecla Mines.

The statement of the Calumet & Hecla Mining Company for the year ending April 30, 1898, gives the product in refined copper as amounting to 45,194 tons, that for the previous year being 46,238 tons; at the price of 11½ cents per pound this gives a valuation of the annual output of over $9,000,000.

Electric Traction Between Buffalo and Lockport.

The most recent application of electricity to a road built on a private right of way and formerly operated by steam locomotives was inaugurated on Monday, August 15, on the branch line of the Erie Railroad which runs from Tonawanda to Lockport, N. Y., feeding into the main line of that road. The service is of a mixed type, the passenger traffic being carried on by trolley cars and the freight service by electric locomotives.

The operating company is the Buffalo & Lockport Railway Company, of which Mr. W. Caryl Ely, first vice-president of the American Street Railway Association, is president, and Mr. Burt Van Horn, general manager of the Buffalo & Niagara Electric Railway Company, is manager. C. K. Marshall, superintendent of the Buffalo & Niagara Falls Electric Railway Company, will also be superintendent of the new company.

The Buffalo & Lockport Railway Company was organized in April, 1898, for the purpose of connecting the cities of Buffalo and Lockport, N. Y., by means of a first-class high-speed electric railway. It has acquired by purchase the road formerly owned by the Lock City Electric Railroad Company, consisting of 5½ miles of first-class single track running through the principal streets of the city of Lockport, with its equipment for local business. It has also acquired by a ninety-nine year lease the Lockport branch of the Erie Railroad from Lockport to North Tonawanda, N. Y., consisting of 13½ miles of single track from Lockport to North Tonawanda, with side tracks and switches at way stations and terminals. This road when a part of the system of the New York, Lake Erie & Western Railroad was operated by four steam locomotives. The schedule gave about eight trains per day each way between the principal stations, and a much less number for the less important places. Passengers went through from Lockport to North Tonawanda, from which point they reached Buffalo or Niagara Falls.

The Buffalo & Lockport Railway Company has also acquired by purchase the roads formerly owned by the Buffalo, Kenmore & Tonawanda Railway Company and by the Buffalo, Elmwood Avenue & North Tonawanda Railway Company, consisting of 7½ miles of single track between Buffalo and North Tonawanda and 1 mile of single track within the city of Buffalo. By these tracks it makes connections with the tracks of the Buffalo Railway in the latter city. The total length of the tracks owned or leased by the company is 29 miles.

By traffic contracts with the Buffalo Railway Company and the Buffalo and North Tonawanda Electric Railway this company thus provides a through line from all parts of Lockport to all parts of Buffalo, and also between Lockport and Niagara Falls. It will do all the freight, mail and express business of the Erie Railroad between Lockport and North Tonawanda, and will in many ways become a component part of the Erie system. The cars and trains between Buffalo and Lockport run direct to the main station of the Erie Railroad at North Tonawanda, and the sight of the steam and electric systems side by side at this point and doing business through the same train yard is a novel one.

Work was commenced May 17, 1898, and at midnight on Sunday, August 14, the steam service was suspended. Nothing has since occurred to mar the perfect and punctual operation of the road on the new schedule. It is already doing a heavy business.

Power is obtained from the Niagara Falls Power Company by tapping its long distance transmission line between Buffalo and Niagara Falls at a point between the Falls power house and the station of the Buffalo & Niagara Falls Electric Railway Company at Tonawanda. It is carried at a pressure of 10,500 volts alternating current over three No. 0000 bare copper wires on triple petticoat insulators set on cedar poles, to the rotary converter sub-station located in a new power house at the Lockport [illegible]. Here it is led into [illegible] 150-kw stationary transformers of the air blast type, arranged in combination and operating [illegible] installed in the Niagara Street power [illegible]. In these the pressure is reduced to [illegible] volts, and at this pressure the current passes to the rotary converters, where it is converted into continuous current at 500 volts. The rotary converters are standard General Electric [illegible]. The switchboard is of the standard panel type, and consists of one high-tension panel for the high-potential transmission, two low-tension panels for the alternating current side of the rotaries, two "K" direct-current railway panels for the direct current sides of the rotaries, and two transformer panels. The air blast for the transformers is furnished by a blower built by the Buffalo Forge Company and driven by a 1½-kw motor.

The switches for the high-tension current are of the quick-break type, each blade being separated from its next neighbor by a marble barrier. The blades are pulled open by means of a hooked stick, the hook being inserted in an eyelet into the end of the blade. The fuses on the high-potential circuits are of the expulsion type, in which the fuse is held between two springs, so that at the moment of fusing the two ends, between which the arc would ordinarily spring, are instantaneously pulled apart. Each of the direct-current panels is, of course, equipped with an automatic circuit breaker. The line is protected by G. E. lightning arresters of the short-gap type, placed on the wall of the sub-station, where the high-potential transmission wires enter the building.

As soon as the present plant is completed another rotary converter sub-station will be erected at Tonawanda, taking current also from Niagara Falls.

From the starting point in Buffalo to the city limits the cars are operated by current from the Buffalo Railway Company's station. The new converter sub-station at Tonawanda will feed 7 miles to Lockport and half way in the direction of Niagara Falls, the converters at Niagara Falls feeding half way back to Tonawanda. The arrangement will be such that the Buffalo & Lockport Railway system can give current to, or take it from, the system of the Buffalo & Niagara Falls Electric Railway. The Lockport converter station will then feed back 7 miles to Lockport and supply current also to the city lines in Lockport itself.

The new rolling stock consists of two 36-ton electric locomotives, supplied by the General Electric Company, for freight service, and ten electric motor cars mounted on eight wheels and built by the J. G. Brill Company, of Philadelphia, for passenger service.

The theory of handling the passenger service has been entirely changed from that in force with steam traction. Instead of long intervals between trains the cars are run on half-hour headway. This requires five cars to operate the 25 miles between Lockport and Buffalo. The speed is high. Over their own right of way the cars ran on their first trip at the rate of 50 miles per hour, including stops. The running time from Lockport to Tonawanda is twenty-six minutes; to Buffalo, one hour and fifteen minutes. In this trip thirty-three minutes are spent in the city of Buffalo in a distance of 6 miles, where the speed has to be kept low to conform to city ordinances. Even with this drawback, however, it is expected that in the near future the running time between Buffalo and Lockport will be reduced to one hour.

The passenger and smoking combination cars are 31 feet 8 inches long over the end panels, and with platforms 4 feet 6 inches long measure 42 feet 4 inches over the buffers. The platforms are inclosed by round-end vestibules with openings on the diagonally opposite corners of the cars. Hinged doors, which fold back against the vestibules, completely inclose the platforms when desired. Folding gates are also provided turning back against the outside of the vestibule. The car is divided into two compartments, one of which is used for smokers and is separated from the remainder of the car by a partition having glass windows on each side of the sliding door. All the seats have spring cushions. The inside finish of the car is cherry, with chipped glass beveled edges in the ventilators. The cars are also fitted with electric heaters, a small one under each seat, and also push buttons.

These cars are run on "T" rails at a speed that will enable them to average 45 to 50 miles per hour. Electric brakes are provided upon each axle, the discs being cast upon the wheels themselves.

The baggage and passenger combination cars are especially adapted to high-speed service. They have a passenger compartment with a seating capacity of twenty-eight and a baggage compartment. The car body is 31 feet 8 inches long over the end panels, 7 feet 8 inches wide at the sills, and 8 feet wide at the widest point. The platforms are 4 feet 6 inches long. The total length over the angle iron buffers is 37 feet 10 inches. Cars and trucks are from the shops of the J. G. Brill Company, Philadelphia.

Each car is equipped with four G. E. 57 (52 horse power) motors and B 8 controllers. The equipment is similar to that on the new cars used on the long-distance lines of the North Jersey Street Railway Company, of Newark, N. J. The weight of each car loaded is from 20 to 25 tons.

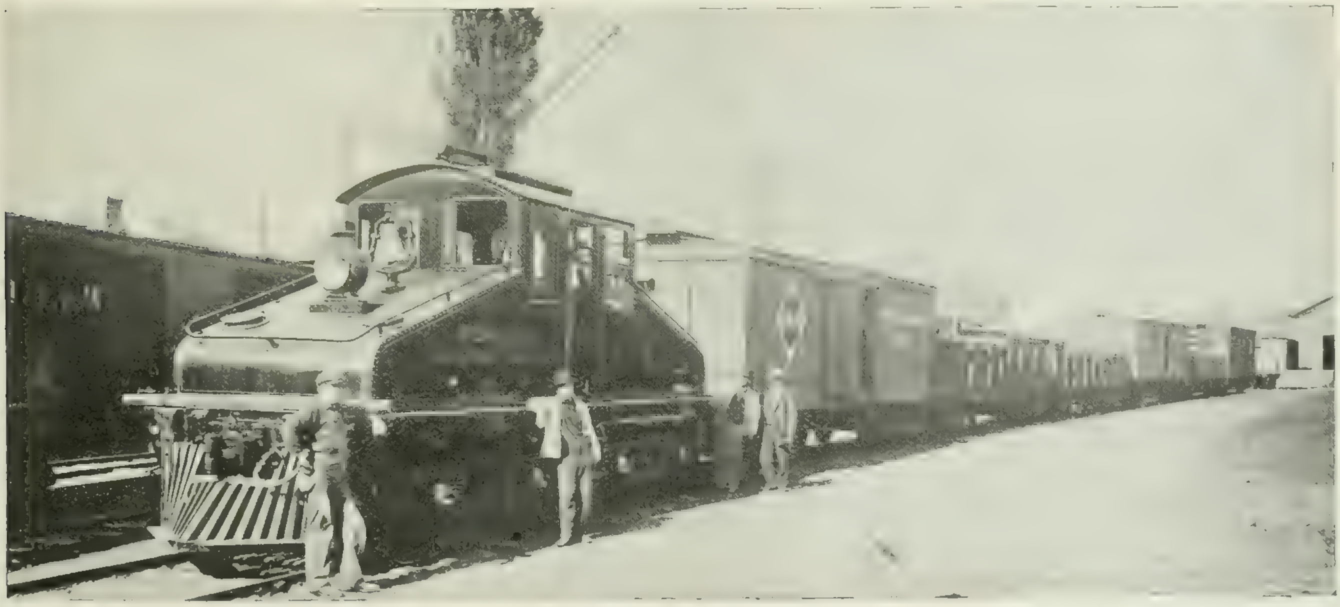
The two locomotives have been built for the purpose of handling the freight business of the road exclusively. The road being a feeder to the main Erie system the freight traffic is considerable. To haul it, therefore, powerful locomotives were necessary, and in them the General Electric Company, which alone has had any experience in building large electric locomotives, has incorporated such improvements as the actual operation of its locomotives on the Baltimore & Ohio Railroad, the New York, New Haven & Hartford Railroad and the Hoboken Shore Road has dictated.

The design follows closely that of the locomotives just mentioned, two sloping shields being placed one on each side of a central cab, the whole carried on two swiveled trucks. The cab frame is made of 1¾-inch x 1¾-inch angles, covered with a sheathing of one-eighth-inch iron.

The platform or main frame is built up of 8-inch channels running the entire length of the platform, and securely riveted to cross plates at the ends directly over the centre truck bearings. Heavy oak buffer beams, to which are attached draw heads and pilots, are secured to the ends of the platform. The trucks have swing bolsters, supported by elliptical springs, and the truck frames are built up of forged and rolled iron securely bolted and riveted together, the pedestals being made of cast steel. The truck proper rests on coil springs, supported by equalizing bars. The wheels are 36 inches in diameter, with steel rims and iron centres.

The locomotives are each equipped with four G. E.-55 motors. The drawbar pull at full speed is approximately 3400 pounds, handling a 340-ton train at about 15 miles per hour. The motors are rated each at about 160 horse-power. As the maximum speed required is quite low, two motors are at all times connected in series.

The controller is of the K-24 type, with cut-out wiring modified to fit the special requirements of the equipment in regard to speed. Outside the resistance points only two combinations of the motors are possible, the first throwing all four motors in series, and the second or running position placing motors No. 1 and No. 3 in series, and the pair in multiple with motors No. 2 and No. 4 similarly connected.



Electric Locomotive Hauling Freight Train at Lockport.

The locomotives are equipped with pneumatically controlled trolleys. With this arrangement it is no longer necessary for the engineer or helper to leave the cab to replace the wheel on the wire or reverse the trolley. This is effected by a handle conveniently placed over the engineer's head. The downward motion is obtained by admission of air to a cylinder, the piston of which in moving compresses the spring holding the pole in place when running. The upward motion is accomplished by the spring and the movement sideways by hand, both pole and handle being on a swivel plate.

The balance of the equipment consists of air brakes, air whistle, bell, air-blast sanding device, air pump, magnetic circuit breaker, magnetic switch, lightning arrester, electric lights, etc.

Interior of Sub-station, Showing Rotary, Stationary Transformer and Switchboard.

The locomotives have already been subjected to several severe tests. They are specified to be capable of hauling trains of 300 tons weight, exclusive of the locomotive, which, estimating the average car at 30 tons, would mean a train of ten cars. The locomotives have already proved themselves equal to hauling as many as twenty-eight loaded freight cars at the specified speed of 15 miles an hour.

The transformation of this line from steam to an electrically operated road marks an important step in the employment of current on the steam road. If in its operation it successfully attains the results expected, it will conclusively prove that electricity can be economically applied to the operation of branches and feeders of steam-trunk line systems. It would be too much to expect an immediate conversion of these latter main lines from steam operation to operation by electricity, but with electric locomotives and motor cars profitably carrying on both freight and passenger traffic on their feeders, the entering wedge will be driven still further and the ultimate result will be by so much nearer of attainment.

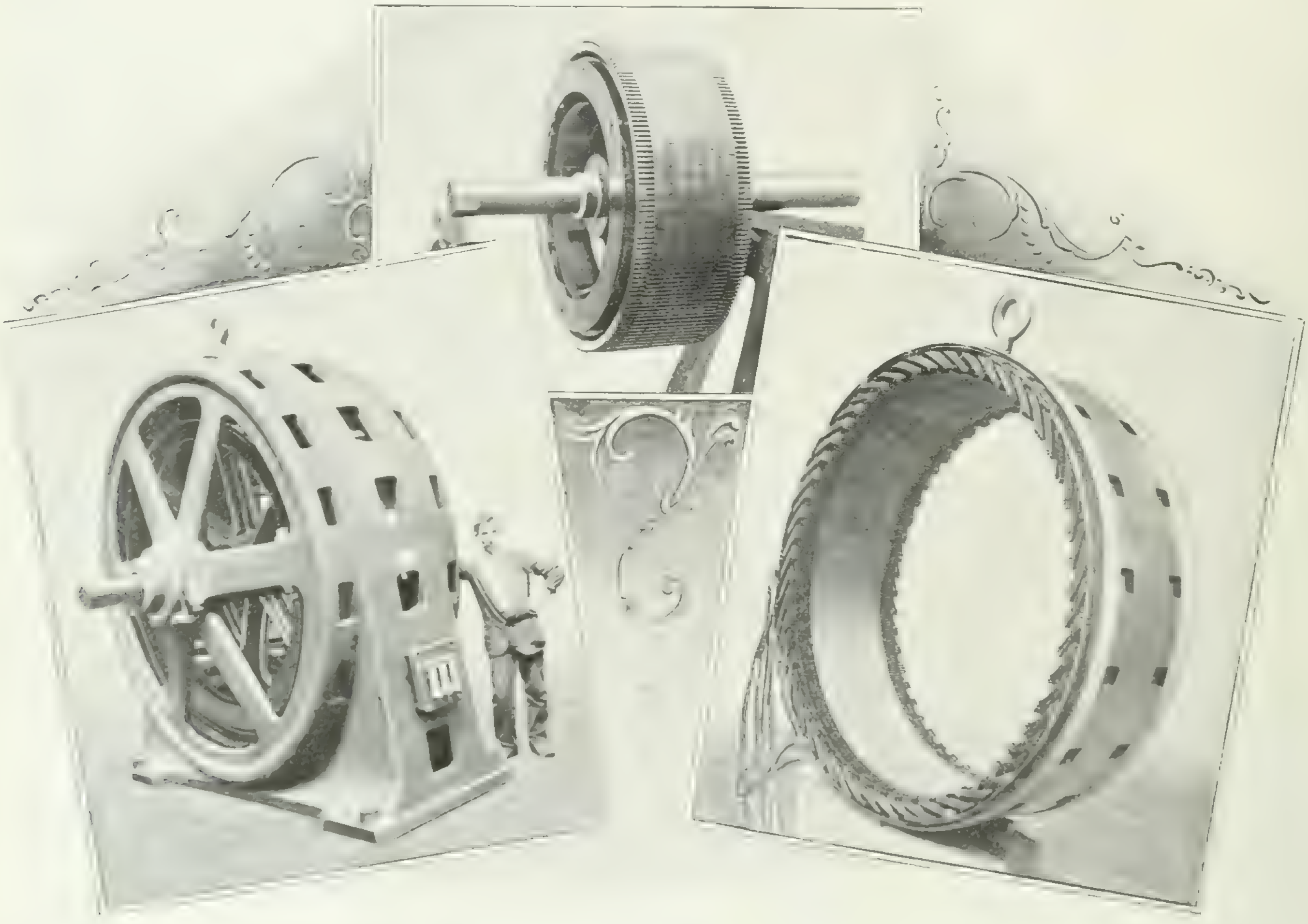
The Largest Induction Motor in America.

In connection with the brief description and illustration in The Electrical World of August 27 of the largest induction motor in the world, made by Brown, Boveri & Co., Baden, Switzerland, the largest machine of this type in America may be of interest. It consists of a motor rated at 500 horse-power, built by the Westinghouse Electric & Manufacturing Company. It is of the company's standard Type C wound for three-phase supply at 7200 alternations per minute and 400 volts. It has 36 poles, giving it a magnetic speed of 200 r. p. m., and is designed for 4 per cent. slip at full load. The secondary is wound with a short-circuited squirrel cage bar winding, the primary being also bar wound, and it is to be started by the Westinghouse standard method of starting motors with short-circuited secondaries, namely, the use of a so called auto-starter, consisting of a set of transformers by which the primary windings can be given a lower voltage until the motor has gained considerable speed, when they can be thrown directly on the mains. The motor is stated to be designed to develop a starting torque of 2¼ times the full load rated torque. The power factor is stated to be [illegible] per cent. at full load, which is apparently a satisfactory figure, considering the low peripheral speed. [illegible] the Swiss machine mentioned above, which is rated at 1000 horse-power, is 27 tons, which is obviously considerably less than double [illegible]

Temporary Power Stations of the Metropolitan Street Railway Company.

The surface car lines on Manhattan Island in New York city are rapidly, as every one interested in street railway matters knows, being equipped with an open conduit electrical equipment. The Metropolitan Street Railway Company, which operates almost the entire mileage of surface lines in Manhattan Borough, started about one year ago to install this system on its lines, after a two years' experiment with a few short lines in Harlem. Along with the track work the company commenced the construction of a central power station designed for an ultimate capacity of 70,000 horse-power, and let contracts for the equipment of about two-thirds of this capacity. The construction of this station is, however, on account of its magnitude, progressing but slowly, and to carry the load in the meantime the company put in two temporary power stations, one on Twenty-fifth Street and one on One Hundred and [illegible]th Street. The track work was actively begun in August 1897,* and the first line was opened in November. Other lines were quickly added, cars purchased and generators erected to supply them, but the magnitude of the traffic has exceeded all expectations. The temporary equipments mentioned are already loaded, [illegible] lines, namely, the Sixth and Eighth Avenue, are now about ready to be put in service, and winter, with its accompaniment of power consumed in car heaters, is not very far distant. The first big generator of the alternating-current rotary system, it is hoped, will be running in the new power house early next spring, but to tide over the winter two direct-current generators of the type [illegible] in the temporary stations are being temporarily erected in the new station.

Of the two temporary stations the larger is that on Twenty-fifth Street, the apparatus being in what is known as the Lexington



A [illegible] Induction Motor, Its Internal Rotating Secondary and External Stationary Primary

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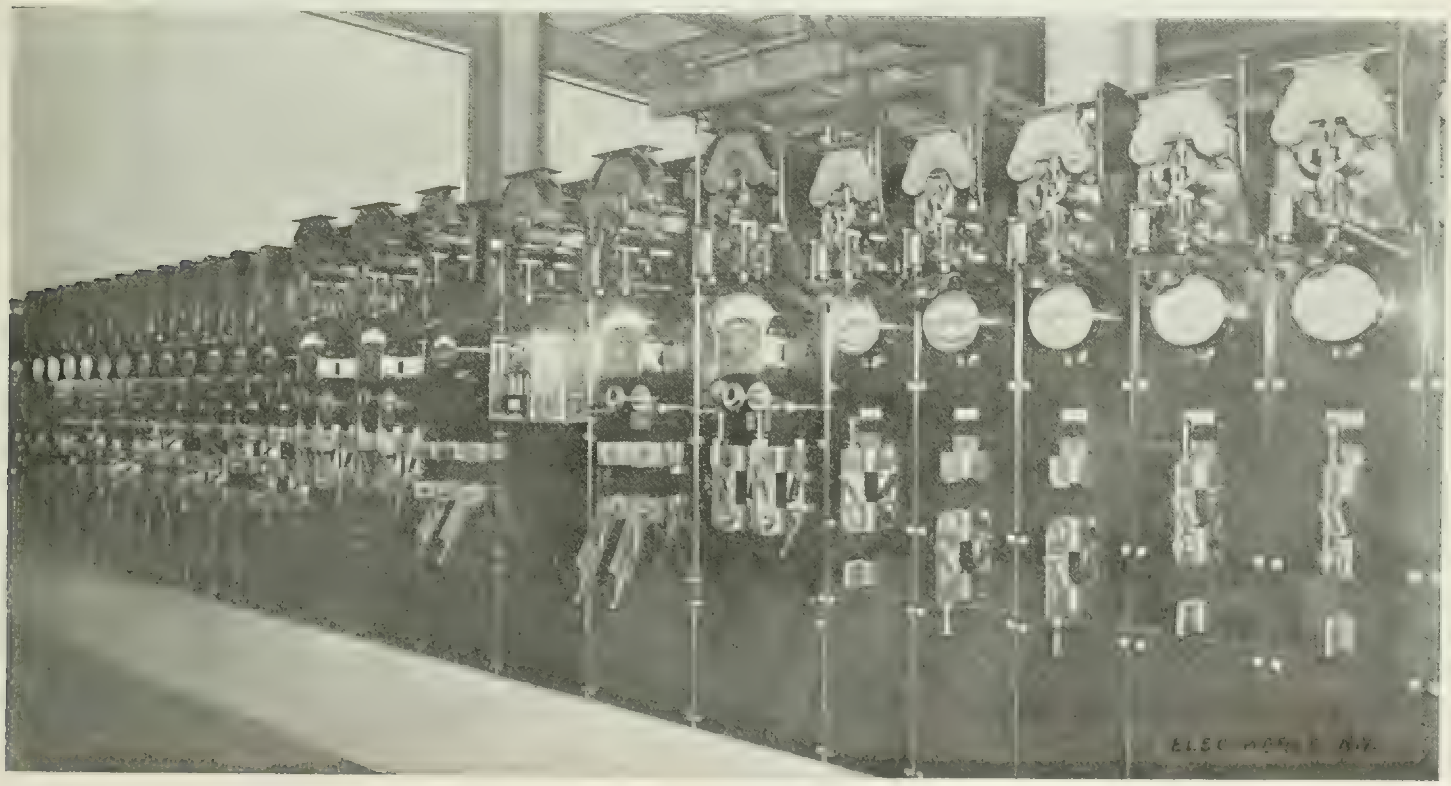
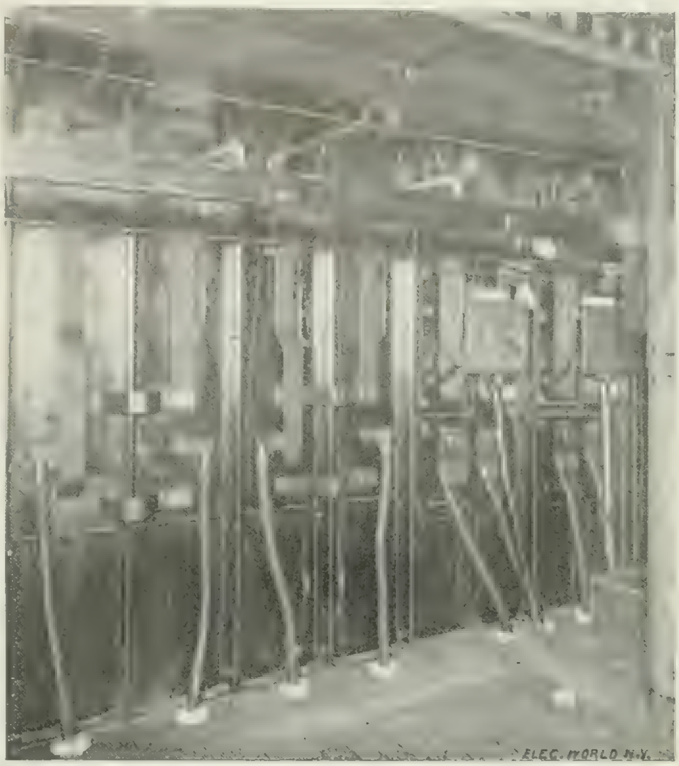
* See The Electrical World of August [illegible]

Building, a large office structure erected by the street railway company, the basement of which was planned for an eight-machine cable traction equipment. Four cable machines were installed and are now in use, the remaining space being occupied by four 850-kw direct-coupled railway generators. The visitor is at once struck with surprise at the substantial completeness of this equipment, which is only to be kept in service about a year, and then not even kept in reserve, but to be torn out to make way for a battery of rotaries. Everything is constructed as though it were a permanent equipment for a high-class road. The engines are cross-compound horizontal Corliss, built by the Pennsylvania Iron Works Company, piped below the floor, equipped with emergency governors, a complete gravity oiling system for constantly filling the sight feed oil cups, permanently attached indicator reducing motions, etc. The space occupied by these machines was designed for cable equipment, and several columns rise right through the engines. One column rises between two eccentric rods of the two wrist plates of one cylinder, and the rock arm of another engine valve motion approaches so closely to a column that to give any clearance it is necessary to cut off a rivet head. Naturally no one crane can be run over this machinery, but runways of the four cranes installed for the cable equipment extend over the generators and this helps materially in erecting and stripping the latter.

The generators are new machines built by the General Electric Company, and guaranteed to carry 50 per cent. overload for one-half hour and well able to carry any load from nothing to this overload without sparking and without brush adjustment, as has frequently been shown in the severe service which they have already been compelled to carry. The machines are mounted on substantial brick foundations carried down 25 feet to the solid rock. They are supplied with steam from a battery of boilers, supplying also the cable equipment, this battery having been increased from twelve to sixteen boilers in order to carry the additional load. The boilers are of the B. & W. manufacture, rated at 250-hp each, and the new ones, having to be crowded in a space below the Twenty-sixth Street sidewalk, are mounted in a pit 12 feet below the boiler room floor. They are stoked by automatic stokers supplied by Alfred Box & Co., Philadelphia, the hoppers of the stokers being some little below the floor level, so that all that is necessary to feed coal is to shovel it over the edge of the floor. The whole arrangement is, instead of being inconvenient, unusually satisfactory, the gauge glasses and water-level cocks being about the level of a man's head, and suggests the advisability of elevating boiler room floors above the fire doors in all cases of automatic stoking, or constructing a gallery at that level. The mechanical parts of the stoker likely to be overheated are kept cool by water-circulating pipes, the water warmed therein being afterward used for boiler feeding.



Part of the Switchboard of the Twenty-fifth Street Station.



Four Panels of the Switchboard from Behind; Generator Panels to the Right and Feeder Panels to the Left.

The fire room is supplied with coal by means of a Hunt conveyor, the fuel, arriving in wagons, being dumped first into a weighing hopper, from which it can be fed into the conveyor, which carries it to a 2000-ton pocket over the boilers. Chutes from this pocket, capable of weighing about half a ton of coal at each filling, empty in front of the boilers, the twelve older boilers, of course, being hand-stoked. The conveyor, on its return trip, passes under ash hoppers and serves thereby to remove the ashes. The steam and exhaust piping of the station is put in in duplicate, and the cable and electrical machinery may be piped together or independent.

The most interesting part of the station, however, is the switchboard, which differs considerably from switchboards of overhead equipments, owing to the all-metal nature of the distribution system. The positive and negative sides are both insulated from the ground or are intended to be, and are equipped alike on the board. The latter consists of a long structure of polished slate panels, which has grown so beyond the contemplated plans that its ends had to be swung around into something of a horseshoe shape, and, no further space being at hand in this direction, more panels are to be added on a gallery. The board has at its centre a total output panel equipped with the usual astatic integrating wattmeter rated to carry 8000 amperes, and also equipped with a reserve circuit breaker, which can be, at times of emergency, cut in in place of any one of the machine breakers. By the side of the total output panel is a water rheostat connecting panel for testing purposes, and flanking these two on either side are the machine panels, which are similar in all respects to standard 3000-ampere panels of General Electric construction for overhead traction work. The feeder panels, however, differ. Each feeder is equipped with two panels side by side, one positive and one negative. Each polarity carries a circuit breaker, a round-type ammeter and a single-pole double-throw quick-break switch, the wiring of which is such that the polarity of that feeder can be quickly reversed by throwing the two switches over. In this way grounds on different sections of the system can be [illegible] properly setting the feeder switches, and even if a dozen or more grounds are on the system [illegible] opposite polarities of [illegible]. The [illegible] attendant [illegible] which are somewhat [illegible] with the overhead, especially when the tracks in service are being extended or crossed by new work. The most lively attention is, however, demanded when there is a ground on the feeders or underground rails [illegible] As the grounded car moves from section to section, every time the grounded side [illegible] the grounded rail [illegible] tive, a short circuit exists and that section must be reversed. Such grounds have frequently been followed by the attendants at the [illegible]

The Boiler Room of the Twenty-fifth Street Station, Showing the Automatically Stoked Boilers in a Pit at the Left.

[illegible] all, of course, run underground in lead covered cable. Seven more [illegible] be added [illegible] The [illegible] at the end of the panels, being [illegible] of opposite polarities, have been separated by partition walls to prevent the current jumping over between the adjacent breakers when either one of them happens to hold an arc through some derangement, an accident which has occurred before these wooden barriers were installed. Another peculiar feature of this board is the fact that no lightning arresters are needed, and on this account the board is remarkably neat. The back of the board is arranged with the buses moved to a considerable distance behind the feeder panels and connected therewith through 1-inch copper rods. The system is watched for grounds by means of ten incandescent lamps connected across the buses, the centre being tapped off to ground. If either group of five lamps burns at full candle power, the other going out entirely, it is known that there is a more or less heavy ground on one side; if one side burns dim and the other comparatively bright there is a weak ground on one side, and if both burn at half voltage the insulation resistance is the same on both sides of the system.

The rated generating output of the station is obviously 3400 kilowatts, and the load already runs at periods of heavy traffic up to and over 3000 kilowatts. Before the station gets through the winter there will probably be some interesting tests of the overload capacity of the dynamos and engines there installed.

The chief engineer of the whole station, cable and electric, is Mr. G. W. Howard, and the electric generating plant is under the immediate charge of Mr. R. B. W. Peck.

The other temporary station is of similar magnitude and arrangement, and occupies a part of the large and handsome structure on One Hundred and Forty-sixth Street, near Lenox Avenue, a lage part of the building being used for car storage. The equipment here consists of three 850-kw machines of the same style exactly as those described above in the Twenty-fifth Street station, driven by the same make of engines. Besides these there are two smaller machines of about 450-kw capacity each, which were originally installed when the experimental Lenox Avenue line was erected. These machines are mounted on the shafts of Allis-Corliss engines. This gives the station also a rated capacity of about 3400 kilowatts. It is not as yet as heavily loaded as its downtown associate. The switchboard arrangement is practically the same, there being, however, thirty-four feeder panels for seventeen feeders. Steam is supplied by a battery of Babcock & Wilcox boilers, but [illegible] stoking apparatus.

The station is in the immediate charge of Mr. Walter Pearson, the electrical engineer of the company.

Undeveloped Water Powers of the Little River, North Carolina.

BY A. F. McKISSICK.

The water powers described in this article are situated on the Little River of Transylvania County, N. C., within 12 miles of the Southern Railway, and 30 miles from Asheville.

This river has a drainage area of 30,000 acres, and while the volume of the stream is rather small there are a series of cascades in the lower part of its course that lend themselves readily to the development of power, requiring in each case very little masonry work.

The falls of Little River are known as Bridal Veil, High, Triple and Hamilton's Mill, named in the order of their descent, and in the opinion of many are unsurpassed for beauty by any falls in the Blue Ridge range of mountains.

The first, Bridal Veil, see Fig. 1, has a fall of 110 feet, and is capable of developing 650 horse-power. A dam about 80 feet in length would afford a reservoir of about 2 miles long, and would be sufficient for the development of the power. The basin of the stream is solid rock, furnishing a good stone for dams and building purposes, and is very easily obtained.

High Falls (Fig. 2), which comes next in order, has an almost precipitous descent of 115 feet, capable of developing 700 horse-power. A dam here would not have to be longer than 90 feet, giving a reservoir of about 1½ miles in length.

Triple (Fig. 3) is, as its name implies, a series of cascades, aggregating 128 feet in descent, with a capacity of 750 horse-power, awaiting development, and is the most picturesque of all the falls. The accompanying illustrations give a very good impression of the beauty and grandeur of these falls, and also of their capabilities in a more utilitarian way.

The last falls on Little River, those at Hamilton's Mill, are now partially used for a saw and grist mill, and have a fall of 96 feet, capable of developing 700 horse-power. At these falls a dam 50 feet in length is all that would be required for their full development. Fig. 4 gives a view at top of falls, Fig. 5 at bottom.

At present the lumber from this mill is rafted down to the French Broad River, and so on to the markets at Asheville and Knoxville.

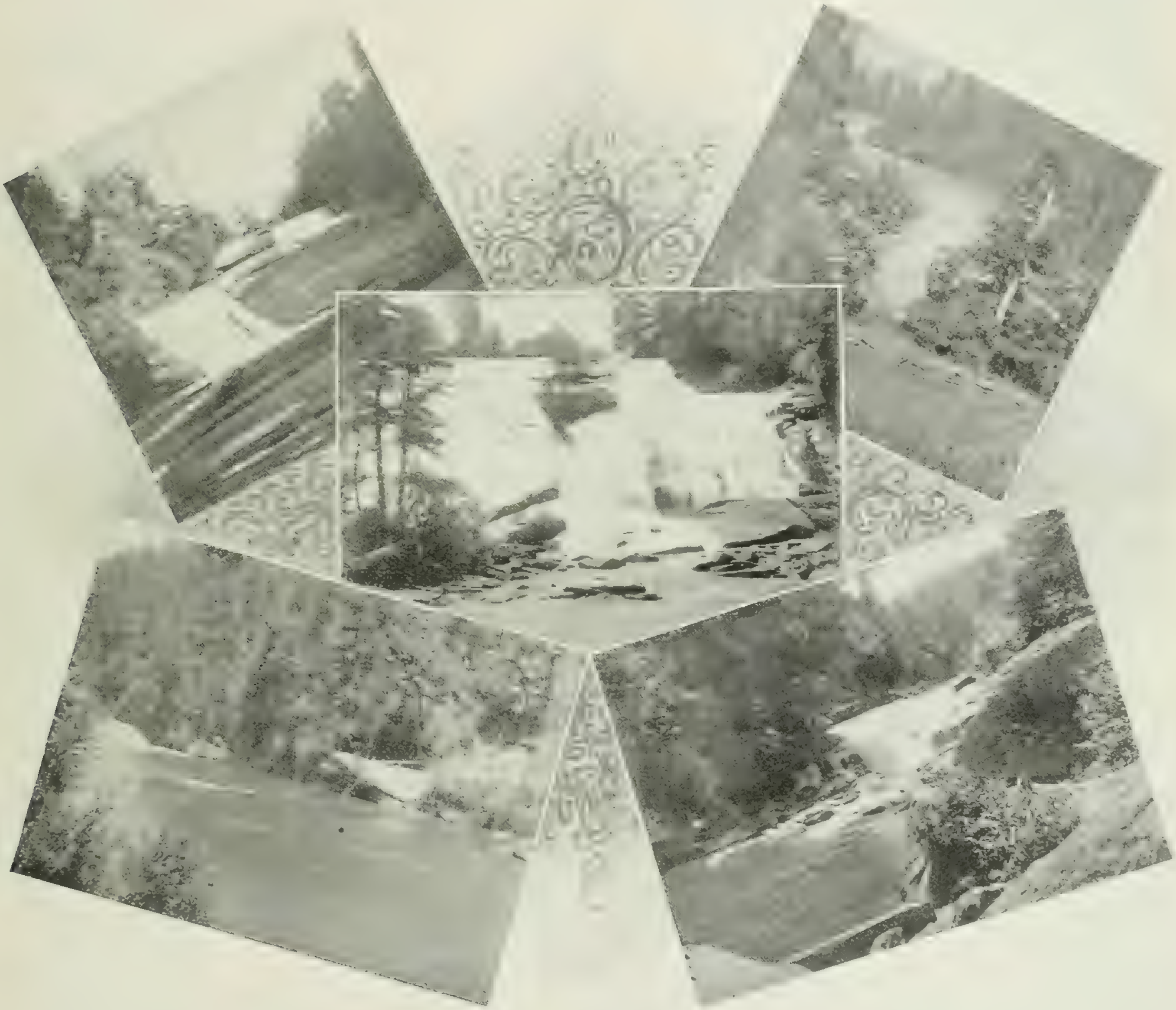


FIG. 3.—TRIPLE FALLS. FIG. 2.—HIGH FALLS. FIG. 1.—BRIDAL VEIL FALLS.
FIG. 4.—HAMILTON'S MILL FALLS FROM ABOVE. FIG. 5.—HAMILTON'S MILL FALLS FROM BELOW.

Wireless Telegraphy and Yacht Races.

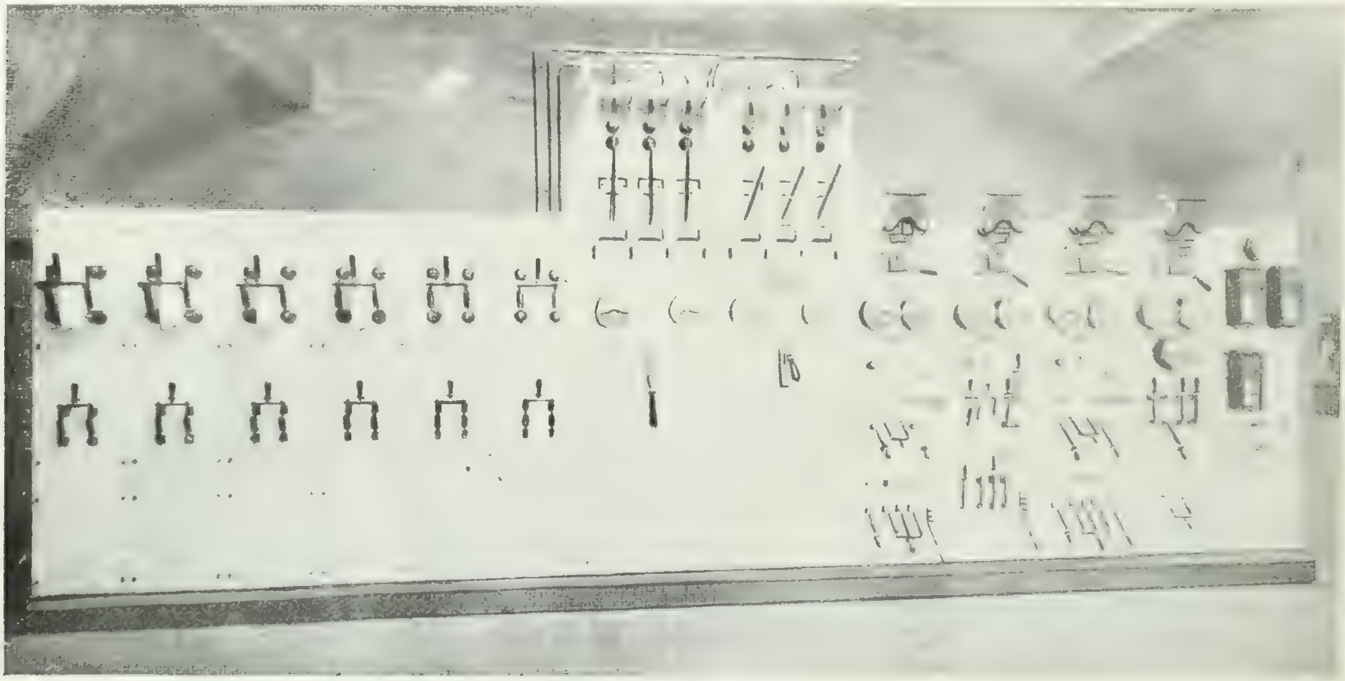
One of the varied applications of wireless telegraphy received an interesting illustration at the Kingstown regatta, says the London "Electrician," when Signor Marconi demonstrated the adaptability of his system to the transmission of press intelligence from a steam launch in motion. The yachting expert on deck dictated his account of the races while these were in progress, and a stream of dictated "copy" descended below deck to Signor Marconi, who sat in a cabin working his transmitter, whence the ether waves carried the news with a minimum loss of time to a fixed receiving station on shore. Arrived at this point, the news was forwarded to the press offices by telephone. It is stated that one edition of the local "Evening Mail" contained two whole columns of news dispatched entirely by wireless telegraphy. This notable event is undoubtedly the germ of an important development of wireless telegraphy in the near future.

An English Street Railway System with Multiphase Distribution.

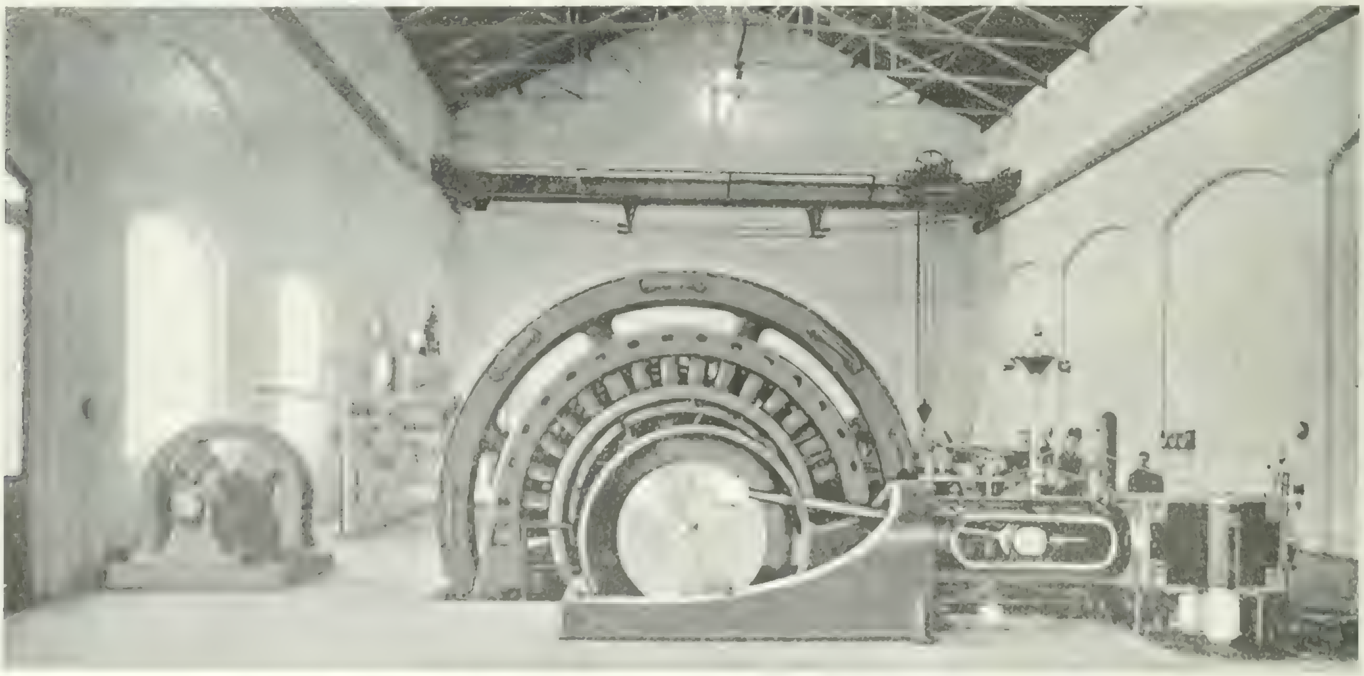
Since the publication in The Electrical World of August 6, 1898, of a descriptive article on the Middlesbrough, Stockton & Thornaby Railway there have appeared in the English technical papers various illustrated descriptions of the equipment of these lines. The accompanying illustrations are taken from the "Railway World" and the London "Electrical Review," and show the main switchboard, with the high tension measuring and controlling apparatus, a view of one of the main generators, and a view of the boiler room with the automatic stokers. A most interesting feature of this plant is the combination of multiphase distribution and [illegible] rent to charge these batteries at will. Instead of installing an ordi- [illegible]

the voltage of the direct current end of the rotary, which, of course, is proportional to the voltage of the alternating current delivered. Step-down transformers for supplying alternating currents to the rotary were made with considerable magnetic leakage, in other words with considerable self-induction, and by means of leading and lagging currents the voltage drop in these self-inductive transformers can be varied widely, giving the proper variation of the voltage delivered. The leading and lagging currents are obtained by varying the field excitation of the rotary, which, if excessive, causes leading leading currents to enter the armature, and vice versa, if small causes lagging currents.

The maximum distance from the power station to the most distant terminal of the line is only about 4 miles, and with proposed extensions about 5 miles further, a distance which would be considered within the limit of direct current feeding in this country, but which requires some auxiliary system in England on account of the Board of Trade rules with regard to the common return. These specify that the maximum difference of potential in the return system should not exceed 7 volts.



The Main Switchboard.



The Main Engine Room, Showing One of the Generators and One of the Rotaries.

The Welsbach Filament.

The publication of certain patents recently granted to Dr. Auer von Welsbach, and described as follows in the "Journal of the Franklin Institute," suffices to give a general outline of the direction in which he is working.

The patents alluded to describe two materials for the light-giving substance. The first is a fine filament of osmium, one of the metals of the platinum group. It must be prepared with great care, because of the extremely poisonous character of its fumes.

The basis of its selection as the substitute for the carbon filament is the fact that it does not fuse at a temperature much higher even than the fusing point of platinum.

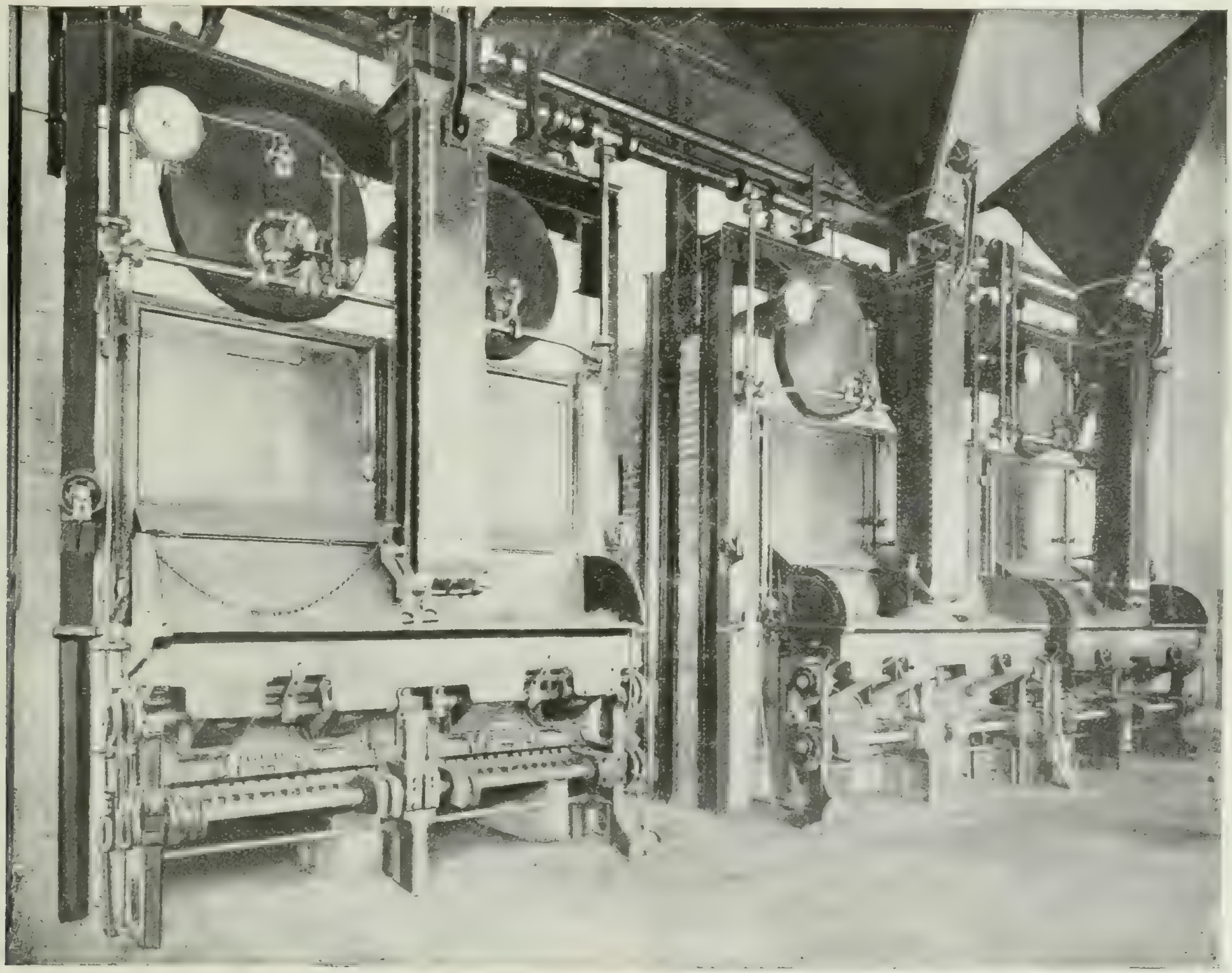
The fact that it is impracticable to fuse osmium (and on this great infusibility its value for Welsbach's purpose depends) makes it impossible to obtain it in any other form than that of a powder which cannot be united into a solid mass by pressure and then drawn into wire. It is necessary then to obtain the osmium filament by indirect means, and for this purpose Welsbach deposits it on a fine platinum wire maintained in an atmosphere of hydrocarbon vapor; and, the platinum wire being heated to incandescence in this atmosphere by the electric current, small quantities of the vapors of osmium tetroxide are blown in from time to time. The result is that a thin layer of metallic osmium is deposited on the platinum wire. This operation, it would seem from the published account, is a slow and exceedingly delicate one, for the deposited film must be quite uniform to answer the purpose, since any irregularity in the deposit would affect the uniformity of its resistance and yield a light more brilliant in spots. Another method of obtaining the deposit is described, which consists in drawing the fine platinum wire through the solution of an osmium salt, and then glowing it in a vacuum. To obtain the film in the required condition, by this method, only an extremely thin layer must be formed at a single operation, so that it must be repeated many times (100 times at least) to obtain the needed uniformity in the superposed layers. Neither of these methods, therefore, seems to present much promise of success on the commercial scale.

A more practical method suggested is the use of vegetable or animal fibres as the foundation for the osmium coating. A liquid pulp is made by mixing finely divided osmium oxide and suitable fibres with sugar solution or other organic cementing material, and, after drying and cutting into the required shape for the lamp, glowing the mixture slightly in an atmosphere of reducing gas. By this and slightly modified methods a carbon skeleton is formed, carrying a certain quantity of unconsolidated osmium. It will be observed that the resulting filament is not a pure osmium filament, but one consisting largely of carbon, and hence open to the same objections as the common carbon incandescent lamps, besides being vastly more costly.

The second proposal of Welsbach is the thoria filament. This substance is one of the rare earths largely used in the manufacture of the Welsbach gas mantles, and is known to possess light-emitting qualities of a high order.

To obtain this filament the inventor employs an extremely thin platinum wire (0.02 millimeters in diameter) approximately as thin as a single fibre of the silk cocoon, and draws this successively through elastic cheeks, which are kept moistened with a solution of a salt of thorium. After each drawing the wire is glowed, and the operation must be repeated, as in the one above described, many times, in order that the resulting coating shall have the necessary permanency.

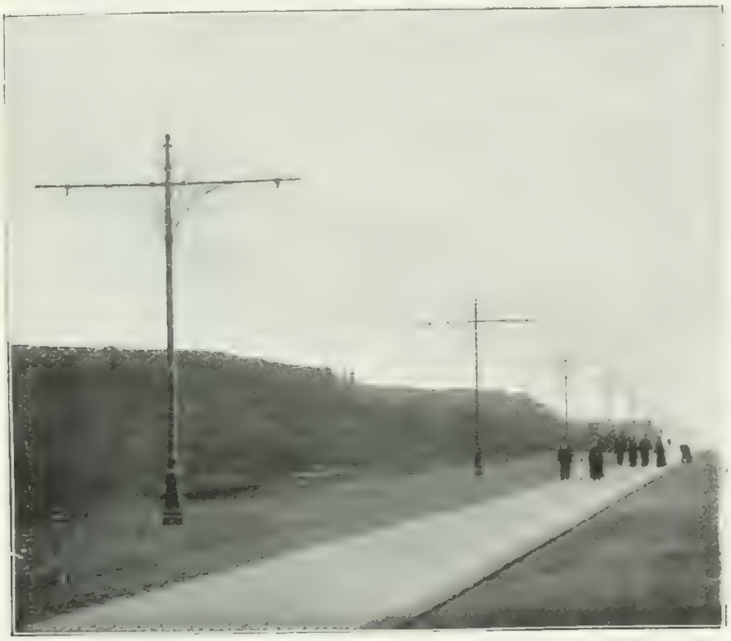
The resulting thread, then, is a platinum core, surrounded by a dense incrustation of thoria. The heat-resisting qualities of the incrusting oxide are said to be so great that the platinum within may be melted without affecting it, while the luminous intensity of the thoria is very great at temperatures low compared with other substances. For this reason the temperature may be kept below the fusing point of platinum.



The Boiler Equipment of an English Street Railway System.

The Overhead Trolley in England.

The English system of overhead railway line construction differs somewhat from the American, owing in part to the more fastidious æsthetic tastes of the public and in part to the different nature of the cars. Bracket construction is used to a greater extent than in this country, and the poles and fittings are as a whole quite ornamental. The accompanying illustrations show some examples of this, the brackets being apparently supported by a graceful scroll of twisted ironwork, but in reality supported by diagonal tension lines running to the top of the pole above. English street railway cars are very frequently double-decked, and to prevent interference of the overhead trolley with the passengers on the upper deck the trolley base is often placed on a post or column rising several feet above the top of the car. A device unknown in this country is that known as the Dickinson side trolley, whereby the trolley wire may [illegible] wheel is swiveled on the end of the pole by a vertical pin, contact with the wheel and wire not being immediately in line with the pin, but somewhat to the rear, so that the wheel flanges as the car moves along adjust themselves to the direction of the trolley wire.



An English Suburban Line.

A [illegible] Car.

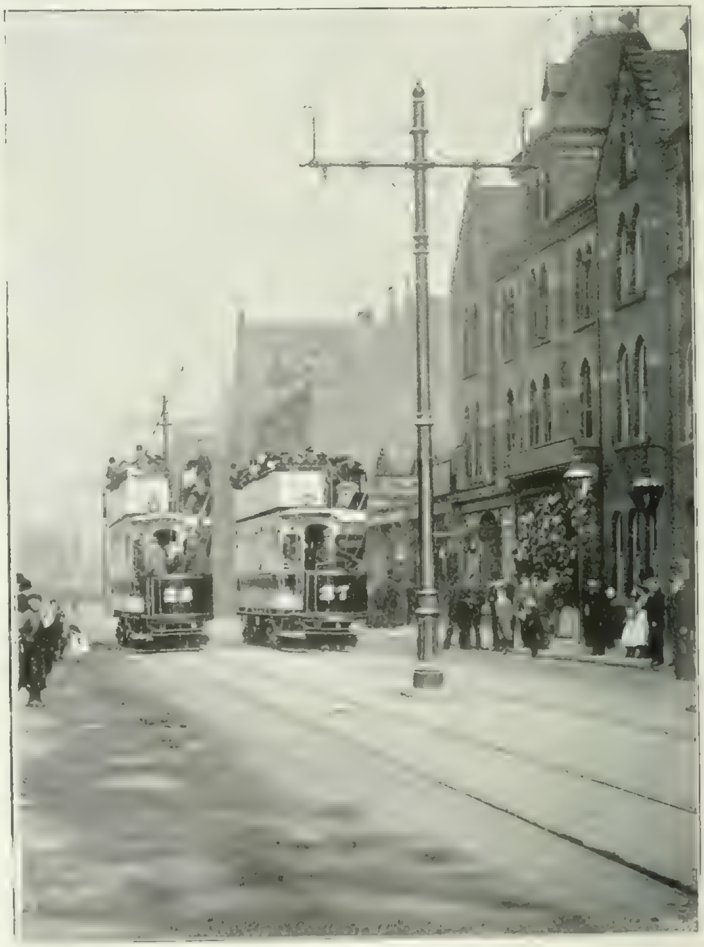
Telephones in Cape Colony.

According to a consular report the telephone service of Cape Colony is under the control of the colonial government. On the 9th of April, 1898, there were 1535 instruments in use, and the revenue for 1897 amounted to $66,137.22. There are 869 miles of wire and 780 subscribers. Seven exchanges in the colony work on the single-wire system, but arrangements are now being made to have all lines duplicated, and in future no exchange will be established except on the metallic-circuit system.

In the course of the next few months the underground cable system in Cape Town will be completed and exchanges established in the suburbs.

The Diesel Motor at the Munich Exposition.

At the exposition now being held in Munich the display of Diesel motors occupies a special building, several manufacturers licensed under the Diesel patents making exhibits. Among these are two built by the Maschinenfabrik Actien Gesellschaft, of Nurnberg, one of which is a 30 h.p. engine fitted with two cylinders coupled directly to a Schuckert dynamo. Another motor exhibited propels a Linde machine for the production of liquefied air, and others drive centrifugal pumps. Besides the four firms exhibiting at the Munich exposition three others in Germany are now engaged in the manufacture of Diesel motors.



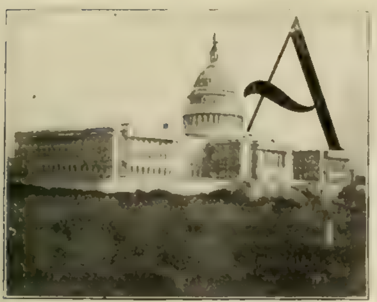
The Overhead Line and Cars of the Middlesbrough, Thornaby and Stockton Road.

Electric Railways in Shanghai.

The United States consul general at Shanghai states that a special committee of the city council contemplates the construction of about 15 miles of street railway equipped with the overhead trolley system. The concession is to be given for the construction, equipment and operation of the line to the highest bidder for thirty, forty or fifty years, according to the tender that may be accepted, the concessionaire to pay the city a percentage of the total gross receipts during this period.

Electricity in the United States Capitol.

BY BUSHROD C. WASHINGTON, JR.



A VAST amount has been written concerning the Capitol building of the United States, but somehow no one has yet undertaken to present to the electrical engineers of the world a detailed description of the electrical machinery which controls the artificial light and ventilation of this tremendous building.

The Capitol is 751 feet 4 inches in length, and 350 feet in width, covering over three and a half acres of ground. The great dome terminates in a lantern 15 feet in diameter and 50 feet in height, which is surmounted by the statue of Freedom, towering 307½ feet above the esplanade. During night sessions of Congress the lantern is lighted by gas, day sessions being indicated by the presence of the United States flag on the Senate and House flagstaffs.

The electrician has in view lighting the lantern for night sessions, with three rows of colored electric lamps, using the national colors, red, white and blue. Red is to signify that the Senate is in session, white the Supreme Court, and blue the House. All three sets of lights are to be lighted when both the House and Senate are in night session.

There are two separate and distinct power plants, located respectively in the Senate and House portions of the terrace on the west front of the Capitol. The terrace is really a part of the Capitol, and was added partly for giving the building better architectural proportions and partly because of the great and growing necessity for more room. The walls are built of marble, granite and brick, and the roof is of brick arches supported by heavy iron I beams. The upper surface is heavily concreted, and numerous skylights furnish ample light for the corridors below. The steam plant on the House side consists of two Babcock & Wilcox boilers, one of 350 horse-power and one of 150 horse-power. The steam pressure is 200 pounds. The 350-hp boiler has just been installed. The 150-hp boiler supplies steam for the House plant. This boiler has developed over 230 horse-power, as indicated by the electrical output, viz.: 1500 amperes at 115 volts. An expansion joint connects the steam mains of the two boilers. A No. 8 Reilly boiler feed pump is used. The separator is located between the boiler room and the dynamo room and is fitted with a Bundy automatic trap. The separator and steam mains are covered with Nonpareil cork packing. The condenser is a 10-inch Buckley, injector type.

Steam is conveyed in 10-inch mains to the two Westinghouse compound engines. Each of these engines is direct connected by means of a flexible coupling to a 75-kw Westinghouse generator. The generators are the standard type of multipolar direct-current machine generating 600 amperes at 125 volts and 300 r. p. m. The usual voltage is 115 at the switchboards. The generators have been run day and night for six weeks at a time without stopping, and during those periods of long continuous runs have been subjected to overloads of more than 25 per cent. without the slightest injury to the machines.

The switchboard is the Westinghouse railway type 5, made of Italian marble 2 inches in thickness. There are five panels, and a small additional marble slab has been added on the right of the board for an equalizer switch. Beginning on the left, the first and second panels are provided with 1000 and 1200 ampere ammeters, respectively, and six double-pole switches. These twelve switches control the motor and light circuits, for the House ceiling, the corridors, and the Capitol grounds.

The third panel consists of one 2000-ampere ammeter; one 125-volt voltmeter; two 2000-ampere circuit breakers and a 125-volt Weston direct-reading voltmeter. The other two panels are each provided with an 800-ampere ammeter, a 600-ampere circuit breaker and a three-pole switch and rheostat. Each panel has a pilot lamp. Equalizer bus bars have been added to the board since it was first installed.

There is urgent need of another generator of the direct-connected type, and an appropriation has been obtained to enable the purchase of such a generator, with a capacity of not less than 225 kilowatts. The present steam plant is sufficient for supplying steam for the present equipment and the contemplated increase.

The Senate plant is considerably larger than the House plant, and besides supplying current to a large number of lamps also furnishes power for several motors driving large ventilating fans.

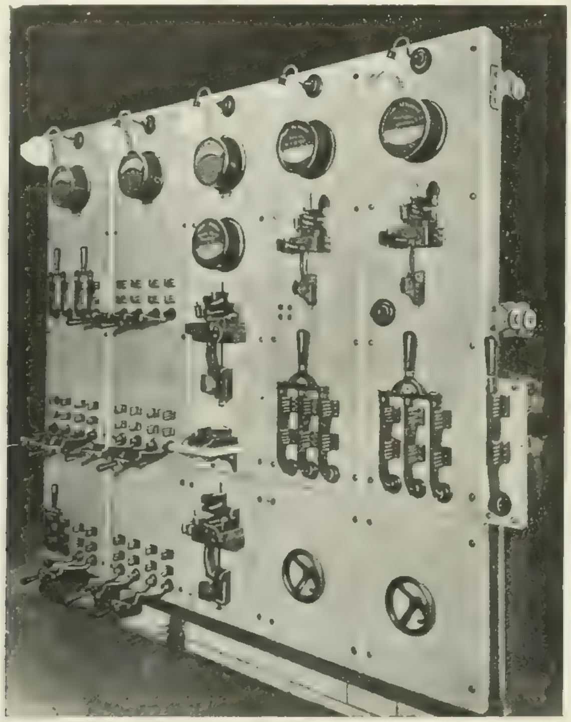
The steam supply for the Senate plant is furnished by three Babcock & Wilcox boilers, one of 100 horse-power and two of 200 horse-power each. The boiler feed pump, separator, and condenser are of the same makes as those in the House plant. Twelve-inch steam mains run from boiler room to dynamo room. The mains and separator are covered with magnesia non-conducting material. There are three generators in this plant. Two are 75-kw Westinghouse generators of exactly the same pattern as those in the House plant, and the other is a 187½-kw Westinghouse generator. The latter at 250 r. p. m. generates 1500 amperes at 125 volts. All three generators are direct connected by means of flexible couplings to Westinghouse compound engines. The oil from these engines, as well as those in the House plant, runs into Westinghouse separators and is used over and over again. The boilers, engines and generators of this plant have been run for long periods at a time without a shutdown, and were frequently subjected to heavy overloads without injury to the machinery. The switchboard is of Italian marble, 2 inches in thickness, and contains six panels. The two left-hand panels are for the two 75-kw generators and equipped like panels 4 and 5 of the House plant. The third panel is for the 187½-kw generator and carries the following: one 2400-ampere ammeter, one 2000-ampere circuit breaker, three single-pole switches, and a rheostat. The load panel carries a 125-volt voltmeter, one 5000-ampere main ammeter, one 1500-ampere circuit breaker, a switchboard voltmeter, one 1500-ampere double-pole switch and one 1500-ampere single-pole switch. Panel No. 5 carries a 1200-ampere ammeter, and six double-pole switches for the various circuits. Panel 6 only differs from panel 5 in the ammeter, which is 1000 amperes capacity. Each panel is provided with a pilot lamp. Equalizer bus bars have been added since the plant was first built.

The floor plans show that every inch of available space has been utilized to the best possible advantage. Owing to the shape of the room and the projecting walls, which interfere with a good view of the entire plant, a photograph of this room was not obtained. The arrangement of the engines and generators is very compact, and only sufficient room is left between the walls and the machines to render the parts accessible to the attendants. The forced arrangement of the machinery keeps the attendants constantly on the move, as there is no one position from which they can watch to advantage the three generators and the switchboard. The two plants are about 370 feet apart, measured across the court on which they open. The cables are run in a conduit laid across the court. For a time the plants were run in multiple without an equalizer, the connections being made by nine 0000 positive and nine 0000 negative cables. At present there are the same number of positive and negative cables and nine 0000 cables connect the equalizer bus bars of the two switchboards.

Each station has a telephone, and the attendants call up each other when they desire to run the plants in multiple, and also when they desire to shut down either of the plants. The attendants in each station are notified when adjournments take place, so that they can cut out the lights in their respective ceiling circuits. They are also notified when the current is required for the House or Senate ceiling on dark days. There are 1400 16-cp lamps over the House ceiling, and 1200 over the Senate ceiling.

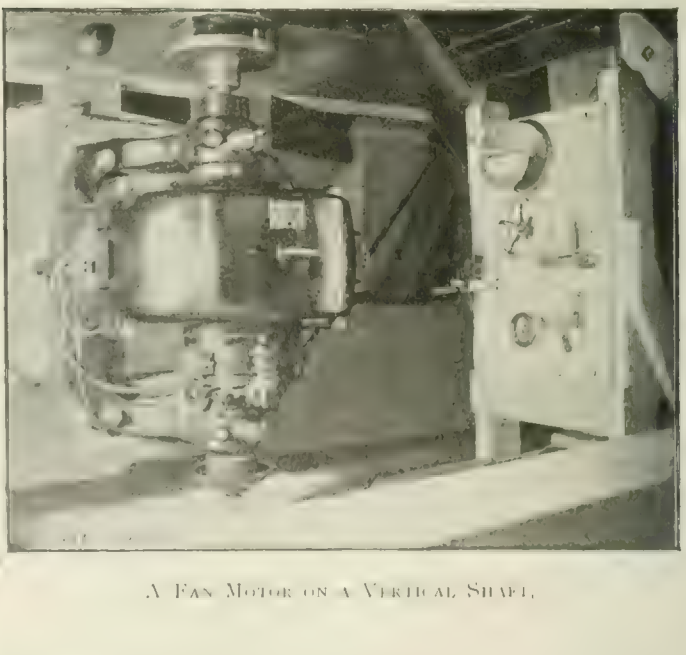
The light is thrown downward through glass panels set in iron frames. The roof is about 15 feet above the ceiling. In the Senate chamber the ceiling panels are painted with the symbols of War, Peace, Union, Progress, the Arts, Sciences and Industries, and those of the House of Representatives with the coats-of-arms of the States. When the lights are on the effect is beautiful, as the light passes through these finely colored panels and lights the Chamber and Hall with a soft glow that is pleasing to the eye. The many long corridors are brilliantly lighted by large clusters of lamps, the immense size of the building rendering it absolutely necessary to depend on clusters instead of single lamps. In some of the rooms the huge chandeliers are of the richest designs, and are highly ornamental, notably in the President's and Vice-President's rooms in the Senate wing. These chandeliers were originally lighted by gas, but were taken down and fitted with electric lights by the chief electrician. Visitors who employ guides are always shown these fixtures. Mirrors at the ends of the rooms multiply the chandeliers until they disappear in the distant perspective. In all there are about 8000 incandescent lamps, a number many times too small to adequately light the building, so that gas is also used. There are many fine points about the building, especially in the rotunda and statuary hall, which could be effectively brought out if there were sufficient power to light the lamps when in position.

There are nearly 150 1000-cp inclosed Manhattan arc lamps on four circuits. These lamps light the East and West fronts of the building, and the grounds. They burn from 100 to 150 hours without being trimmed. The mains are placed underground. The conduits were built and the new posts and fixtures supplied by J. P. Hall, of New York. The manholes are brick-lined, with cement bottoms fitted with drain connections. The tops are of cast iron, with a simple locking device. The lamps in the grounds are arranged at short intervals along the walks and driveways and are placed so closely together that one can read a paper while walking through the grounds at night. Many of the ornamental posts used for gas lighting were reconstructed and equipped with arc lamps. The electrician in charge states that these lamps rarely get out of order, and that their mechanism is so simple and accessible that repairs are easily and quickly made. The beautiful clear white lights in these grounds make a strong contrast with the yellow clusters of incandescents which light the library building and grounds adjoining. The installation of electric lighting in the grounds rendered necessary considerable trimming of the trees bordering the walks, and also rendered the grounds safer to pedestrians.


The Switchboard of the House Plant.

The effects following the substitution of electric lighting for gas lighting are very marked, and the benefits are of great importance. There was always a noticeable rise in the temperature on the floor of either the House or the Senate following the lighting of the 1200 to 1500 gas burners over the ceilings; but since the installation of electric lighting no such rise has been noticed, and consequently no sudden change has been required in the operation of the ventilating system. The occupants are also saved now from [illegible] falling glass. During cold weather in consequence of the [illegible] hot air which [illegible] with the plates of glass in the skylight [illegible] between the outer and inner sections that the large plates were frequently fractured. Since the introduction of electric lighting there have been comparatively few plates cracked from this cause. The temperature [illegible] from [illegible] to [illegible] Under the present system the temperature [illegible] The glazing over the ceiling was done by J. [illegible] Hall, of New York City.

The ventilating system is practically as perfect as can be attained by the use of the best of modern appliances and engineering skill. The ventilation of the Capitol was carried out under the plans of Prof. S. H. Woodbridge, heating and ventilating engineer, of Boston, Mass. The ventilating fans are driven by electric motors. An 18-hp Westinghouse multipolar motor is directly connected by means of a quarter-turn flexible coupling to a fan 10 feet in diameter, built of steel. The motor is shunt-wound for 110 volts. This motor undergoes a very severe service, often running for one or two months without stopping. A field rheostat is provided, consisting of 162 turns of No. 12 wire, and carrying the 5.6 amperes of field current. The fan driven by this motor at its lowest speed of 125 revolutions delivers 35,000 to 36,000 cubic feet of air per minute to the Senate chamber. At a speed of 150 revolutions the fan delivers 48,000 cubic feet of air per minute. The air is carried by one channel to the Senate floor, and by another to the gallery. The temperature of each supply is under independent control and the gallery supply is a degree or two higher in temperature to reduce the tendency of the air from the gallery to fall to the floor of the Senate chamber. The air is passed through the floors, and the velocity of the flow reduced by means of large diffusing surfaces at the points of issuance into the chamber. This result is obtained by having finely divided openings for each desk in the floor risers, covering about 100 square inches in addition to 120 square inches in the desk-leg diffusers. In the gallery the air is diffused through the chair legs and in the reporter's gallery through the stool legs. The air discharged through the Senate ceiling is removed through the roof by means of an 8-foot inverted Blackman wheel run by a direct-connected Westinghouse 8-hp motor at 130 r. p. m. This motor is located over the press gallery. Another large exhaust fan driven by an 8-hp motor of the Westinghouse multipolar shunt-wound type exhausts the air over the Senate chamber. This motor is arranged with special bearings for operation with the shaft in a vertical position. These two fans and motors are mounted on frames of massive construction and are exceedingly stable, producing no noticeable vibration and running without noise. A small compartment was built for the attendant, who has telephone connection with the chief engineer. This process of removing the air is done with an expenditure of only one-twentieth of the power required by the former method. The hot-air fan is driven by an 18-hp Westinghouse motor of the same type as previously described.


A Fan Motor on a Vertical Shaft.

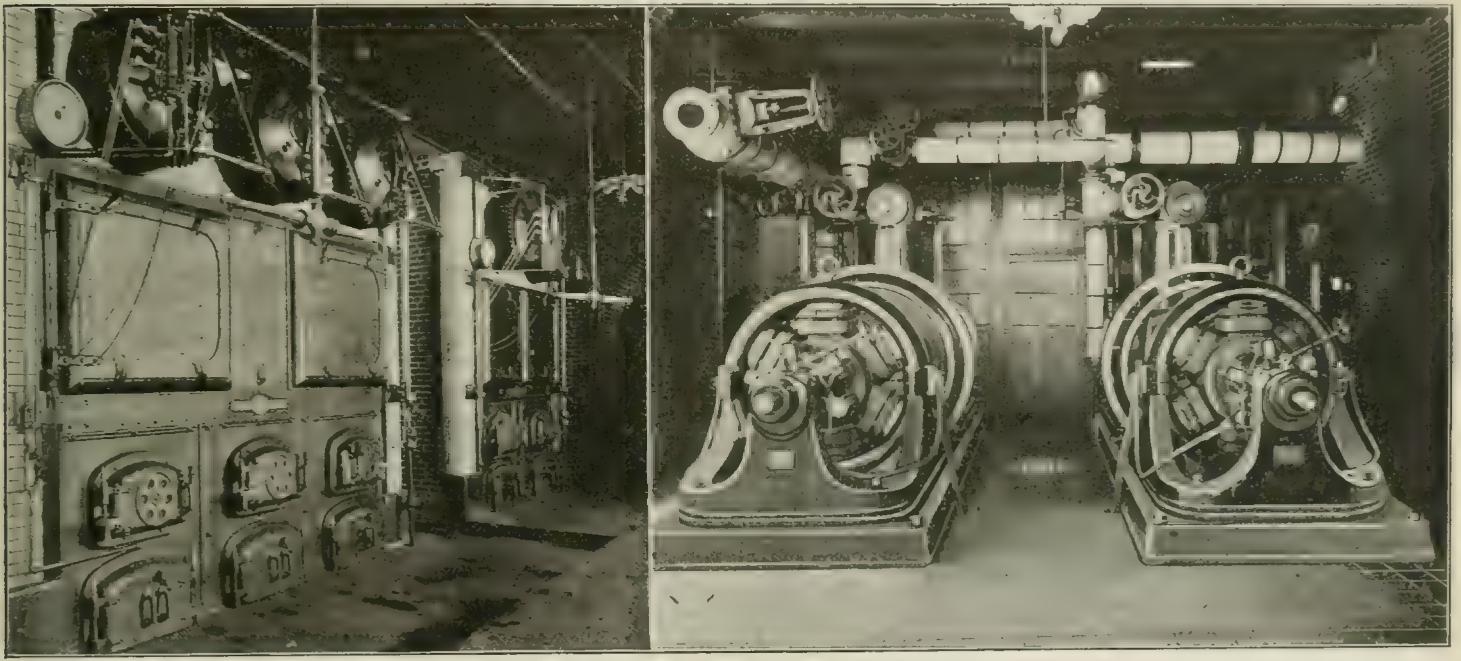
The terrace is ventilated by a Sturtevant fan driven by a motor built by that company. The motor is wound for 110 volts, at 1500 r. p. m. The fan runs at 225 r. p. m. This company also furnished the two 10-foot fans driven by Westinghouse motors previously mentioned.

The cloak rooms are connected by air ducts with the roof, and the smoke-laden air is taken out by small exhaust fans, at the rate of about 1000 cubic feet of air per minute, from each cloak room. There is an inverted Blackman fan, motor driven, placed in the ceiling of the Senate toilet room and the air is kept pure and fresh, as there is a strong current between the open door and the exhaust fan.

In the chief engineer's office there is a system of gauges, thirteen in number, by which the steam and water supply for heating and ventilating is always under observation. There is also an Edson recording gauge for keeping a constant record of the boiler pressure. In his private office is located a three-panel switchboard, on which are mounted ammeters, switches and circuit breakers for the large fan motors in the terrace and the exhaust fan over the press gallery. Under each ammeter is a card, showing the number of amperes of current required to drive the fans at different speeds. This affords a simple system for indicating the amount of air sent into the various parts of the building, and is a great factor in the close regulation of temperatures.

On the west side of the Senate wing is located a Sprague electric elevator of 4000 pounds capacity, and a maximum speed of 300 feet per minute. This elevator is run for the exclusive use of the Senators and Senate employees.

The graphophone plays an important part in the House and Senate proceedings, and there are many of them in almost constant use. The official stenographers, who record the speeches and debates, alternate every fifteen minutes, and during the intervals they read their notes into the graphophone receiver. The record cylinder is taken off immediately and sent to the typewriters' room, where a corps of experts place the cylinders on their graphophones, and as the graphophones reproduce the speeches they are typewritten. Two copies are made, so that a Senator or Representative receives a copy of his speech, as it was delivered, within fifteen or twenty minutes from the moment he yielded the floor to another. After he has corrected his copy it is sent to the government printer, and appears next morning in the "Congressional Record." All the graphophones are run with current taken from the lighting circuit. They were originally operated by storage batteries. Charging the batteries required considerable time, and they were not always available and had the habit of giving out at inopportune times, so that they had to be discarded. The chief electrician overcame all the difficulties by utilizing the current from the lighting circuit. Two 110-volt, 32-cp lamps are connected in series multiple with the motor. The lamps are so placed that they furnish light to the typewriter, thus rendering double service.



THE BOILER AND ENGINE ROOMS OF THE HOUSE PLANT.

At present the members call the pages by pressing electric buttons at their desks, doing away with the noisy custom of clapping hands, a custom still retained by the senators. There is a 200-drop annunciator on either side of the floor of the House, and an attendant sees to it that prompt service is rendered at all times, and also that the pages answer calls in proper rotation.

When books are desired from the congressional library it is the work of a very few moments to have the desired volume transferred from its shelf in the library to the member's desk. Calling a page the order for the book goes to the receiving station and is sent to the library through a pneumatic tube. The book is sent over in a heavy leather case, which travels in a steel carriage on a rope cable. The cable is driven by an electric motor in the basement of the library. The current for the motor is supplied by the library electric plant.

The Western Union and Postal Telegraph Companies and the long-distance telephone render excellent service for communication with the outside world, not only for the senators and members, but the large corps of newspaper correspondents who throng the building. The three companies maintain offices at both ends of the Capitol.

Congress has already begun to interest itself in acquiring the Great Falls of the Potomac, and the electrical development of the power there. There are so many electric light and power plants now operated in Washington by the Government that the question of economy renders it advisable to build a large central station to supply the many demands for light and power. I desire to express my thanks for the valuable assistance rendered me in the preparation of this article by the architect's office, the chief electrician and the chief engineer of the Senate.

Resistances for Absorbing Large Powers.

A contributor of "L'Electricien" describes an ingenious construction of rheostat for absorbing an output of 400 kilowatts used in testing the generators in the station at Nancy, France. The rheostat consists of galvanized iron netting ordinarily used in protecting the underground distribution cables, the particular advantage obtained in using this material apparently being the enormous radiating surface per unit cross section. A strip of this netting about 11 inches wide, composed of sixteen strands of galvanized iron wire with a cross-section of about 8-100 of a square inch, the whole strip being 180 feet long, absorbs 500 amperes at 240 volts, the strands remaining at a temperature below that of the fusing point of lead.

Search Lights Mounted on Captive Balloons.

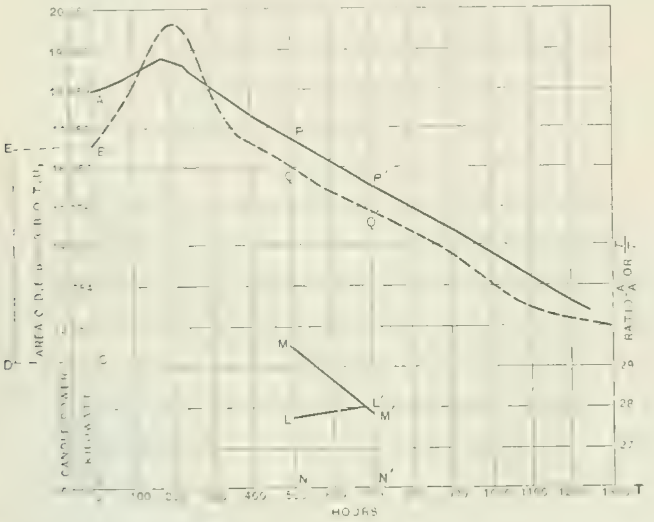
It is said that the War Department of the Russian Government is conducting a series of tests with projecting lanterns mounted in captive balloons, the current being supplied through the cables holding the balloons to the earth.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE
AMERICAN AND FOREIGN

By Carl Hering.

Lights and Lighting.

SMASHING POINT OF INCANDESCENT LAMPS. Carter. Lond. "Elec. Rev.," August 19.—A description of a method of determining what is known as the smashing point in the life of a lamp (as the candle power of a lamp diminishes when the lamp grows older there is a point at which it is cheaper to throw the lamp away than to let it burn out, and this age of the lamp is termed its smashing point). He assumes that instead of breaking the lamps they are transferred to places where less light is required after that age has been reached; in his calculations he assumes that the cost of this transfer is added to the initial cost of the lamp. The full line in the adjoining diagram gives the average relation between candle power in a definite direction, and time of burning for lamps of a particular type; the dotted curve gives the relation between the power taken and the time of burning; in any time represented by *O N*, for instance, the amount of light obtained from the lamp in cp-hours is represented by the area *O A P N*, and the amount of energy used by the area, *O B Q N*; to the latter is added the area *C D E B*, representing the total cost of the lamp. The smashing point will be reached when the ratio of the total amount of light obtained to the expenditure on the lamp is as great as possible—that is, when the ratio of the area *O A P N* to the area *O C D E B Q N* is as great as possible; this he shows analytically to be the case when the ratio of these two areas is equal to the ratio of the distance *P N* to *Q N*; the equality of these ratios can be determined with sufficient accuracy by finding the ratio of the areas and the lengths of these lines, for a time represented by *N* and again for a time represented by *N′*; let *N L* equal the ratio of the areas and *N M* the ratio of the lines for the first case and similarly lettered lines in the second case, then the intersection of these two lines joining similar points will give the point at which these ratios are equal, and the time corresponding to this point is the smashing point; in the case illustrated this point is about 670 hours for that particular lamp. He then discusses the question of whether or not there may be a second maximum point, and shows how to find this out. The particulars required to construct the original curves should be known to the makers of the lamp, and he suggests that a table giving the smashing point for different values of the ratio of the cost of the lamp to that of a unit of energy would be of considerable value to large consumers.



Power.

SPEED REGULATION IN POWER DISTRIBUTION.—Lond. "Elec. Eng.," August 19.—An answer to a request to state the relative advantages and disadvantages of direct current and multiphase-current systems as far as speed regulation alone is concerned.

HUNTING OF ELECTRIC LIGHT ENGINES.—Lond. "Elec. Eng.," August [illegible].—An editorial answer to a request to state what the cause of this hunting is and how it may remedied.

SNOQUALMIE FALLS TRANSMISSION. "West. Elec.," August [illegible].—A brief, illustrated description of the transmission plant, with which power is to be sent to Seattle and Tacoma, Wash.; the work of construction is now well under way, the illustrations show the work accomplished.

SNOQUALMIE PLANT.—"Elec. Eng.," August [illegible].—A short article on the transmission plant (see abstract above). It is expected that within a few months [illegible] kilowatts will be transmitted to Seattle and [illegible] to Tacoma, the falls are about 24 miles from Seattle and 34 from Tacoma. The transmission voltage will be 29,000 at the Falls; it has been decided to use aluminum wire for the transmission line, as the cost of it is cheaper than that of copper; the metal will contain 99.30 per cent. of aluminum and 1.50 per cent. of copper; about 150,000 pounds of it will be used; there will be two circuits of three wires each, to each of the cities. 30,000 horse-power are available at the Falls at extreme low water.

CANON CITY.—"Elty," August 31.—A brief description of this plant, which has just been started, and with which power is transmitted to the Cripple Creek gold mines, 24 miles distant. The generating plant is in the midst of extensive coal fields, and is said to be one of the largest and best equipped electric plants in the West.

LARGE ENGINES FOR CENTRAL STATIONS.—"Eng. News," August 25.—An illustrated description of one of the two engines of 1500 horse-power for the central stations in Berlin, Germany; it is a cross-compound condensing engine.

Traction.

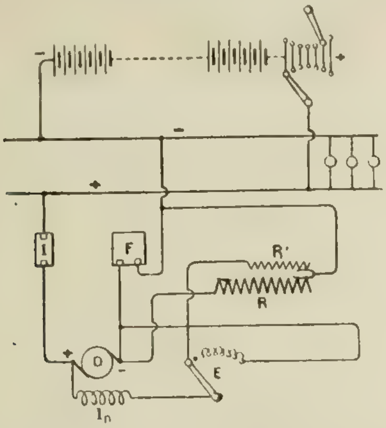
ALTERNATING-CURRENT TRACTION. Davis and Forbes. "Eng. Mag.," September.—The second article on this subject (see "Digest" August 6). In this one they consider in detail the indirect application of alternating currents to railway work; they consider three cases, the first where the source of power is a considerable distance from the railway, then when it is at one end, and finally when it is at the middle of the line. In order to compare the relative first cost and operating expenses of the two methods—namely, that of a cheap source of power located at a distance and that of the application of power from points along the railway—they consider the definite case of a high-speed line running between New York and Philadelphia, a case in which they claim that electric traction is the only satisfactory or profitable solution. They show how fallacious the usual assumption is that the utilization of a cheap source of power at a distance results in greater economy than the use of power stations close to where the power is applied. A tabulated estimate is given of the first cost and running expenses of the two methods; these show that the items which must be added to the cost per car mile by the use of two-water power located 100 miles away, about balances the greater cost of fuel, wages, etc., when the stations are located close to the track and operated by steam power, and hence the total expenses will be practically the same; as the transmission line costs $25,000,000, the interest on this is the total increase in the expenses when the water powers are used instead of the steam power plants. They claim to show conclusively by this that it would not pay to utilize the water powers.

UNDERGROUND RAILWAYS OF LONDON. Cooper. "Eng. Mag.," September.—An illustrated article describing the construction of the various underground railways, chiefly the Metropolitan, which is operated by steam; a brief reference to the electric underground roads is also given.

POWER FOR KEEPING A CAR IN MOTION.—"El'ty," August 31; reprinted from the Lond. "Railway World."—A short article in which a clear and simple explanation is given of the way to calculate the power necessary to keep a car in motion on a level and on grades; the formulas are already well known. He assumes that the average pull is equal to about 30 pounds per ton, which may, under very favorable conditions, be as low as 10 or 12 pounds on a level steam railway.

Installations, Systems and Appliances.

STARTING GAS ENGINES.—Lond. "Elec. Rev.," August 19.—A long abstract, with some illustrations, of the article abstracted in the "Digest" June 11. A description is given of a method of starting gas engines in private plants when a battery of accumulators is available; it appears that a number of difficulties arise, and these are overcome by the method described; advantage is taken of the fact that the shunt-wound dynamo, while acting as a motor, will revolve in the same direction while the current is in the opposite direction. The arrangement is shown in the accompanying diagram. *I* and *F* are two switches, the latter being automatic; the rheostat, *R*, should be so arranged that one part is always in circuit during starting, while the other part is divided into a large number of sections to be successively cut out; the second rheostat immediately above it is cut out by the same moving contact; connection is made, as shown, to an insulated contact at the head of the field regulator, the handle of this regulator resting upon that contact during starting; this is, therefore, cut out entirely before the field rheostat is moved in order that the magnetic field should have its maximum value at the moment of starting. To start the motor the switch *I* is at first left open and the contact above the resistance *E* is moved to the left, there should be no compression in the gas engine until the proper speed has been reached. The resistance above *F* might be omitted by placing the lever of the resistance *E* to the extreme right, but this would cut down the field current, owing to the resistance *R*, and there might be a dangerous current in the armature. To make a sure start of a 45-hp engine required 90 to 110 amperes during 25 to 30 seconds; a 25-hp motor connected to a heavy shaft required 70 amperes for about twenty seconds; a 50-hp engine required 85 to 90 amperes; these figures are about two-fifths of the maximum power produced, but the time required is very short. A single rheostat can be made to serve the purpose of starting a number of engines in the same installation; a diagram showing this is given.



CHARTERS TOWERS.—Lond. "Elec. Rev.," August 19.—A brief, illustrated description of the plant in this town in Australia.

Wires, Wiring and Conduits.

RULES AND REGULATIONS. Cahen. "Elek. Zeit.," August 4.—A discussion of those adopted in Germany.

Electro-Physics and Magnetism.

CATHODE RAYS PARALLEL TO ELECTRIC FORCE. Lenard. "Wied. Ann.," No. 7; abstracted in Lond. "Elec.," August 19.—He describes what is said, in the abstract, to be a new and important discovery, resulting in the further confirmation of the emission theory of cathode rays. When a beam of these rays is transmitted along the lines of force of an electrostatic field, the deflection by electrostatic or magnetic forces undergoes a modification; he shows that the transmission of cathode rays through the electrostatic field in the direction of the lines of force diminishes their velocity.

RADIATIONS FROM THORIUM COMPOUNDS. Schmidt. "Wied. Ann.," 65, page 141; abstracted briefly in the "Elek. Zeit.," August 11.—Thorium and its compounds emit rays which are similar to those from uranium; they will blacken photographic plates through paper and are absorbed by metals and other dense bodies; they make the air a conductor of electricity; are refracted and probably diffusely reflected, and cannot produce chemical reactions; they are distinguished from uranium rays in that they are not polarized by the passage through turmaline. The rays from fluorspar, turpentine oil, zinc, etc., are distinguished from the uranium and thorium rays by the fact that they do not make the air a conductor.

SOLAR RADIATIONS AND ELECTRICITY. Bach. "Comptes Rendus," 126, p. 479; abstracted briefly in Lond. "Elec. Rev.," August 19.—In order to solve the question whether solar radiations are transformed into electricity, he carried out a series of experiments with the reduction, electrolysis and photolysis of carbonic anhydride. No conclusions are given in the abstract.

ABSORPTION OF ELECTRIC WAVES BY WATER. Drude. "Wied. Ann.," No. 7; abstracted in Lond. "Elec.," August 19.—He made experiments with glass troughs containing water, the thickness of the layer of water being varied.

ELECTROLYTIC THERMOPILES. Duane. "Wied. Ann.," No. 6; abstracted briefly in Lond. "Elec.," August 19.—He made experiments with dilute solutions to test the validity of Nernst's formula. The apparatus is reproduced in the abstract; the circuit is made of tubes filled with the liquids, so as to avoid electrodes. As far as the results go they completely verify Nernst's theory, both with one and with two electrodes.

CONDUCTIVITY OF MIXED SOLUTIONS. Hopfgartner. "Zeit. Phys. Chem.," 25, page 115; abstracted briefly in Lond. "Elec. Rev.," August 19.—He describes a method of calculation, the results of which were found to agree well with certain experimental determinations.

CONDUCTIVITY OF DILUTE SOLUTIONS. Schaller. "Zeit. Phys. Chem.," 25, page 497; abstracted briefly in Lond. "Elec. Rev.," August 19.—The results of experimental investigations of the electrical conductivity of dilute solutions at temperatures up to 100° C.

MAGNETIZATION OF HOLLOW AND SOLID RINGS. Kirstaedter. "Wied. Ann.," 65, page 72; abstracted, with some of the illustrations, in the "Elek. Zeit.," August 11.—In the field of solenoids up to 300 units Grotrian found that solid and hollow iron cylinders of the same length and outside diameter, but different thicknesses, have the same magnetic moment; the reason was thought to be the magnetic screening action which the outside iron had on the inside. In the present paper experiments are described which were made to find out whether there really is such a screening action; he therefore used a hollow and a solid ring in the place of the cylinder, and magnetized it peripherically. He used a solid ring and then made it hollow, and finally fitted a solid ring into the hollow space; the curves of magnetization are given. His conclusions are that a screening action of the outer layers, as claimed by Grotrian, could not be found in the case of the rings.

MAGNETIC AFTER-EFFECT. Fromme. "Wied. Ann.," No. 65, page 41; abstracted in the "Elek. Zeit.," August 11.—He describes researches to determine the after-effect which follows a reduction of the magnetizing force. In conclusion he shows how the experimental results can be explained by the theory of rotating molecular magnets.

HYDRAULIC ILLUSTRATION OF WHEATSTONE BRIDGE. Hallock. "Elec. Rev.," August 31.—A reprint of the article abstracted in the "Digest" last week.

Electro-Chemistry and Batteries.

ELECTROLYSIS OF ALKALINE CHLORIDES. Wohlwill. "Zeit. f. Elektrochemie," August 4.—A very long article, in which he describes researches made to investigate some of the secondary reactions to which are due the formation of hypochlorites, chlorates, and perchlorates. A question of great importance, both scientifically and practically, is to determine how the anions of the oxygen acids of chlorine, like ClO, can be brought into solutions which contain only Cl, OH and O ions as anions, and this is the problem which he endeavors to solve. Extended researches were made at different voltages, and the results are given in curves and tables; from these researches he concludes that with the very smallest e. m. f. with which an extremely small current can be maintained there is a formation of hypochloric acid; it is also proved that below 2 volts there may be a formation of the chlorate. The formation of the chlorate does not depend on the addition of Cl or OH ions; nor is there a secondary chemical reaction similar to that in the formation of the hypochlorite; the chlorate is generally formed together with the hypochlorite, and it is thought that the latter has something to do with the formation of the former. In the repeated electrolysis of the same solution the chlorate products increased constantly, while the hypochlorite products diminished; from this it follows that in course of time, in the continued electrolysis, the chlorate products increase, and that the solutions containing hypochlorite give more of the chlorate during electrolysis than plain alkaline chlorine solutions; it is almost certain, therefore, that the chlorate is produced by the hypochlorite. With circulating electrolytes the hypochlorite products at the end of the electrolysis were appreciably greater than with a stationary electrolyte. An important result is the variation in the amount of the products, due to the voltage and the current density; researches made between 2.1 to 2.5 volts showed the following: With increasing voltage the total output of the hypochlorite and the chlorate increases; with increasing voltage and current density the relation of the chlorate to the hypochlorite increases. Under the same conditions the output of hypochlorite increases at first and then diminishes. A striking result was that the relative output of the hypochlorite at low voltages of 2.1 to 2.2 reaches 50 per cent., which has never been observed before in strong alkaline solutions. His results are contradictory to those obtained by Oettel and by Haber; he discusses this disagreement. In conclusion he gives the principal results of his researches, briefly; the electrolysis will take place at a difference of potential of at least 1.2 volt between the anode and the hydrogen electrode, forming hypochlorite; the formation of hypochlorite in large quantities will begin to take place above 2.1 volts, and depends on the secondary chemical action of the chlorine and the alkali; the chlorate is produced by an ion reaction, which is possible only by the addition of positive electricity; it is formed from the ClO ions which have been formed.

ELECTROLYSIS OF ALKALINE CHLORIDES. Winteler. "Zeit. f. Elektrochemie," August 4.—A continuation of his serial describing researches. He discusses briefly the formation of hypochlorites, chlorates and perchlorates; no conclusions appear to be drawn.

EXTRACTION OF ZINC; COWPER-COLES PROCESS.—Lond. "Elec. Rev.," August 19.—A brief description, with illustrations of the apparatus. The process is intended to apply to refractory ores like those at Broken Hill; the process is claimed to have entirely overcome the difficulties encountered, and has the advantages of economical working and purity of products; it has been tried on a commercial scale at the experimental works in Cornwall, where 40 to 50 tons of ore per week have been treated. The anodes are of sheet lead and the cathodes of aluminum. The difficulty of the roasting has been overcome by the addition of a mixture of other ores. The sulphur is oxidized in the roasting instead of being driven off; the zinc is leached with a weak solution of sulphuric acid, and is deposited either in the form of plates or zinc sponge, which, when dried, is a substitute for zinc dust, for which there is considerable demand. By using a suitable strength of solution only the zinc and copper are removed from the ore, while the other metals present are not dissolved; the lead and silver remaining in the residue can be extracted by any of the well-known methods. A more detailed description is promised.

SOLUTION OF NOBLE METALS. Margules. "Wied. Ann.," No. 7; abstracted in Lond. "Elec.," August 19.—He found that platinum may be dissolved in acids or caustic alkalies by passing a secondary current from an induction coil through an electrolytic cell with platinum electrodes. He also obtained a solution by inserting the cell between the hammer and the anvil of the interrupter, in which case it was accomplished by the extra current. Gold was similarly dissolved, but the solution of carbon in a similar way has not yet been accomplished; if carbon could be made to combine with some anions some important new developments in organic chemistry might be expected.

POLARIZATION CAPACITY OF REVERSIBLE ELECTRODES. Elsa Noumann. "Zeit. f. Elektrochemie," August 18.—If an electrolytic cell is placed in one branch of a Wheatstone bridge it will not act like an ordinary resistance, but like a resistance with a capacity in circuit with it; it was first thought that this polarization capacity acted like that of a condenser, but Wien and Orlich have shown that this is not the case; Warburg showed how the polarization capacity could be calculated theoretically for the so-called unpolarized electrodes; the researches described in the present article were made to demonstrate his method experimentally.

DETERMINING HEAT OF DISSOCIATION OF ELECTROLYTES. Van Laar. "Zeit. Phys. Chem.," 24, page 608; abstracted briefly in Lond. "Elec. Rev.," August 19.—He points out a source of error in such determination.

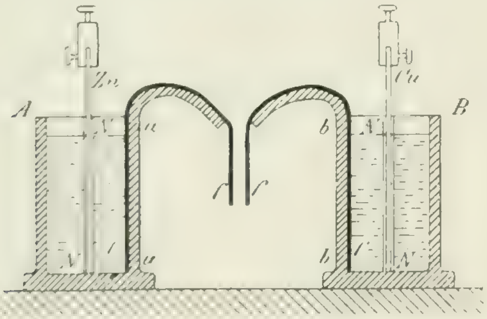
LEAD-ZINC-CADMIUM STORAGE BATTERY.—Lond. "Elec.," August 19; abstracted from "L'Ind. Elec."—A description of the Werner accumulator, which was noticed in the "Digest" May 21 and June 4.

STORAGE BATTERY.—"West. Elec.," August 27.—A reprint of the discussion of Appleton's paper, which was noticed in the "Digest" last week.

Units, Measurements and Instruments.

DANIELL STANDARD CELL. Grotrian. "Elek. Zeit.," August 18.—A description of a convenient and simple form of this standard cell. While the Clark and Weston standards are superior, the Daniell is often sufficiently exact and has the advantage of being easily constructed in the present form, which avoids all necessity of stop cocks such as are used in the Fleming form. The arrangement is shown in the adjoining figure; there are two retaining cells, which are provided with a long lip on one side; a piece of glass bent to this shape and inserted in an ordinary rectangular cell would also answer; one of these contains the zinc and its solution, while the other contains the copper and its solution; the plates should be held in a fixed vertical position, as, for instance, by means of grooves in the [illegible] of the cell; the heavy black lines, f f are pieces of filter paper 2 or 3 inches in width, the ends hanging down over the ends of the lips and lower than the surface of the liquids; each is first saturated with its solution; by capillary attraction the liquids will be drawn over the strips and those that run will drop off, thus keeping the solutions pure; to accomplish this there should be about five strips in the zinc solution and two strips in the copper solution; when in use the two overhanging parts of the strips are brought together, being pressed together with the fingers until they adhere. The copper plate should first be freshly plated electrolytically with copper and the zinc plate should be amalgamated; the irregularities of the cell are due to the coating of copper, which should, therefore, be as [illegible] as possible; there is practically no effect of temperature on the value of the e. m. f.; the density of the zinc solution should be 1.200 and of the copper 1.100, which are the same concentrations [illegible]. He made a number of determinations [illegible] Clark which had been standardized by the Reichsanstalt; the mean value of the e. m. f. [illegible] 1.101; the [illegible] and it will stand [illegible] [illegible] about 1 to 2 thou[illegible]

ELECTROMOTIVE ACTION OF CADMIUM AMALGAM. Jaeger. "Wied. Ann.," No. 7; [illegible] with a curve in the "Elek. Zeit.," August 11.—A [illegible] from the Reichsanstalt in which he describes experiments with cadmium amalgams of [illegible]. He found that amalgams containing [illegible] per cent. of cadmium are absolutely alike with reference to the e. m. f., and do not change to a one-hundredth of a millivolt; with more than 15 per cent. they are not permanent; the e. m. f. increases gradually, approaching that of pure cadmium; the results are given in a curve. A rod of cadmium which has been amalgamated is very changeable in its electromotive properties. For the cadmium cell he recommends a more dilute amalgam than one-sixth, as the latter is near the bending point of the curve.



GALVANOMETRY OF SUDDEN DISCHARGES. Witting. "Wied. Ann.," No. 7; abstracted briefly in Lond. "Elec.," August 19.—An ordinary mirror galvanometer may be used for measuring the intensity of rapidly recurring discharges such as those from an influence machine, but if the discharges are not perfectly regular the needle will oscillate. A much more certain method is based on the method of multiplication or of Toepler's reversals; if the spark current is sent through a galvanometer the needle begins to oscillate about the new zero $+ a$; commute the current when it reaches the first turning point and the zero will then be displaced from $+ a$ to $- a$, and on repetition the needle oscillates between two new positions from which the current intensity is easily calculated (no further description is given in the abstract). Experiments with a large machine show that the current depends largely on the resistance of the circuit and length of the spark gap, but increases in direct proportion with the speed of revolution.

MEASUREMENT OF OSCILLATING CURRENTS. Kopp. "Elek. Zeit.," August 11.—An abstract of a paper from a Swiss scientific journal on the measurement of constant and rectified oscillating currents by the electromagnetic rotation of the plane of polarization of light; in the paper he describes a method for determining the constant of the apparatus.

ELECTRICAL INTERFEROMETER MEASUREMENTS. Drude. "Wied. Ann.," No. 7; abstracted in Lond. "Elec.," August 19.—He examined the indications of this apparatus and came to the conclusion that it was unsuitable for measuring electric waves.

METER FOR ACCUMULATORS. Aron. "Elek. Zeit.," August 18.—A reprint in full, with illustrations of the paper, an abstract of which was noticed in the "Digest" July 16.

CONDENSER FOR INDUCTION COILS. Dubois. "Wied. Ann.," No. 65, page 86; abstracted, with some of the illustrations, in "Elek. Zeit.," August 11.—He measured the secondary current with an electro-dynamometer, varying the resistance in the secondary circuit and the capacity of the condenser shunting the brake in the primary. Three of the six curves are reproduced in the abstract; one of them shows that a condenser of too great a capacity can reduce the current below the value which it would have without a condenser; he also showed that a condenser at the spark gap of a primary can increase the current appreciably, even doubling it, but that the capacity of the condenser is determined by the resistance in the secondary circuit; with an increase of this resistance the capacity diminishes.

INDUCTION COIL CONDENSERS. Dell. "Elec. Rev.," August 24.—A brief description of some experiments, in which the condenser was connected in various ways. No conclusions are drawn, as this is left to the reader.

Telegraphy, Telephony and Signals.

SPARK TELEGRAPHY. Tietz. "Elek. Zeit.," August 18.—A long article describing some interesting experiments with a view to devising a selective method of telegraphing by means of Hertzian waves—that is, to enable any one station to communicate with any other particular one. The researches which he made seem to have been quite extended, although the distances used in most of them were only a few meters. The main element in the Marconi system is the use of wires connected with the radiator and the coherer; he determined quantitatively the effect of these wires; instead of a coherer he used a thermocell or a bolometer, by means of which he could measure the energy in a galvanometer, thus giving quantitative results. The deflections were measured for different distances between the receiver and the transmitter, and the results are given in a curve; if the radiation starts from a point it should diminish inversely as the square of the distance; if it starts from a wire infinitely long it should be inversely proportional to the distance; both of these curves are also given, showing that the experimental curve lies between these two. Another set of experiments was made with resonance; the radiator was provided with two wires of equal length, and likewise the thermocell, except that in the latter case the length of the wires as varied, the galvanometer deflection in each case being measured; in all the curves obtained, in which this deflection was shown as a function of the length of the wires of the receiver, there was a very decided maximum when the wires of the receiver were equal to those of the transmitter showing resonance; the best effect will, therefore, be obtained when the wires are of equal length; by making the wires equal a selective system may therefore be constructed, as only that receiver will respond which has the same length of wires. Marconi, however, has only one wire at each station, the other pole being grounded; researches showed that the curve in that case does not show resonance, as the deflection remained the same for different lengths of wire. The results obtained were quite different when the thermocell or bolometer were used than when they were replaced by a coherer, so that the results obtained do not apply directly when a coherer is used: the thermocell or bolometer measured the energy received in a unit of time, but the coherer responds in proportion to the difference of potential. To investigate resonance with the use of a coherer he placed a galvanometer in the coherer circuit and found that there was no maximum for a given length of wire, but as the results were not very definite he also tried them with the spark micrometer, obtaining no maximum, but found that the spark length increased with the length of wire. He believes, therefore, that the selective system by means of resonance, in connection with the Marconi system, is not possible as long as a coherer is used for the receiver; the coherer, however, is much more sensitive. The vertical wire of Marconi often involves difficulties in its construction, while the two horizontal wires can be erected much more easily; the waves are assumed to pass out perpendicularly from the wire, and the direction of radiation will, therefore, be more favorable for the horizontal wires; the maximum is obtained only when the four end points of the wires of the receiver and transmitter form a rectangle (he may mean a square); he therefore endeavored to increase the sensitiveness of the receiver; the effect was greatly strengthened when he used several spark gaps in series at the radiator; a condenser parallel to the spark gap also increases the action; in this way he found that the action of the radiator could be increased about twenty times, and this is by no means the maximum which could be obtained; as it is a question of the transmission of energy, the use of transformers and alternating currents of appreciable power will increase the result. The bolometer is more sensitive than the thermopile, but the latter may be improved by the use of a number of cells connected as one. He increased the distance to 200 meters, and obtained satisfactory results, although the conditions were very unfavorable; with the improvements suggested he thinks that the results will be as good as those obtained with coherers. The current, however, is not sufficient to operate a relay for an ink writer; to accomplish this he proposes what he calls a "light relay," which has the same sensitiveness as a mirror galvanometer; if a beam of light from the galvanometer is thrown on a selenium cell this result could be accomplished, but he did not try it; another method would be to use ultra-violet rays reflected by the mirror galvanometer onto a spark gap in a local circuit.

WIRELESS TELEGRAPHY.—Lond. "Elec. Rev.," August 19.—A long, illustrated description of Lodge's syntonized system. The chief idea of this improved system of Hertzian telegraphy is to enable one to send messages to only one particular receiver, and this is accomplished by a system of syntonizing, so that the receiver will respond only to a particular frequency and to a sufficiently prolonged series of oscillations. There is a relay with a subsidiary circuit, which responds only to oscillations of that particular frequency, or some multiple or submultiple of it; the conductors in this relay circuit have a large capacity and are combined with a self-induction coil, the object of which is to prolong the oscillations, constituting a radiator of a definite frequency, and this renders syntonizing possible because the response depends on the fact that the total number of oscillations is very great, so that the feeble impulse is gradually strengthened according to the principle of sympathetic resonance. Methods of tuning are described and illustrated. A coherer is also described, in which a fine point is in light contact with a vibrating strip of metal; when a telephone is used the coherer restores itself without any special vibrator; moreover, a telephone is the quickest responder that can be used. He has transmitted signals over 1 mile. It appears also that the inconvenience of the long vertical conductor in the Marconi apparatus may be overcome in this way. (See American patent 609,154, issued to Oliver Lodge, August 16, 1898.)

MARCONI TELEGRAPHY.—Lond. "Elec. Rev.," August 19.—A few further particulars regarding the recent successful trial in telegraphing from the royal yacht Osborne to the Queen at Osborne House. In one case the distance was nearly 2 miles and a hill intervened, rendering optical signals impossible; while the yacht was on a cruise messages were sent to a distance of 7.5 miles.

TELEPHONY IN GREAT BRITAIN.—Lond. "Elec." and "Elec. Eng.," August 19.—A reprint of the report of the select committee on telephones; it is also discussed editorially. A reprint is begun in the Lond. "Elec. Rev.," August 19.

MINE SIGNALS. Clements. Lond. "Elec. Rev.," August 19.—An abstract of a paper read before a South African society on the various methods of signaling, with special reference to the electrical method, which is considered to be the best.

CLEVELAND.—"Elec. Rev.," August 31.—A brief, illustrated description of the new telephone exchange, which is said to be the most modern in the world

Miscellaneous.

LIGHTNING STATISTICS.—"Elek. Zeit.," August 4.—An abstract of some statistics for Prussia during the years 1891 and 1895. For each year there are given the number of lightning bolts in large and small cities and in villages, classified into those in which the lightning produced fire and in which it did not. A table also gives the total loss by fire and the proportion caused by lightning.

LIGHTNING STATISTICS.—"Zeit. f. Elek.," August 7.—A discussion of the statistics for Steiermark and Kaernten from 1886 to 1896.

MEETING OF GERMAN ELECTRICIANS.—"Elek. Zeit.," August 4.—A verbatim report of the proceedings of the annual meeting held last June; it is chiefly of local interest, the papers themselves being published separately in that journal (and noticed under the respective headings in the "Digest"), although some of the brief discussions are given in this report these discussions seem to contain nothing of special interest. Hundhausen presented his report concerning the standard screw-thread sockets for incandescent lamps, reviewing the chief features; a more lengthy description was referred to in the "Digest" June 11 and 25. The rules and regulations were briefly discussed. In the discussion of Passavant's paper (see "Digest" July 30) the question was brought up whether the neutral wire in a three-wire system with 220 volts on each side should be grounded; Passavant claims that it should be, stating that it would be quite doubtful whether he would connect a house installation with such a system if the middle wire were not grounded; it was thought that the higher voltages would make the system safer, because a fault would develop itself quickly.

OMAHA EXHIBITION.—"West. Elec.," August 27.—A brief illustrated description of the Machinery and Electricity Building and some of the exhibits in it.

Book Reviews.

DISTRIBUTION DE L'ENERGIE PAR COURANTS POLYPHASES. By J. Rodet, Ingénieur des Arts et Manufactures. Published by Librairie Gauthier-Villars, Paris, France. One volume, octavo; 338 pages. Illustrated. Price, 8 francs.

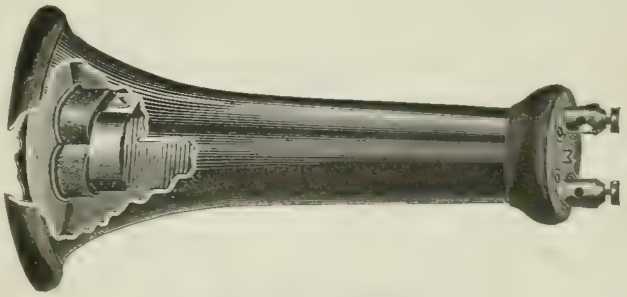
This work discusses completely but apparently without any new light the now generally understood elementary theory and application of polyphase currents to power transmission purposes. It takes up the subject historically and treats analytically the rotary field, the production, transmission, transformation and translation of multiphase currents, describing generators, lines, transformers, meters, etc., and closes with descriptions of various systems which have been and are in practical operation, beginning with the Lauffen-Frankfurt installation and ending with those of Mechanicville and Lyons.

"STREET RAILWAY ROADBED." By Mason D. Pratt and C. A. Alden. Street Railway Publishing Company, New York; 135 pages, illustrated. Price, $2.

This work is so far as can be ascertained the first treating particularly of this subject, the conditions of which differ so widely from those of standard steam track construction as to make a special treatise of considerable value. The experience of both of the authors in this particular field insures the reliability of the statements made. The work is largely made up of contributions of the authors to various technical papers and society proceedings during the last few years, brought up to date and properly divided under various headings. It discusses the subject briefly from an historical standpoint, and then proceeds to present in a concise way the best practice of to-day. The art of track laying is described largely from the civil engineering standpoint, the surveying of the road, the use of various curves, cross sections of rail, foundations and joints being clearly and accurately described.

The "M" Receiver.

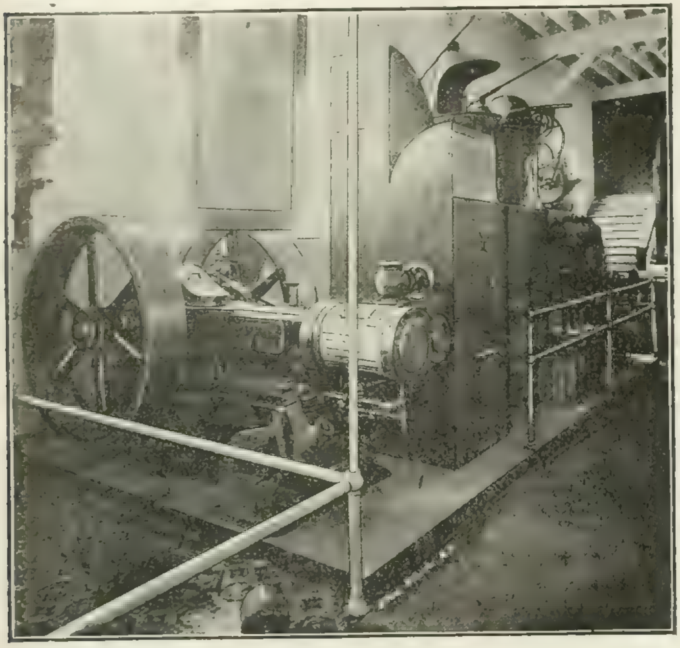
The "M" telephone receiver illustrated herewith is manufactured by the firm of William J. Murdock & Co., 160 Congress Street, Boston, Mass. It is claimed to be of strictly high-grade manufacture, pony type, with highly finished hard rubber case. It is a bi-polar receiver, with metal head spools mounted on a horseshoe magnet made of the best magnet steel, the magnet being supported near the diaphragm so that change in temperature does not affect the adjustment. The binding posts are of new design and mounted on metal plates. The receiver weighs 12 ounces, and will operate any standard switch. For exchange work some excellent testimonials have been received for this receiver, and it is said to be giving satisfaction wherever used.



The "M" Receiver.

Two of the Exhibits at the Omaha Exposition.

THE BUFFALO FORGE COMPANY.—One 12x12 high speed horizontal engine is an interesting feature of the exhibit of the Buffalo Forge Company, beside which the company shows a complete installation of fan heating apparatus for aiding in the ventilation of large buildings by air supplied under blower pressure. The outfit is equipped with a complete arrangement of dampers for shunting the cold air around the steam heating coils, which dampers can be controlled by hand or by automatic thermostats, such an arrangement obviously giving a quicker control of the temperature than the operation of valves affecting the steam supplied to the heating coils. The exhibit contains a large number of smaller machines made by the Buffalo Forge Company, one of these of interest being a 6x6 vertical engine with a shaft governor.



The Booth of the Buffalo Forge Company.

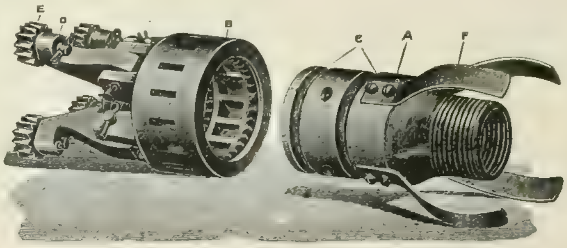
THE CLONBROCK STEAM BOILER COMPANY.—A section of the Morrin Climax steam boiler, showing the arrangement of the water tubes, forms a central column in the exhibit of the Clonbrock Steam Boiler Company of Brooklyn. The exhibit consists largely of views of large and small boiler-house equipments, fitted with the Morrin Climax and compound steam boilers and [illegible] of the [illegible] showing the [illegible]

The Clonbrock Steam Boiler Company's Exhibit.

Ball Bearing Boiler Tube Cleaner.

[illegible] The water entering [illegible] the [illegible] steel [illegible] the [illegible] the scale, which is washed out through the tube by the water as it leaves the cleaner.

The illustration shows the details of construction. *A* is a hollow brass shaft, *B* brass turbine water wheel, *C* are grooves, which are bearings for the steel balls, corresponding grooves being provided in the turbine *B*. *D* represents the cutter arms, of which there are four carrying the steel cutters *E*. *F* are steel springs which keep the cutter arms pressed outward.



Novel Boiler Tube Cleaner.

This cleaner is the invention of H. F. Weinland, and is manufactured by the Lagonda Manufacturing Company, 690 East High Street, Springfield, Ohio.

A New Railway Motor.

For elevated and underground railroads, as well as suburban and interurban railways, the General Electric Company has recently developed the GE-55 motor. The new motor, while differing but slightly in outward appearance from previous GE motors of similar capacity, embodies many important improvements, which, it is claimed, render it the only suitable motor for this class of work. It has already been tested on the New York, New Haven & Hartford Railroad, the Metropolitan and the Lake Street elevated roads, Chicago, and on the locomotives of the Buffalo & Lockport Railway, under actual steam road conditions, and has proved by its success the suitability of its design and the excellence of its construction.

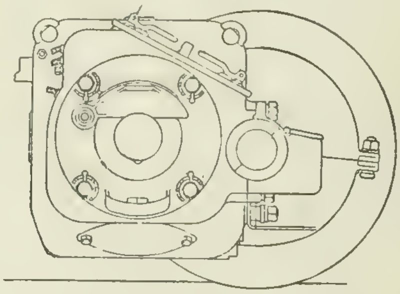
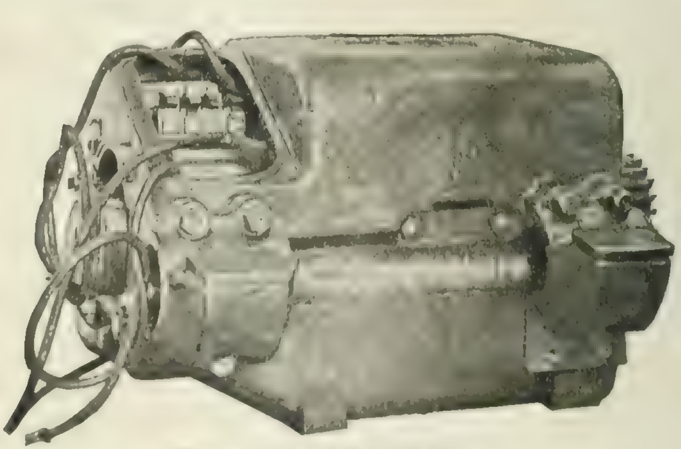


Diagram of Field Frame.

The magnet frame is of soft steel cast in one piece in the form of a cube with well-rounded corners. In each end is a bored-out opening large enough to allow of the removal of the armature pole pieces and field coils. Into this opening fits a frame head held in place by four bolts, and carrying the armature shaft bearing. The axle bearing caps are bolted to vertically planed surfaces on the frame. The four pole pieces are built up of soft iron laminæ, and are bolted to the top, bottom and sides of the frame, with the nuts on the outside.



Perspective View of Motor.

The four field coils are wound on metal spools held in place by laminated pole pieces. The winding is of strip copper of ample cross section, tested to a potential of [illegible] volts.

The armature is of the iron-clad type, with a core built up on a composition metal spider securely keyed to the shaft. The winding is of the series drum-barrel type. Before assembling on the motor the armature is tested to withstand a potential of [illegible] volts between the commutator and the core.

Each commutator is subjected to a high potential test of 5000 volts between segments and shaft and [illegible] volts between adjacent segments. Under all normal conditions it will run without injurious sparking.

The bearings of the armature are supported in the frame heads which extend inside the armature and commutator. They are lubricated by oil and waste, put in place through a hand hole, as with the ordinary car-box bearing. The brasses take the form of a sleeve with the sides cut away to expose the shaft to the oily waste. The commutator end bearing is 3¼ inches in diameter and 7½ inches long, and the pinion end bearing 3¾ inches in diameter and 11 inches long. A similar system of lubrication is employed with the axle bearings, which measure 5¼ inches in diameter and 10½ inches long, as with the armature shaft bearings.

All the leads are brought out through rubber bushed holes in the magnet frame, and are easily removable. The two brush holders are of cast brass, each carrying four carbon brushes, which slide in finished ways and are pressed against the commutator by independent fingers, giving a practically uniform pressure throughout the working range of the brushes. The holders are bolted to guides, which in turn are clamped to a specially designed mica insulated stud. The GE-55 motor is rated at 160 horse-power. It weights approximately 5000 pounds.

Magnetic Blow-Out Automatic Circuit Breakers.

The inherent tendency of all circuit breaking devices to draw an arc at the last point of contact introduces a serious problem in the design of all switches and cut-out appliances. The roughening effect of the arc on the contacts destroys in a short time the usefulness of the apparatus, and as the voltage and current increase the difficulty is rapidly magnified. The advantages of the use of the magnetic blow-out wherever a direct-current electric circuit is to be opened are familiar to all users of electrical apparatus. By adding to a switch equipped with a blow-out magnet a tripping device to open the circuit at a predetermined current an automatic circuit breaker is obtained which, for convenience and reliability, may be said to surpass any other form of cut-out.

The General Electric Company manufactures four different forms of magnetic blow-out automatic circuit breakers for different classes of service. Each is rated by two numbers, the first indicating the lowest current that will automatically open the circuit, and the second number giving the maximum normal current carrying capacity, except in case of the form MM circuit breaker, when the second number indicates the maximum capacity on the basis of intermittent service common in railway work. The tripping point is adjustable in any desired current, from the lowest rating to 50 per cent. in excess of the maximum capacity, by adjusting the calibrating spring of the tripping armature.

The four different forms in which those circuit breakers are made have certain radically different features, which adapt them to the special classes of service for which they are designed. All of them may, however, be used on any direct current circuit, and, with reasonable care and attention, will operate satisfactorily under the most severe conditions.

The form MK circuit breakers are made for 150 to 8000 lamps, and are especially intended for severe service, such as on generator and feeder panels, where the circuit is subject to repeated and violent overloads. Destructive arcing is prevented by the use of supplementary contacts placed in a strong magnetic field, and arranged to break the circuit a moment after the main contact. The transfer of the arc from the main to the supplementary contacts and the immediate extinguishing action of the magnet has made possible the construction of effective circuit breakers for 8000 amperes capacity. The main contact, which is built up of leaf spring, bears upon the main contact blocks when the breaker is closed. The coil of the blow-out magnet and the secondary or plug contacts are in multiple with the main contact. Owing to the comparatively high resistance of the secondary contacts practically no current passes through them until the main contact opens; the whole current then passes through the magnet coils, and the strong magnetic field extinguishes the arc as soon as it is formed on the plug contact. The plug is not withdrawn until after the leaf contacts have left the contact blocks.

All sizes of MK circuit breakers are furnished for back connection, up to and including 800-1200 amperes capacity; they can also be furnished for front connection. Circuit breakers up to 1200-2000 amperes capacity are made when desired with an automatic locking device operated by a handle. When the circuit breaker is open it can be locked open by removing the handle, and when it is closed the handle cannot be removed. The automatic locking device is especially valuable in street railway service, as it permits circuit breakers to be left open without danger of accidental closing. All the circuit breakers in a station may be thus placed under the exclusive control of a single operator.

For power circuits and classes of work where the conditions are less severe than in regular railway service the General Electric Company manufactures the form ML circuit breaker for 100 to 800 amperes. Its principle of action is the same as that of the form MK, but the moving parts are somewhat lighter and differ slightly in general form. The form ML circuit breaker is made for both front and back connections and in two capacities: 100-500 amperes for front or back connection and 200-800 amperes for back connection only. As in the case of the form MK, the main contacts of the form ML are laminated and connected in multiple with a secondary plug with a contact, upon which the arc is broken.

The form MQ circuit breaker is made from 15 to 100-175 amperes only, and is designed especially for protection power circuits and stationary motors. In general appearance it is somewhat similar to form ML, but it has no secondary contact. The current is broken on a segmental contact similar to the contacts used in railway controllers. There is but one coil for both the tripping magnet and the magnetic blow-out. The magnetic circuit is so arranged that the arc is ruptured in its field.

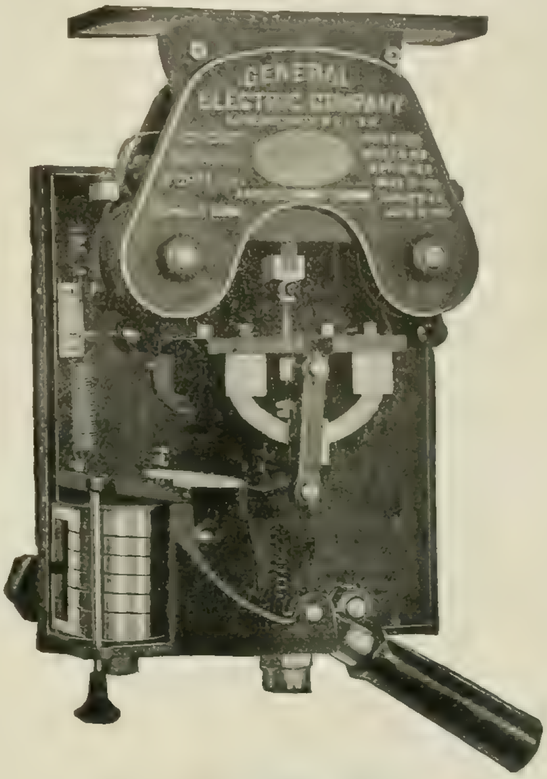
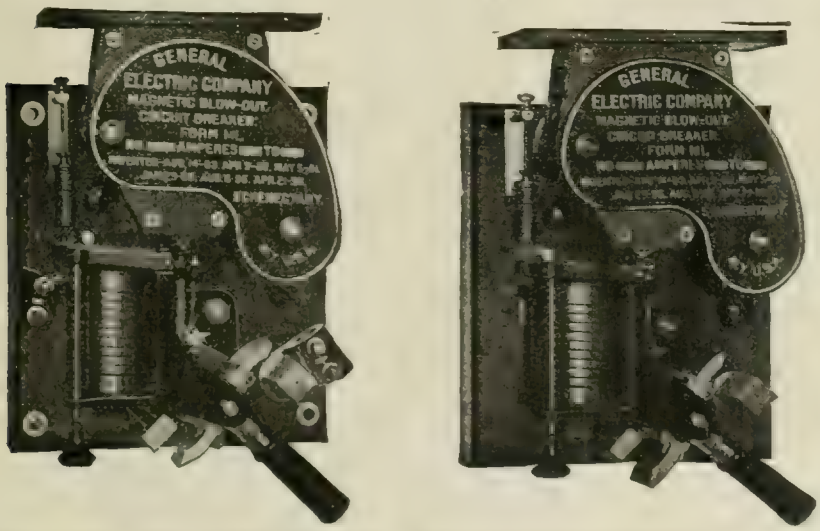


Fig. 1.—MK Circuit Breaker.

The form MM circuit breaker, for 15 to 150 amperes, is designed especially for street car work, and consequently its rating is based on the intermittent currents usual in railway service. It should not be used where it will have to carry its maximum rated capacity continuously. It is intended to supersede both the old hood switch and the fuse box. The fuse box, which has heretofore been the only protective device available for motor and other car equipment appliances, has usually been placed in a more or less inaccessible position beneath the car. The blowing of fuses resulted in annoying and troublesome delays, and the form MM circuit breaker was at once received with favor, as it affords perfect protection to the apparatus, and can be instantly reset.



Figs. 2 and 3.—ML Circuit Breaker. Front and Back Connected.

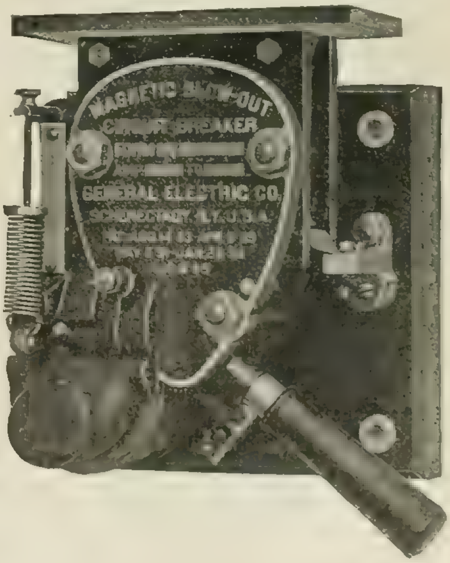
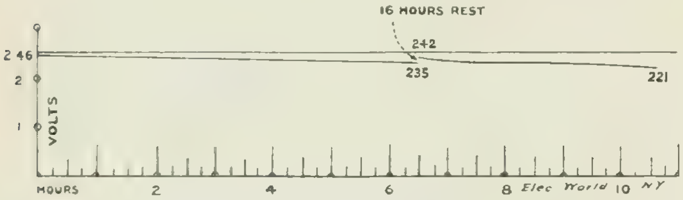


Fig. 4.—MQ Circuit Breaker.

A New Primo-Secondary Dry Battery.

The ideal battery curve which can, of course, never be produced from a practical battery, because, among other reasons, of the internal resistance and chemical changes incident to all batteries—is a straight line parallel to the axis of abscissæ when this represents times of discharge and the ordinates corsponding voltages. With so-called "dry" batteries, this ideal curve is even more difficult to approximate than with a fluid battery, because the chemical changes in the dry battery are localized, and the voltage runs down as the discharge continues due to want of circulation of the electrolyte. To attain an approximation to a desirable curve, changes of concentration of solutions and consequent changes of resistance have to be thoroughly understood and worked out. This has been done, it is claimed, with the "dry" cell, a discharge curve from which is shown in the accompanying illustration. The cell itself consists of a copper containing vessel partially-lined with zinc, both vessel and zinc being electro-chemically amalgamated, in which condition the potential difference between the two metals is only 0.03 volt in an acid solution, as against 1.3 volts for ordinary amalgamation of copper and zinc electrodes. Within this vessel is contained the absorbent and the positive electrode, which is of somewhat peculiar construction, and is the subject matter of numerous letters patent, and will be later described in these columns in wider applications. In the small cell from which the accompanying curve was taken the positive electrode weighs a little less than 2 ounces; therefore the ampere-hour capacity is more than one ampere-hour to the ounce of complete positive electrode with its lug, etc.—a remarkably high figure. For small cells—that is, up to sizes of 3 inches diameter by 6 inches height—the cylindrical form has been adopted, for the advantages obtained therefrom of mechanical strength and the absence of plate supports and separators. The cell for which the working curve is given is 1½ inches in diameter and 3 inches in height, an inch being allowed for sealing, air space, and to allow room for liquid that might be driven out of the absorbent if the cell be overcharged. This size of cell has a mean electrical capacity—between the e. m. f. of 2.46 volts initial and 2.21 volts final in discharge, a drop of 55 to 60 per cent. of that usually allowed—of 2.14 ampere hours, or 5.05 watt hours, the mean e. m. f. being 2.36 volts, at a current rate of one-tenth of this normal discharge. The cell weighing 5 ounces (avoirdupois) complete, with connections, this corresponds to 16.16 watt hours per pound of complete battery. Dr. Kennelly in a recent paper read before the American Institute of Electrical Engineers stated that the best storage batteries hitherto constructed, and these fluid batteries, gave only five to six watt hours per pound, so that the battery here described shows considerable advance in this direction. One of the claims for this battery is that there is nothing "secret" about it—the results are obtained by skillful manipulation and thorough knowledge of the materials employed, as attained by a long series of experiments and actual trials. These batteries are perfectly dry, and are susceptible of high and quick charging rates, with efficiency of about 80 per cent. Dr. Leonard Paget, well known as a collaborator of the late M. Planté and as an electrical engineer, is the inventor. The tests, as recorded, were made on standard Weston instruments by Mr. S. Barr Devlin, of the College of the City of New York, and the batteries are being put upon the market by the Reliance Lamp Electric Company, of 131 Liberty Street, of the same city.



Discharge Curve.

India Mica.

Although mica is extensively used in the electrical industries comparatively few persons know much about its nature, how it is mined, etc.

Some interesting facts regarding the mining of mica in India are given in [illegible] by Messrs. Eugene Munsell & Co., 218 Water Street, New York City. The mica mines of India are in the interior of the country and very inaccessible. The "Abruker Mine," it is stated, produces the finest mica that has ever been mined, both for lamination and color. It has been sunk about 200 feet, following the pitch of the vein, and all this mica and [illegible] by the natives. No machinery of any kind except drill and hammers is used in their mining operations. The refuse and the mica are placed in baskets, each holding about 10 pounds, the baskets [illegible] ladder. The contents of the baskets are deposited at the top, and the baskets are re-[illegible] another [illegible] by means of pipe. It is [illegible] been carried on for many hundreds [illegible]

[illegible]

[illegible]

Portable X-Ray Outfit on the Hospital Ship "Solace."

At the beginning of the Santiago campaign the necessity of equipping the hospital ships with efficient and powerful X-ray apparatus was immediately perceived by the Surgeon-General of the United States Navy, who realized the importance of installing apparatus which should be powerful and so simple in construction and operation that it could be properly handled by any ordinary mechanic. An order was placed with the Edison Manufacturing Company for one of its latest portable cabinet X-ray outfits, to be placed on board the United States naval hospital ship "Solace," and the entire apparatus was placed in position ready for use within forty-eight hours after the placing of the order. A brief description of this apparatus, which is illustrated below, may be of interest to our readers.

The cabinet, which is made of polished quartered oak, of massive construction, occupies a floor space of 2 feet 8 inches by 1 foot 8 inches, and is furnished with four wrought-iron Ls screwed onto the base of the same, by which it can be rigidly fastened to the deck. The Edison coil, which is mounted on top of the cabinet, is also furnished with brass Ls and strips to hold it firmly in position, and the base of the adjustable focus tube stand is similarly screwed to the top of the cabinet.

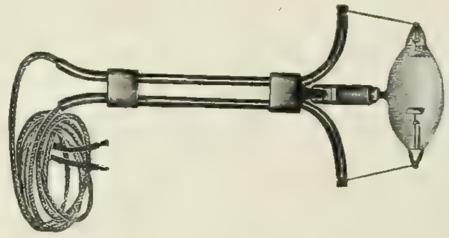


Fig. 2.—Focus Tube Holder.

The distinctive feature of the Edison X-ray outfits is that there is no vibrator on the induction coil, its place being taken by the instantaneous air-break wheel device shown in the bottom part of the cabinet. This device consists of two tooth-wheels mounted on the same shaft. The projections or teeth make contact with two flat brushes, which bear on the outer peripheries, and by which the current is brought in and led out again. These wheels are rotated at a very high speed, by a small direct-current motor, which also runs a pressure blower. The air blast from this blower enters a bifurcated tube, and is conducted to two flat nozzles immediately over the contact brushes. The spark formed at the brushes, when the coil is energized, is instantaneously blown out by the air blast at the moment of formation.

The controlling rheostat shown in the upper shelf of the cabinet is used to vary the current in the primary of the coil, and the lever arm of the rheostat is connected to the extension rod passing through the side of the cabinet so that the doors of the cabinet can be closed and the rheostat actuated by means of this extension rod, which is shown on the right-hand side of the illustration. The main switch is shown on the left-hand side of the cabinet, near the top, and the cut outs directly underneath the same. The apparatus is entirely protected when not in use. In cases where the patient is so seriously wounded that it is necessary for him to maintain a reclining position, the focus tube is attached to the portable focus tube holder, shown in Fig. 2, and the focus tube stand is dispensed with.

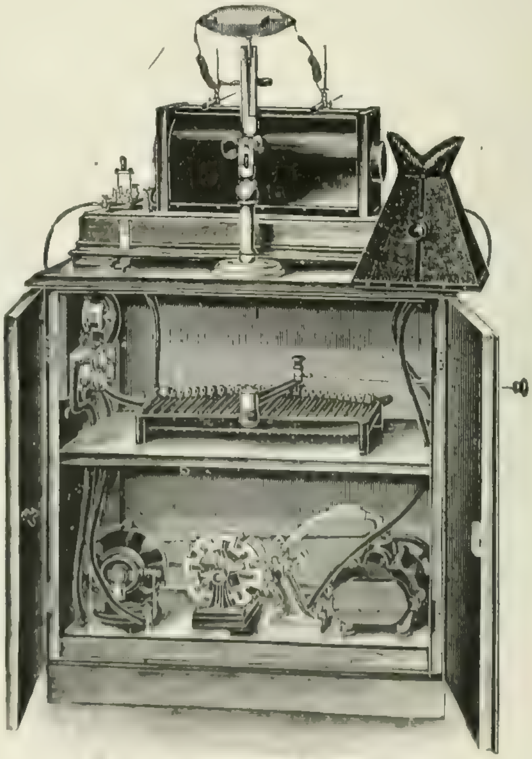
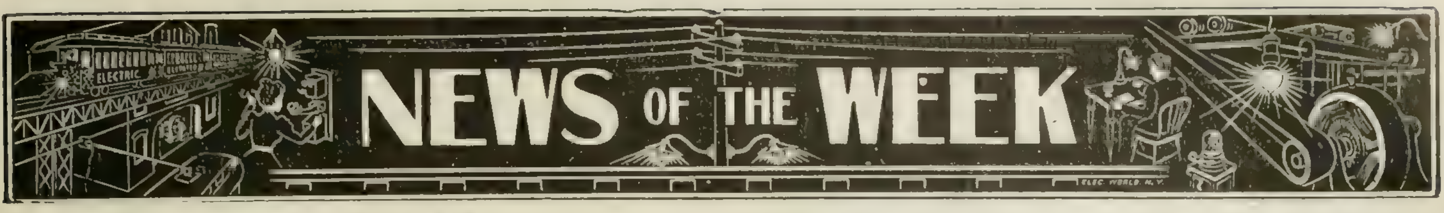


Fig. 1.—Portable X-Ray Outfit.

The work that has already been done has shown the great value of such an apparatus in warfare, and the necessity of equipping all naval, marine and military hospitals with a device of this kind. One great advantage possessed by it is that it can be moved from place to place without delay.



Financial Intelligence.

THE BROOKLYN RAPID TRANSIT RAILROAD COMPANY reports gross earnings for August of $563,257, an increase of $85,857, as compared with the same month last year.

Special Correspondence.

New York Notes.

Office of THE ELECTRICAL WORLD,
9 Murray St., NEW YORK, September 5, 1898.

THE AUXILIARY CRUISER "YANKEE," whose officers and crew include several electrical engineers, after an active and honorable career in the naval operations against Spanish dominion in the West Indies has returned to the United States, and is now at the League Island Navy Yard, Philadelphia. The "Yankee's" crew constitutes the New York Naval Reserve, and they acquitted themselves during the war in a truly heroic manner. The vessel was a participant in some of the important naval engagements in Cuban waters and her crew return to private life with a large measure of honor and glory to their credit. The ship's "company" has been mustered out of Uncle Sam's service, and they returned to New York on Friday last. They marched up Broadway to their armory at the foot of East Twenty-eighth Street—the old wooden warship "New Hampshire." They were in fine spirits and glad to get home again after their exciting experience of the past few months. Lieut. S. Dana Greene, assistant general manager of the General Electric Company, was the second officer in command of the "Yankee."

THE PACIFIC CABLE.—A meeting of the directors of the Pacific Cable Company was held in the office of J. P. Morgan & Co. in this city on September 1, at which important steps were taken toward carrying out the purpose for which the company was organized. The company's plans provide for the laying of a cable from San Francisco to Hawaii, with branches to Japan and Australia. According to the "Herald," at the meeting of September 1 it was decided to add to this a duplicate system, starting at San Francisco and running up the Pacific Coast to Sitka, Alaska, touching again at the Aleutian Islands and connecting with the other line in Japan. It was decided to begin work at once on surveys for this line. Mr. James A. Scrymser, president of the company, has started for Vancouver, whence he will sail on September 12 for Japan. The object of his trip, it is stated, is to make contracts with the Japanese Government and obtain from it a subsidy of at least $100,000, for which in return the Government of Japan will have free telegraph privileges for twenty years. The cost of the Sitka and Aleutian Islands branch cannot be determined until surveys are made, but the route connecting the Hawaiian Islands and the spurs to Australia and Japan, will, it is stated, cost about $10,000,000. The work will involve the laying of about 10,000 miles of cable. The Pacific Cable Company was organized under the laws of New York State in December, 1896, its authorized capital being $10,000,000.

MR. GEORGE R. BIDWELL, collector of customs at the port of New York, has been instructed by the Treasury Department at Washington to appeal from the decision of the Board of General Appraisers in assessing electric light carbons at 35 per cent. ad valorem. The department holds that they are subject to duty at the rate of 90 cents per hundred, which was the rate originally assessed by the local appraiser under the tariff act of July 24, 1897. It will be remembered that when the tariff act became operative the appraiser contended that electric light carbons were dutiable under paragraph 98, at the rate of 90 cents per hundred, while the importers claimed that they came under the head of paragraph 97, which provides a duty of 35 per cent. ad valorem on "articles composed of carbon." When the law went into effect the importers of carbons brought these goods into the country in lengths of 24, 29 and 36 inches, afterwards cutting them into proper lengths for use. The Treasury officials regarded this as an evasion of the tariff act, and directed the collector at New York to charge at the rate of 90 cents per hundred for carbons of commercial length, so that sticks 36 inches in length would be chargeable as consisting of three carbons of 12 inches each, other lengths to be charged for in proportion. The matter was referred to the Board of General Appraisers, who, represented by Judge Somerville, decided, in brief, that these goods come under the head of paragraph 97, and are therefore dutiable at the rate of 35 per cent. ad valorem, as "articles composed of carbon." An appeal from this decision was ordered by the Washington authorities, as above stated.

THE FUTURE OF CUBA AND PORTO RICO.—The opening up of Cuba and Porto Rico to American enterprise, which is one of the most important results of the war with Spain, will no doubt offer a rare and excellent opportunity for the utilization of electricity in every known form. As the islands become Americanized electric railways will become a very important factor in their development; electric light will become more extensively used than it is at present, and the telephone will play an important part in the advance of these insular territories. The transmission of electrical power will also find a broad field for application, and in many ways electricity will aid very largely in turning to good account every possibility inherent in these valuable possessions. One large electrical concern, we understand, has already developed plans for the application of electrical power on sugar plantations, while others in the same line of industry are actively at work laying plans to share in the large business that is promised. Experts and agents are preparing to visit the various cities where up-to-date electrical appliances will be needed. It is stated that Col. Eugene Griffin, of the First Regiment of Engineers, who, with his regiment, is now in Porto Rico, will make a special study of the needs of that country in the matter of electrical improvements in the interest of the electrical company with which he is connected. As to the Philippines nothing can yet be said with certainty, as the future possession and government of the islands are problematical. There exists a belief among some, however, that American enterprise will, in any event, be given free rein in that far-off country, and so strong was this belief in the minds of three or four young electrical engineers in this city that they enlisted in the engineer regiment. which was sent to Manilla, in order that they might be on the ground when the doors of enterprise and prosperity were opened.

New England Notes.

Branch Office of THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., September 1, 1898.

BOSTON'S subway system is now entirely completed, and was finally inspected by the Transit Commission this week. It is expected that it will be opened to the public next Monday, September 5.

MR. W. A. BENT is now the treasurer of the Bates Machine Company, Boston, succeeding Mr. H. N. Bates. Mr. Bent has been connected with the Lowell (Mass.) Electric Light Company for a number of years, and enters upon his duties with a full knowledge of how to discharge them.

THE PAGE ELECTRIC COMPANY, Worcester, Mass., is now nicely housed in its new quarters at 24 Pearl Street, immediately adjoining its old quarters, which it occupied for so many years, and has also recently succeeded to the business of the Central Electric Company. The Page Company is well and favorably known to the electrical trade, having been established in 1885 and incorporated in 1897. It has always done a large supply and construction business, and since it has been under the management of Mr. J. P. Coghlin its business has materially increased.

MR. H. N. BATES has resigned his position as treasurer of the Bates Machine Company, Boston, which position he held for so long. Mr. Bates' resignation is due to the fact that he will hereafter be identified with the Continental Construction Company, a new Boston corporation organized for the purpose of constructing street railways, and which, it is said, will, with ample capital and facilities, become an important factor in this business. The company is certainly fortunate in having secured the services of Mr. Bates, who is known to everybody in the electric lighting and power fields throughout the country.

THE BIBBER-WHITE COMPANY'S offices and salesrooms, 49 Federal Street, Boston, have recently been materially enlarged and changed. The increase in its railway supply business has necessitated additional facilities, and a room almost equal to its original floor space has been secured in the adjoining building. This space is used largely to store railway supplies. The well-known manager of this department, Mr. Herbert W. Smith, has by his indomitable persistence built up a remarkably large trade in a short time, while the well-known executive ability and energy of President Charles E. Bibber, the "Little Giant," as he is termed by his numerous friends and acquaintances, is always telling for business. Treasurer Brown, General Manager Thomas C. Bibber and David W. Dunn are also important factors in the conduct of the business of this company.

THE SWETT & LEWIS COMPANY, Boston, dealers in X-ray apparatus, recently secured the contract for furnishing the X-ray outfit for the hospital ship "Bay State." A 10-inch coil of special design was furnished to run from storage batteries, the batteries being charged from the dynamo of the ship. Six of the type W tubes, manufactured by the Swett & Lewis Company, as well as a large fluoroscope, were furnished. The tube stand was particularly adapted to the work. The main part of the stand and base is of iron, and very heavy; the arms holding the tube and wires are of fibre, with an adjustable wooden clamp for the tube. With this stand it is possible to hold the tube in any position from within a few inches of the floor to 8 feet above it. The ship also carries about a gross of X-ray plates and a full developing and printing outfit. We understand that this company is putting out a large number of its static machines and has several large hospital orders on hand.

A UNIQUE LIGHTING CONTRACT.—Mayor Quincy has submitted to the Board of Aldermen a message and special report on the subject of street lighting in Boston after February 20, 1899. The communication included a copy of the new contract with the Boston Electric Light Company to light the streets for a period of ten years after the date mentioned, which contract contains some unique provisions. It provides for a board of arbitration to settle disputes between the parties, and for a change of rates when conditions are favorable. The existing prices for the present number of lights will be charged to begin with, but a material reduction in the cost of lights is provided for on a sliding scale as the number increases. There is a further provision enabling the city to have the price revised by arbitration every two and a half years, so that it shall not yield to the company, after it has met that portion of its operating expenses and depreciation account properly chargeable to its public lighting business, more than the actual return, not exceeding 6 per cent. in any event, which it pays upon the capital invested in its business, whether raised from the sale of capital stock or of bonds; if the company pays a larger dividend than 6 per cent. during the term of this agreement it will therefore have to come entirely from its profits on private lighting. The difficulty in connection with arbitration of fairly apportioning the expenses of the company between its private and public business has been met by providing for the measurement, under the supervision of the city engineer, of the electrical output for private and public business. On the whole this is thought to be the fairest method of determining the proportion of capital invested, operating expenses and depreciation which should be charged to the public lighting account. The contract further provides that the lighting company shall substitute enclosed arc lamps for the open arcs now in use and for the removal of the iron poles and the substitution of wooden ones. The prices for lighting are as follows: For not less than 2365 nor more than 2749, 35 cents per night, $127.75 per year; for not less than 2750 nor more than 2999, 34½ cents per night, $125.92 per year; for not less than 3000 nor more than 3249, 34 cents per night, $124.10 per pear; for not less than 3250 nor more than 3499, 33½ cents per night, $122.27 per year; for not less than 3500 nor more than 3749, 33 cents per night, $120.45 per year; for not less than 4000 nor more than 3999, 32½ cents per night, $118.62 per year; for not less than 4000 nor more than 4249, 32 cents per night, $116.80 per year; for not less than 4250 nor more than 4499, 31½ cents per night, $114.97 per year; for not less than 4500 nor more than 4749, 31 cents per night, $113.15 per year; for not less than 4750 nor more than 4999, 30½ cents per night, $111.32 per year; for not less than 5000, 30 cents per night, $100.50 per year. Under the present contract the city pays 35 cents per light per night.

CANADIAN NOTES.

OTTAWA, Ont., September 1, 1898.

MR. C. E. GREEN, who comes from Rochester, N. Y., but who has spent several years in Toronto, Ont., claims to have discovered a mode of producing electricity for light and power purposes without the aid of either fuel or water. He declares that he can produce unlimited quantities at Toronto at a cost to consumers far below one-half that at present involved in the production of electric energy. The secret of this miracle working is, he says, a very simple affair, but he does not propose to give any clue to it just now. In a few weeks he expects to be able to place the scheme on a working basis.

NEW WAGE SCHEDULE FOR MOTORMEN.—The new rate of wages put into force by the Ottawa Electric Railway Company is as follows: All men who have been in the employ of the company three years and over will receive 15 cents per hour; those under three years and over two will receive 14 2-7 cents per hour; those under two years and over two months, 14 cents per hour. This schedule only applies to all men at present in the employ of the company. Those employed in the future will be graded at 13 cents per hour for the first year, 14 cents for the second and third years, and 15 cents thereafter. Ten hours are to constitute a day's work.

THE CATARACT POWER COMPANY, of Hamilton, Ont., formed its first connection with that city last week, sending in 22,000 volts over the wires from its water-power canal near Thorold, Ont., thus demonstrating its ability to convey electrical power a distance of 40 miles. The plant to do this cost about $500,000. A large driving motor of 40 horse-power was used in the test, and 200 incandescent lamps had been arranged in the form of a shield, which was illuminated. It is expected the company will supply the Hamilton Electric Light & Power Company with power for its dynamos by October 1. The voltage will be reduced by transformation to 2000 volts.

THE SHAWINIGAN WATER & POWER COMPANY, which proposes to utilize Shawinigan Falls on the St. Maurice River, in the Province of Quebec, 17 miles from the town of Three Rivers, Que., has decided to install at once a plant capable of developing 100,000 horse-power. The plans have been prepared by Messrs. T. Pringle & Son, of Montreal, assisted as consulting engineer by Mr. W. C. Johnson, of Niagara Falls, N. Y., and the company is now calling for tenders. It is understood that power will be sold at Three Rivers cheaper than it can be obtained at any other port in the world reached by ocean-going vessels, and also at the Falls at a proportionately low figure. A strong company has been formed, with the following directorate: Messrs. A. F. Gault, Thomas McDougall, Hon. L. J. Forget, P. N. Greenshields, all of Montreal, and John Joyce, H. H. Melville and J. E. Aldred, of Boston, Mass. The company is confident that the advantages which it can offer to manufacturers on a large scale are so great that it will mark an era in the industrial development of the Province of Quebec.

ENGLISH NOTES.

(From Our Own Correspondent.)

LONDON, August 21, 1898.

MR. PREECE.—A rumor has been spread that Mr. Preece, who reaches the [illegible] from the service of the Post Office, has been requested by the Duke of Norfolk to continue for a further period [illegible] the development of a state telephone system [illegible] rumor were [illegible] without foundation.

[illegible] at the Agricultural [illegible] a substantial [illegible] Among the exhibits are cabs by [illegible] of Mr. A. L. [illegible] Headland Patent Storage Battery Company [illegible] London, [illegible] a neat "Victoria" [illegible] of which the accumulators [illegible] Headland type, and consist of [illegible] and having a capacity [illegible] The average [illegible] per cent. grade [illegible] measuring about [illegible] recorded from [illegible] used for controlling, but three steps are provided; the first step is made by the motor fields being put in series and the cells divided into two parallels of twenty-one cells in series. The second step is provided by the cells being all in series and the motor fields also in series, while the third step is provided by the cells being put in series and the motor fields connected in parallel with each other. At 1650 revolutions of the motor per minute the car makes 9 miles an hour. The wheels are 3 feet 6 inches in diameter, and provided with solid rubber tires. The Riker phaeton on show is also provided with the Headland cells, but does not limit itself to any particular type of battery. The Headland Company shows a neat cab, with the motor driving onto the front wheels, its former design using the rear wheels as the drivers. No resistance is used or alteration in the motor connection is made in regulating the speed of this cab, the cells being merely split up into four sets of cells and various combinations made. The Fulmen Accumulator Company, of France, makes an interesting exhibit of its cells, and the Electrical Cab Company, whose cabs are daily in use in London, shows its latest design.

THE BRADFORD ELECTRIC TRAMWAYS.—There are several lines of electric tramway now being built in Bradford, and the first of these was opened recently. The length of this line is 1 mile 1517 yards. There are 1727 yards of single track and 1575 yards of double track line. The total rise is 326 feet and the steepest gradient 1 in 16, for a distance of 70 yards. The track construction is the same as that of the old steam tramways in the town, 103-pound rails being used with heavy fish plates, and an extra plate fastened under the flange of all the joints. Cast-steel points and crossings are used, and a special feature is a short section of drain rail every few hundred feet. The track is bonded with No. 0000 B. & S. Crown bonds, fastened under the web of the rail under the fish plates, and only about 6 inches long. Cross bonds are also used. The power for operating the tramways is being supplied from the Bradford Corporation lighting station, the generators being arranged so that they may be used either for lighting or power work. The tramway switchboard is, of course, entirely independent of the lighting switchboard. It contains four generator panels of the usual type and two feeder panels, each arranged for two feeder circuits. A seventh panel is arranged with the requisite testing instruments, according to the Board of Trade requirements, and is placed between the other two. The switchboard has been installed by Mr. Robert W. Blackwell, of London, the line and cars having been supplied by the Westinghouse Company. Centre poles and side poles are both used to support the trolley line, and are 31 feet long, buried 6 feet deep and set in concrete. They are fitted with cast-iron joint rings, bases and tops, and wrought-iron ornamental brackets, and they present a very handsome appearance. The line is divided into half-mile sections, in accordance with the Board of Trade requirements, each section being connected to feeders through a junction box in which are the fuses controlling that section of the line. Guard wires, also divided into sections, are erected wherever the line is crossed by telegraph wires. There are no overhead frogs, the trolley wire being double throughout the entire length of the line. Copper trolley wire is used, the guard wires are of steel cables and the feeders are armored and all underground. At present sixteen cars have been delivered—seven for the line just opened and nine for another, which will in all probability be opened next month. The car bodies, made by the Brush Electrical Engineering Company, are roomy and comfortable, seating twenty-two inside and twenty-three outside. Standard "Peckham" cantilever trucks, fitted with 30-inch wheels, are used. The motors are Westinghouse No. 49 slow-speed single-reduction railway motors. Standard Westinghouse controllers are used, and each car is provided with an automatic switch and cut out with magnetic release.

General News.

NEW INCORPORATIONS.

THE ALTON ELECTRIC LIGHT & POWER COMPANY has been incorporated at Concord, N. H.

THE WISCONSIN STORAGE ELECTRIC & WATER COMPANY, Sheboygan, Wis., has been incorporated with a capital stock of $25,000.

THE GORDON TELEPHONE COMPANY, Chester, Ill., has been formed with a capital stock of $5000. Among the incorporators are A. G. Gordon, E. R. Gordon and C. Gordon.

THE JEFFERSON ELECTRIC LIGHT COMPANY, Chicago, Ill., has been incorporated with a capital stock of $50,000. The incorporators are M. A. Fort, H. Ferguson and W. H. Copeland.

THE STANDARD TELEPHONE COMPANY OF MISSOURI, Kansas City, Mo., has been incorporated with a capital stock of $300,000. T. T. Crittenden is counsel and S. J. Angew secretary of the new company.

THE DUNMORE ELECTRIC LIGHT COMPANY, Dunmore, Pa., has been incorporated with a capital stock of $50,000. The incorporators are J. E. Watkins, A. T. Irwin, A. B. Dunning, J. H. Fellows and J. C. Vaughn.

THE JOHN KAMMER COMPANY, Chicago, Ill., has been incorporated with a capital stock of $50,000, for the purpose of manufacturing electrical appliances. Among those interested are John Kammer, Joseph Staab and William J. Rhode.

THE SILOAM SPRINGS TELEPHONE COMPANY, Clayton, Ill., has been formed with a capital stock of $[illegible]. The incorporators are G. L. Thompson, John Padgett, John W. Buttz, George Waner, John R. Wallace, B. A. Curry and W. H. Breckenridge.

THE WETMORE ELECTRIC COMPANY has been incorporated at Al[illegible], N. Y., with a capital stock of $[illegible]. The directors are George W. [illegible], of [illegible], N. Y., Jacob Strife and Oliver P. Hedden, of Lowville, and Thomas Glenn, of Croghan.

THE MACON COUNTY TELEPHONE COMPANY, Macon, Mo., has been formed by H. H. Abbott, [illegible] H. Nash, R. B. Turner, C. W. Davidson, John W. [illegible], J. T. Rogers, George F. [illegible], D. A. and Joseph Nickell, all of Macon County. The capital stock of the new company is $[illegible].

THE NORTHERN TRACTION COMPANY, Michigan City, Ind., has been formed for the purpose of building an electric railway from Michigan City to La Porte. The capital stock of the company is $150,000. Among those interested are John W. Lovett, W. W. Huffman, W. E. and C. W. Hooven and George Nichol.

THE GAINESVILLE PARK STREET RAILWAY COMPANY, Gainesville, Tex., has been formed with a capital stock of $100,000, for the purpose of acquiring the right of way and the construction, operation and maintenance of a system of street railways within and near the city of Gainesville. The incorporators are J. M. Lindsay, Lewis Lindsay, Henry Lindsay, George Lindsay and H. E. Elbridge.

THE TELEGRAPH AND TELEPHONE.

OLDTOWN, ME.—The New England Telephone & Telegraph Company is extending its lines from this city to Lincoln.

SAGINAW, MICH.—The new telephone line constructed by the Valley Telephone Company between Flint and Saginaw is now in full operation.

FREMONT, OHIO.—The Home Telephone Company, of Fremont, has been granted a franchise to construct and operate a telephone system and exchange in this city.

MENOMINEE, MICH.—It now looks reasonably certain that the long-distance telephone extension to Escanaba, Iron Mountain and the Marquette iron range will materialize.

CLINTON, IA.—The Tri-City Telephone Company is putting in a new 600-drop switchboard, and is making other changes which are made necessary by a contemplated extension of its business.

MORRIS, ILL.—The Chicago Telephone Company is extending its Braidwood line to Gardner, Coal City, Braceville and Carbon Hill, which will give Morris a connection with these towns.

GALENA, KAN.—The Galena-Kansas Telephone Company will have poles on the ground about September 1 for a subscribers' line from Galena to Girard, via Columbus, Weir City and Cherokee, Kan.

BROOKFIELD, MO.—Mr. W. H. Alley has sold the Brookfield Telephone exchange to the Western Telephone Company, of which Judge H. G. Orton, of Princeton, Mercer County, Mo., is president.

PORT BYRON, ILL.—The Central Union Telephone Company is making arrangements for extending its line directly from Port Byron to Hillsdale. It has secured the right of way for most of the distance.

JOLIET, ILL.—By a unanimous vote the City Council of Joliet has refused to grant an ordinance to the proposed new telephone company. The persons seeking the franchise are John W. Arnold, E. R. Conklin and Thomas F. Ryan.

MANKATO, MINN.—Arrangements are under way to connect this city with Blue Earth City by telephone. The officers of the companies in both cities have had a conference concerning the matter, and it is believed that the connections will be made in a short time.

TACOMA, WASH.—The Sunset Telephone Company has reached Yelm with its new Tacoma-San Francisco line. The work of stretching the wires is progressing rapidly at this end of the line, and it is expected but six weeks' more time will be needed to reach Portland.

SAULT STE. MARIE, MICH.—The Michigan Telephone Company will soon install several automatic pay stations in the city for the benefit of non-subscribers. The charge will be 5 cents for a local message and 10 cents for people desiring communication with the Canadian Soo.

TERRE HAUTE, IND.—Final steps in the organization of the People's Telephone Company were taken at a recent meeting of the directors. A loan of $75,000 was negotiated, and the line will be built at once. W. R. McKeen, M. F. Hoberg, W. E. McLean and B. F. Havens are the directors.

DES MOINES, IA.—A large party of workmen have been at work for the Iowa Telephone Company the past few days building another wire between Des Moines and Indianola. The new circuit will complete the metallic circuit between Des Moines and Oskaloosa and the towns in the eastern part of the State, reaching as far as Davenport.

FORT DODGE, IA.—The stockholders of the Fort Dodge Telephone Company met and perfected the organization of the company. The officers chosen were: F. E. Seymour, president; C. D. Koch, vice-president; R. O. Green, secretary, and G. C. Kettering, treasurer. The company will proceed at once to the erection of its plant and to the completion of the details of its business.

FLUSHING, N. Y.—The number of subscribers to the local telephone exchange, which includes Flushing, College Point, Whitestone, Bayside, Little Neck, etc., has increased to upward of 200, making too much work for a single operator. In order to relieve this condition the management has decided to establish a new exchange for College Point and Whitestone. The new office will be located at College Point and will be connected with trunk lines, etc.

FLORENCE, ALA.—The Lawrence Telephone Company has been organized at Iron City, Tenn. The company will build lines connecting neighboring towns with Florence and Columbia, giving Florence and Iron City long-distance connection through Nashville. The Southern Bell Company guarantees the Lawrence Company 10 per cent. on its investment, and will cancel the stock at the option of the stockholders. The officers of the new company are: J. W. Becket, president and treasurer; John A. Pruitt, secretary and general manager.

CLEVELAND, OHIO.—A company headed by Henry A. Everett, a well-known capitalist of this city, has been organized and incorporated to cover Ohio with a cheap rate long distance telephone system. It will be known as the Union Suburban Telephone & Telegraph Company. The incorporators are H. A. Everett, M. W. Moore, J. B. Hanna, James B. Hoge, Charles W. Wasson, Frederick Storm and H. B. McGraw. The capital stock is $1,000,000. It is proposed to establish telegraph and telephone lines all over Ohio and into other States. Mr. Everett is largely interested in the Home Telephone Company, which is putting in an extensive underground system in Cleveland to compete with the Bell Telephone Company.

FORT WAYNE, IND.—The local telephone fight has developed another phase in the efforts of the Central Union Company to stifle the Independent Home Company. The four local managers of the express companies, the Adams, American, United States and National, called on President Beers and gave him sixty days' notice of their intention to remove the Home 'phones from their offices unless it be furnished without cost. They explained to Mr. Beers that the announcement was obnoxious to them, but they had received orders to give him the notice and must do so. Mr. Beers said he realized that they had a disagreeable piece of work to do, and that while he had nothing against them personally, from henceforth he was against them as agents of the companies. The Home service, he said, would not be furnished free. What the result will be is not yet known. There are 123 independent companies in the State, and the fight may be carried to the next Legislature, which will be asked to pass an anti-trust law that has an edge on it. The alliance of the express companies, not only with each other, but with a powerful financial concern, such as the Bell Telephone Company, is plainly evident from the developments of the year. It is probable that the State Telephone Association will soon have a meeting to discuss the situation.

ELECTRIC LIGHT AND POWER.

QUINCY, ILL.—Edwin L. Barr and W. H. Schott, two Chicago capitalists, have been in the city for several days with the view of purchasing the Empire Electric Light & Power Company's plant.

GRAND RAPIDS, MICH.—A special meeting of the Board of Public Works adopted the new specifications for the lighting plant, drawn by the consulting engineers, Nagle & Ball. Clerk Twamley was directed to advertise for bids to be received up to September 20.

SHELBYVILLE, ILL.—The Trout Brothers electric light plant, which has been in the hands of a receiver, was sold to the Shelbyville Water & Light Company at private sale for $9300. The purchase gives the latter company a monopoly of the water and light supply of the town.

NEWPORT, PA.—A charter has been granted at the State department for the Perry Electric Light, Heat & Power Company, of Newport, with $13,000 capital. Its incorporators are A. D. Van Dyke and S. S. Leiby, Marysville; J. K. Van Dyke and John H. Smith, Philadelphia, and J. S. Leiby, Newport.

ELGIN, ILL.—The trustees of West Chicago have purchased the electric light plant for $18,000, agreeing to pay $3,000 annually for the same. This amount is what it is now costing for street lighting, and the incandescent circuit and the business arc lights will, it is said, pay the operating expenses.

WORTHINGTON, IND.—This town, which has so long been without street lights of any kind at night, has let a contract to the Fort Wayne Electric Light Company for a $12,000 plant, calling for thirty-four arc lights. A $27,000 water-works system was also let to the same company, both to be completed January 1, 1899.

FREDERICK, MD.—James Legore, of Legores Station, this county, is planning to build a monster dam in the Monocacy River, near what is known as the Iron Stone Bridge. The idea is to develop water power for the generation of electricity to be used on the Frederick, Thurmont & Northern Electric Railway. The dam is to be 40 feet high.

PITTSBURG, PA.—Electrical firms throughout the United States and Great Britain are striving to secure the contract for lighting the Vatican with electricity. The contract will embrace the installation of four isolated generating and distributing plants, furnishing power sufficient to illuminate 11,000 rooms. It is not known that the Westinghouse Electric Company has filed a bid for the order, but the belief is that its London agency is in communication with the authorities.

LAS ANIMAS, COL.—The question of granting a twenty years' franchise to J. B. Downing, of Pueblo, to put in an electric light plant in Las Animas was submitted to a vote of the people here, and was voted down by over two to one. Those working against it favor the city putting in its own plant, as it now owns the water works and could do it at a small expense. They say they will pay for one year's lights in advance, which would pay for putting in the plant.

GLENS FALLS, N. Y.—The capitalists who purchased the Kinderhook & Hudson Railroad have bought the Frisby water power at Stuyvesant Falls to run the dynamo which will generate power for the electric cars. The water power cost $125,000. The railroad company will also furnish power for Mr. Frisby's cotton mills.. The fall from the upper dam is 130 feet, and it is proposed to take water from that point through a steel tube. The company also proposes to furnish electric light for the surrounding villages.

HARTFORD, CONN.—T. C. Perkins & Co., this city, have about completed the arrangements for the establishment of an electric lighting plant at Mystic. The plans and specifications have been completed by the engineers, and the contracts for the building and apparatus will be let probably in two or three weeks. The building will be 30x60 feet, of brick and a 150-hp boiler and engine and a 1500-light alternating dynamo will be installed. The company will build with the intention of doubling the size of the plant inside of a year. Besides lighting Mystic, light will be supplied to Stonington and other places and the system will probably be in operation by November 1.

WEST SUPERIOR, WIS.—The City Council has voted to accept the proposition of William Burgess as the basis for a contract for furnishing street lighting to the city. Five bids were received and that of Burgess was the lowest on all kinds of lighting. For three months there has not been a light burning in the whole city, owing to the strained relations betwen it and the water, light and power company. Over $300,000 is represented in the plant of the company. The present company bid $90. Following is the proposition upon which the contract will be based: Five years, for 1200 candle power, 150 arc lamps, $75; 200 arc lamps, $75; 300 arc lamps, $72.50; all lamps over 300, $70; for 2000 candle power, 150 arc lamps, $80; 200 arc lamps, $80; all lamps over 200, $77.50; over 300, $75. Commercial lighting: Arc lamps, 7 o'clock, per month, first, $5, additional, $5; 10 o'clock, per month, six nights per week, $6, additional, $5.50; 12 o'clock, per month, seven nights per week, $7, additional, $6.50; all night, seven nights per week, $8, additional, $7.50. Incandescent lights: Meter rates, 5.10

cents per lamp per hour or [illegible] cents per 1000 watts; contract rates; running later than 10 o'clock, $50; not later than 12 o'clock, $55; all night, $65; sixteen candle power.

THE ELECTRIC RAILWAY.

EAST RADFORD, VA.—The Radford street railway, which has been in the hands of a receiver for several months, has been sold to the Electric Light & Power Company, of Radford, for $3000.

SAN FRANCISCO, CAL.—The Southern Pacific Railway Company has petitioned for authority to substitute electricity for steam in moving its local trains. A large power house will be built. F. S. Douty is secretary.

KANSAS CITY, MO.—The gross earnings of the Metropolitan Street Railroad of Kansas City from June 1 to July 31 were $383,072, against $329,925 last year. The net returns were $164,775, against $148,465 in 1897.

LAWRENCE, KANS.—The City Council of Lawrence granted a twenty-year franchise to the Lawrence Railway Company to build and operate an electric street railway here. The construction of the line is to begin inside of sixty days.

BUFFALO, N. Y.—The Buffalo, Kenmore & Tonawanda Electric road was sold to the bondholders last week under foreclosure of a mortgage held by the Fidelity Trust & Guaranty Company. Spirited bidding brought the price up to $63,147.32. The road cost about $150,000, and the amount due for which it was sold is about $75,000.

CHICAGO, ILL.—Contracts have been let by the Chicago City Railway for the erection of several buildings at Sixtieth Street and Cottage Grove Avenue. There will be two two-story buildings of pressed brick and stone, connected by a veranda, and there will also be a bicycle track, children's pleasure ground and an electric fountain. About $50,000 will be expended.

TERRE HAUTE, IND.—The first mortgage bondholders' committee of the Terre Haute Street Railway Company, of which W. H. Henkle of the Illinois Trust and Savings Bank of Chicago is chairman, has prepared an agreement and has secured the deposit of more than a majority of the bonds under it. The limit of time for receiving deposits at the Illinois Trust and Savings Bank has been fixed at September 15.

WALTHAM, MASS.—It is stated that the Newtonville & Watertown Street Railway Company would like to sell its extension from Watertown to the Watertown Arsenal and to Allston. The Newtonville line now runs from the Watertown Arsenal to Needham, a distance of over 8 miles, and the fare is but 5 cents, and it is claimed the extension to the arsenal does not pay. The line is being further extended across the North Beacon Street bridge to Union Square, Allston.

NEW YORK, N. Y.—Deputy Commissioner Walton, of the Department of Public Buildings, Lighting and Supplies, has declined to issue a permit to the Brooklyn Heights Railroad Company for an overhead trolley line on Montague Street as a substitute for the cable. Mr. Walton says that the necessary consent of the State Railroad Commission had not been secured, and besides he is opposed to overhead trolley wires. He is willing to issue a permit for an underground conduit system.

NEW YORK, N. Y.—Recently Daniel Cortelyou began a suit against the Midland Electric Railroad Company, Staten Island, to recover 5 cents, paid by him, under protest, as an extra fare. This was a test case to determine the right of the Midland Company to charge two fares instead of issuing transfers. The case was decided a few days ago in favor of the plaintiff, Justice Raynaud holding that the company's franchises called for the carrying of passengers from any point on the railroad to any other point, for a single fare.

NEWARK, N. J.—The sale of the Suburban Traction Company, of Orange, has been completed. The road was put up at auction on July 6, and was purchased by the Orange & Passaic Valley Railroad Company. For three and a half years previous to that it had been in the hands of Watson Whittlesey as receiver. The purchasers of the road paid $10,000 down. On August 24 they gave another check for $17,000. Besides that, they assume liabilities of $73,000, which include receiver's certificates and accrued interest. There is $800 due in interest accrued since the transfer was made. Many changes and improvements in the road are in contemplation.

FRANKLIN, MASS.—In THE ELECTRICAL WORLD of August 20 appeared an item [illegible] "Franklin, R. I.," in regard to the probable granting of a franchise to the [illegible] & Franklin Street Railway Company. It should [illegible] progressive town [illegible] Rail-road. It is an important manufacturing centre. Insulated copper wire for electric [illegible] one general return wire for exchange purposes instead of earth connections on [illegible]

PERSONAL NOTE.

MR. THOMAS V. HALL, a mechanical and electrical engineer, well known [illegible]

Trade and Industrial Notes.

DRY BATTERIES have been found very useful for signal service in the field. The Western Electric Company manufactures the W. E. dry battery, which is said to have a high efficiency and long life, and is admirably adapted for emergencies.

IN THE SPRING of the year the city electrician of Chicago, Mr. Ellicott, installed a small motor-generator outfit to operate the police signal and fire-alarm circuits while the storage batteries were being charged. The Western Electric Company furnished the city with this outfit. The motor-generator was soon put to continuous use to help out the storage batteries, and has been running continuously twenty-four hours a day for over 120 days.

MESSRS. FRANK H. STEWART & CO., 35 West Seventh Street, Philadelphia, Pa., have just issued an attractive catalogue of electric bell, electric gas lighting, telegraph and speaking tube supplies. The catalogue is 8¾x11½ inches in size, is bound in orange cover and is well illustrated. This firm carries, in addition to household electrical supplies, a large and varied stock of electric light supplies. A copy of either or both catalogues may be obtained on application.

TELEPHONES FOR TROLLEY AND OTHER ROADS.—The Viaduct Manufacturing Company, Baltimore, Md., makes from the stump all styles of telephone apparatus, district messenger call boxes and a special trolley outfit—a most useful article. Also a small portable telephone to be carried on street cars where the regular trolley set is not used, connection being made with a telephone wire at the different trolley poles and communication held with the central office.

THE M. C. BULLOCK MANUFACTURING COMPANY, Chicago, Ill., reports that the past sixty days have been a busy period with it. Orders have been received for two central valve engines to be direct coupled to dynamos, one for lighting and the other for power transmission. The company's rock drill business is increasing, a number of Monarch drills having been placed in entirely new fields. The company is preparing its works and force to meet a heavy demand for the various lines of its manufacture.

A CONTROLLING INTEREST in the stock of the Safety Third Rail Electric Company has been purchased by Messrs. Emerson, McMillin & Co., 40 Wall Street, New York, who, after an investigation, have become so convinced of the merits of the system that they will install several miles of road with it as a practical demonstration of its advantages. Captain Murphy, the inventor, will continue his connection with the company. It is understood that the company is making excellent progress. The system will be exhibited at the street railway convention in Boston in the shape of a miniature electric railway, with car one-sixth the regular size.

"ONE-QUARTER OF A MILLION HORSE-POWER of Polyphase Electric Transmission Apparatus" is the title of one of the most atttractive pamphlets the Westinghouse Electric & Manufacturing Company has ever brought out. The volume gives a partial list of Westinghouse polyphase installations, with an explanatory statement that a complete list would require a volume too bulky to circulate in the ordinary way for commercial purposes. It illustrates handsomely various representative and interesting installations, such as the Niagara power plant, the Dolgeville plant, the Canadian Niagara power plant, and various machines, such as the Type C motor, the inductor generator and other types manufactured by the company.

THE ELECTRICAL ENGINEERING COURSE of the American School of Correspondence is, it is stated, supervised by experts in close touch with the latest advances in the science. The instruction is carefully graded, thoroughly practical and scientific, and is intended to give electrical students and engineers a complete electrical training. Among the members of the school's advisory board is Mr. Charles Thom, chief of the quadruplex department of the Western Union Telegraph Company. The school is chartered by the commonwealth of Massachusetts, and is said to be a purely educational institution. It has been warmly indorsed by leading educators and engineers throughout the country. Hand books containing complete information will be sent on application to the school at Boston, Mass.

"PEGAMOID" BRAND LEATHERS.—"Pegamoid" is a liquid composition which, when applied to substances such as cloth, leather, paper, etc., renders them waterproof, besides generally protecting and strengthening the material. It fills the fibres and pores. "Pegamoid" brand leathers are made from cloth or paper, and closely resemble real leather. The advantages claimed for "Pegamoid" brand leathers are durability and that they are waterproof and stainproof. The surface is firm but flexible, and its wearing qualities are said to be greater than those of leather. It stands extreme heat and cold without change. It may be washed and scrubbed and the surface is not damaged by grease, acid or moisture. These goods are said to be meeting with favor among street railway men for upholstering of cars and other purposes.

MESSRS. SANDERSON & PORTER, contractors for the Meriden & Compounce Electric Railroad Company, have let the contract for furnishing several bridges and buildings on the line of this road to the Berlin Iron Bridge Company, of East Berlin, Conn. The work consists of seven spans of bridges, varying in length from [illegible] feet to [illegible] feet, a car barn 50 feet wide and 100 feet long, and a power house [illegible] feet wide and [illegible] feet long. The bridges are of steel, and the buildings have steel framework, brick side walls and fireproof roofs. The roof of the power house will be covered with corrugated iron and lined with the Berlin Iron Bridge Company's patent anti-condensation roof lining. This lining, it is stated, has shown itself efficient in preventing condensation and moisture from the underside of covering and doing away with the danger and annoyance of water dripping on the machinery below.

FAN MOTOR OUTFIT FOR TELEPHONE BOOTHS.—The Edison Manufacturing Company, Broadway and Twenty-sixth Street, New York, is making two styles of fan motor outfits for telephone booths. One style is for use on [illegible]-volt direct current circuits, and the other for use with battery current. The motor is suspended by a heavy rubber ring from a bracket attached to one of the interior walls of the booth. Connection is easily made by unscrewing the nearest lamp bulb from its socket and inserting the current tap. The lamp bulb must be replaced in the socket of the current tap. The connecting cord leads from the side connections on current tap to the stop-and-start switch on under side of motor. The switch is so arranged that the lighting of the lamp will start the fan. This convenience will no doubt be greatly appreciated, as it will keep the interior of the booth cool and endurable to those who have frequent occasion to shut themselves up in these limited quarters.

MESSRS. MACHADO & ROLLER, 203 Broadway, New York City, state that the call for Whitney instruments is increasing and that the A. E. G. lamp is also meeting with increased demand. These lamps are maintaining their reputation for long life, freedom from blackening and high efficiency. For central station work particularly they are said to be very satisfactory, as they withstand the fluctuating voltages met with in central station practice. A good proof of the excellence of these lamps is a large order received as the result of a competitive test of all the standard lamps, in which the A. E. G. lamps gave the following results: At start, three 110-volt, 14-cp, 2.7-watt lamps; after 400 hours of burning the average candle power was a little under 12 candle power and the efficiency 2.78 watts per candle. The lamps were burned in a horizontal position, and were so continued in use after the completion of the test, having burned 1300 hours at the time of this report. Messrs. Machado & Roller carry a large stock of these lamps, from which prompt shipments can be made.

ENGINE SALES.—Among the recent sales of engines and generators by the Ridgway Dynamo & Engine Company, Ridgway, Pa., are the following: One 18-hp engine direct-connected to a 10-kw generator, for W. H. Brown's Sons, Pittsburg, Pa.; one 30-hp engine, direct connected to a 15-kw generator, for H. H. Stevens, Colorado Springs, Col.; two 250-hp engines to the Berwind-White Coal Mining Company, making seven engines of this size and three 150-kw generators furnished to this concern during the past fifteen months; one 160-hp engine, direct connected to a 110-kw generator, for the Schoen Pressed Steel Company, this being the fourth direct-connected unit furnished the Schoen people; one 40-hp engine, direct connected to a 25-kw generator, and one 80-hp engine, direct connected to a 50-kw generator, for the Collins State Homœopathic Hospital, Collins, N. Y.; two 100-hp engines, direct connected to two 60-kw generators, for the Jefferson Medical College, Philadelphia. Besides these the Ridgway Company has made sales of several engines of 125 and 159 horse-power to go to various parts of the country.

"THE DEVELOPMENT OF THE TELEPHONE" is the title of a handsomely printed pamphlet which the Elkhart Telephone Company, furnishing the independent telephone service in Elkhart, Ind., has recently brought out. The work gives the history of the telephone business in Elkhart, describing the unobliging nature of the Bell Telephone treatment of the public and the growth of the independent system. The latter is forcibly emphasized by a series of illustrations, the first showing a 100-drop board with one attendant, under date of December 1, 1895; the second a 200-drop board, also with one attendant, installed in January, 1896; the third, a 300-line board with two attendants, installed June, 1896; the fourth, a 350-line board with three attendants, installed January, 1897, and the fifth and last, a 600-line board with four attendants, now in service. The company states that the initial expense of the publication is rather out of proportion to local benefits, so that if exchanges now in their formative periods desire copies as aids in their promotion they can secure them by remitting 10 cents per copy to the Elkhart Telephone Company.

THE BOSTON CONVENTION.—The General Electric Company will be well represented at the Boston Convention of the American Street Railway Association, both by engineers and agents, and will have an interesting and novel exhibit at Mechanics Hall. It will establish its headquarters at the Brunswick Hotel, with a reception room on the first floor, whither all delegates are invited and will be made warmly welcome. Advantage will be taken of the fact that Boston is distinctly a General Electric centre to arrange a series of visits to different stations where General Electric apparatus may be seen in commercial operation and to illustrate the history of rapid transit and the actual development of the electric railway. The proximity of the Lynn works of the company will also afford the delegates an opportunity of visiting them and of appreciating the excellence of the methods employed in the construction of railway apparatus. Much new literature will be published by the General Electric press for distribution at the convention, and will be found by delegates at Mechanics Hall and at the company's headquarters. To Mr. W. J. Clark, general manager of the railway department, the interests of the General Electric Company will be confided. He will be assisted by representatives from various sales offices throughout the country.

Directory of Scientific Societies, Associations, Etc., and Meetings of the Same.

FRANKLIN INSTITUTE (Electrical Section), Philadelphia, Pa.—Secretary, William H. Wahl.

THE NEW YORK ELECTRICAL SOCIETY.—President, Gano S. Dunn; secretary, George H. Guy, New York.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. —F. W. Putnam, secretary, Salem, Mass.

ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA, Pittsburg, Pa.—Meetings, third Tuesday of each month.

CANADIAN ELECTRICAL ASSOCIATION.—President, William H. Browne, Montreal; secretary, C. H. Mortimer, Toronto, Ont.

CHICAGO ELECTRICAL ASSOCIATION.—Meetings, first and third Fridays of each month, from October 1 to June 1; J. R. Cravath, secretary.

NORTHWESTERN ELECTRICAL ASSOCIATION.—President, F. A. Copeland, La Crosse, Wis.; secretary, Thomas R. Mercein, Milwaukee, Wis.

MASSACHUSETTS CHARITABLE MECHANIC ASSOCIATION, Boston, Mass.—Exhibition of Motor Carriages, October 10 to December 3, 1898.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK. —President, G. Tracy Rogers, Binghamton, N. Y. Next meeting, Manhattan Beach, September 13 and 14, 1898.

NATIONAL ELECTRIC LIGHT ASSOCIATION.—President, A. M. Young, Waterbury, Conn; secretary, George F. Porter, New York. Next meeting, New York, May or June, 1899.

AMERICAN STREET RAILWAY ASSOCIATION.—President, A. E. Lang, Toledo, Ohio; secretary, T. C. Penington, Chicago, Ill. Next meeting, Boston, Mass., September 6, 7, 8 and 9, 1898.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS.—President, W. W. Ryder, Chicago; secretary, P. W. Drew, Milwaukee, Wis. Next meeting, Wilmington, N. C., June 19, 1899.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, New York.—President, Dr. A. E. Kennelly; secretary, Ralph W. Pope. Meeting, third Wednesday of each month, from September 1 to June 1.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES.—President, Samuel Insull, Chicago; secretary, Wilson S. Howell, Harrison, N. J. Next meeting, Sault Ste. Marie, Mich., September 12 and 13, 1898.

THE PACIFIC COAST ELECTRIC TRANSMISSION ASSOCIATION. President, W. F. Pierce; secretary, George P. Low, 427 Tenth Avenue, San Francisco, Cal.

THE OHIO ELECTRIC LIGHT ASSOCIATION.—President, Emil C. Schmidt, Sandusky; secretary and treasurer, Samuel Scovil, Cleveland. Next meeting place, Cleveland, 1899.

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION.—Dr. C. R. Dickson, Toronto, Can., president; Dr. John Gerin, Auburn, N. Y., secretary. Next meeting, Buffalo, N. Y., September 13, 14 and 15, 1898.

PENNSYLVANIA STATE STREET RAILWAY ASSOCIATION.—President, Robert E. Wright, Allentown; secretary, S. P. Light, Lebanon. Next meeting, Scranton, Pa., September 7-8, 1898.

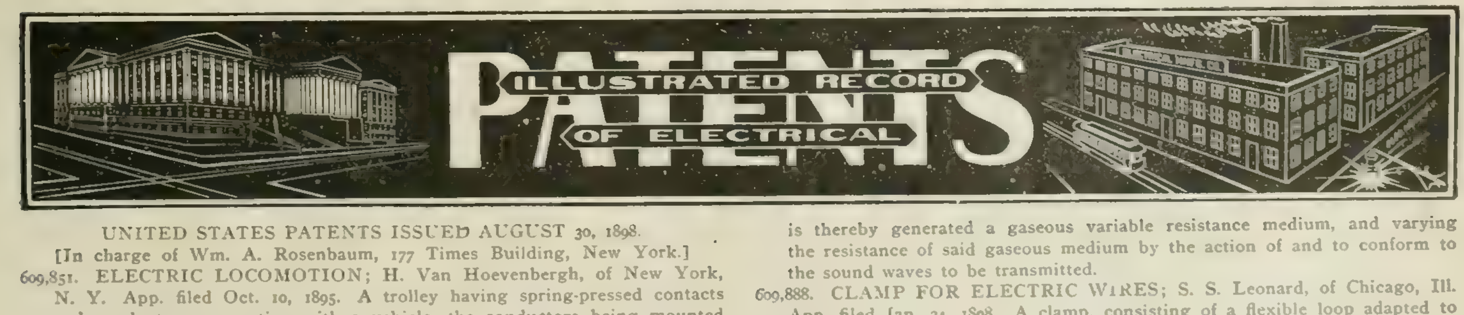
ASSOCIATION OF FIRE AND POLICE TELEGRAPH SUPERINTENDENTS AND MUNICIPAL ELECTRICIANS.—President, J. W. Aydon, Wilmington, Del.; secretary, H. T. Blackwell, Jr., New York. Next meeting, Wilmington, Del.

THE SOUTHWESTERN GAS, ELECTRIC AND STREET RAILWAY ASSOCIATION.—President, Carl F. Drake, Austin, Tex; secretary, E. L. Wells, Jr., Marshall, Tex. Next meeting, Austin, Tex., April 19, 1899.

INDEPENDENT TELEPHONE ASSOCIATION OF THE UNITED STATES.—President, Judge James M. Thomas, Chillicothe, Ohio; secretary, W. J. Vesey, Fort Wayne, Ind. Next meeting, June, 1899. Place to be named hereafter.

Business Notice.

THE ILLUSTRATIONS in this issue were made by the Photo-Engraving Company, 9-15 Murray Street, New York City.



UNITED STATES PATENTS ISSUED AUGUST 30, 1898.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

609,851. ELECTRIC LOCOMOTION; H. Van Hoevenbergh, of New York, N. Y. App. filed Oct. 10, 1895. A trolley having spring-pressed contacts and conductors connecting with a vehicle, the conductors being mounted on the frame by a laterally movable connection.

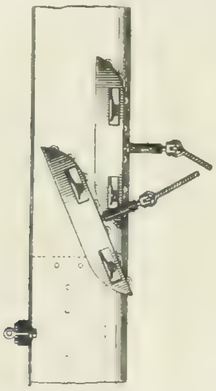
609,875. ELECTRODE FOR MEDICAL PURPOSES; M. N. Clarke, of Wilkesbarre, Pa. App. filed Jan. 8, 1898. In an electrical apparatus for medical purposes, a suitable source of electricity and a pair of electrodes, consisting of a suitably shaped metal plates filled with small perforations.

609,877. TENSION REGULATOR FOR ELECTRICAL TRANSMISSION OF SPEECH; A. C. Cousens, of Newark, N. J. App. filed June 15, 1895. The herein described method of transmitting sound, which consists in subjecting to the action of the transmitting current a substance from which is thereby generated a gaseous variable resistance medium, and varying the resistance of said gaseous medium by the action of and to conform to the sound waves to be transmitted.

609,888. CLAMP FOR ELECTRIC WIRES; S. S. Leonard, of Chicago, Ill. App. filed Jan. 24, 1898. A clamp, consisting of a flexible loop adapted to embrace the glass insulator and a pair of clamping blocks loosely secured the loop at one end, and each provided at the other end with a notch adapted to receive the free end of the wire, said free end being provided with means for clamping it upon said blocks.

609,969. TROLLEY; D. Libby, of Mansfield, Ohio. App. filed Feb. 23, 1898. The combination of the pivoted mast a horizontal rod, provided with suitable bearings secured in a post, connections between the mast and the rod, a coil spring surrounding the rod to hold the mast in a vertical position, the said rod being adapted to have a longitudinal movement in the bearings, the masthead provided with a series of holes radiating from the pivot centre to increase or diminish the leverage upon the spring.

609,972. HANGER FOR ELECTRIC LAMPS; W. F. Murphy, of Iowa City, Ia. App. filed Dec. 21, 1897. In a hanger for electric devices, the combination of bracket arms, metallic spindles connected with and extending inwardly from the bracket arms, and adapted to be electrically conected with the opposite poles of an electric generator, the spool or drum having metallic bushings in its opposite ends snugly receiving the spindles, wires wound on the spool and adapted to be connected with an electrical device, metallic screws connecting the wires to the spool or drum and impinging against the bushings thereof, suitable means for rotating the spool to wind the wires thereon, and suitable means for normally holding the spool against rotation.

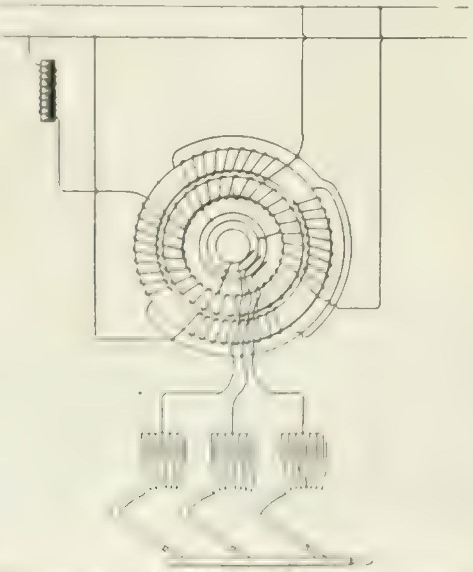

No. 609,851.—Electric Locomotion.

609,977. ELECTRIC RAILWAY MOTOR; A. Schmid, of Pittsburg, Pa. App. filed May 10, 1894. In an electric car, a motor sleeved at one end upon the axle of the car, suspension bars secured to said motor above its centre of gravity, springs supporting the ends of said bars, and means whereby said springs are attached to the truck.

609,990. MEANS FOR CONTROLLING NON-SYNCHRONOUS ALTERNATING CURRENT MOTORS; B. G. Lamme, of Pittsburg, Pa. App. filed March 11, 1896. A variable speed, non-synchronous motor having a comparatively large secondary resistance and a small degree of magnetic leakage between its primary and secondary members, in combination with means for varying the e. m. f. applied to its primary member whereby the speed of the motor is varied.

609,991. METHOD OF AND MEANS FOR SECURING CONSTANT TORQUE IN POLYPHASE MOTORS; B. G. Lamme, of Pittsburg, Pa. App. filed Feb. 10, 1898. The method of securing constant torque in an induction alternating current motor, which consists in supplying the actuating currents through choke coils, the magnetic circuits of which become saturated at a predetermined point in the increase of the quantity of current.

610,004. RAIL BOND; William H. Talley, of Waco, Tex. App. filed Nov. 26, 1897. A rail joint, comprising a suitable rail, having a base angle bar located on either side of said rail, and having basal flanges, normally in contact with the base of the rail, angular-shaped grooves formed in the basal flanges of the base bar and [illegible] bars located in said grooves and [illegible] surfaces of the base of the rail.


No. [illegible].—Alternating Current Motor.

610,00[illegible]. CONTACT SUPPLY FOR ELECTRIC RAILWAYS; J. E. Walkins, of Springfield, Mass. App. filed Feb. 2, 1898. The combination with the [illegible]

610,008. CONTACT-RAIL APPLIANCE FOR ELECTRIC RAILWAYS; J. E. Walkins, of Springfield, Mass. App. filed Feb. 2, 1898. The combination with the support rail of insulating material, provided at opposite sides with the continuous longitudinally ranging metallic contact conductors, of a double-shoe trolley device, consisting of a depending trolley support having a roller-carrying yoke to run on the top of the support rail, and provided with the oppositely arranged depending inwardly spring-pressed shoes, said trolley support being provided at its upper portion with the paired lateral arms having perforations; and the depending rods or posts downwardly extending through said perforated arms, and the springs.

610,009. ELECTRIC RAILWAY; L. E. Walkins, of Springfield, Mass. App. filed Feb. 2, 1898. In an electric railway system, the combination with a longitudinally ranging series of transversely axial roller wheels horizontally arranged, each having a central rim, and at either side thereof an annular section of metal insulated from the central rim, and each of said annular sections having a surrounding collar in contact therewith, of means for preventing the rotation of the collar, line and return wires and electrical connections between said wires and said collars.

610,023. AUTOMATIC CUT OUT FOR MAGNETO-GENERATORS; W. J. Bowen and Charles A. Federer, of Cleveland, Ohio. App. filed May 26, 1898. In an automatic cut out, a rotatory spindle having a projection of insulating material provided with a recess, a loosely mounted wheel connected with the generator and having a pin resting within the recess of the projection, a contact plate in the recess and a spring arranged to normally hold the plate and pin in contact.

610,025. ALTERNATING CURRENT MOTOR; C. S. Bradley, of Avon, N. Y. App. filed Sept. 17, 1897. An electric motor having a primary winding provided with a plurality of branches, one or more of which includes inductance to set up in the primary core a rotary field when connection is made with a single-phase current, and a secondary element, the winding of which is connected with an adjustable phase-leading device.

610,064. CONTROLLING DEVICE; K. A. B. D. Kottgen, of Charlottenburg, Germany. App. filed Dec. 30, 1897. The combination in a controlling device with a plate provided with a branched guiding slot, of a laterally movable slotted controller part, a controlling lever extending through said slotted parts, a mounting therefor adapted to permit the composite movement of said lever, and connecting parts uniting the controlling lever and part with the controlled machinery.

610,067. INDUCTION MOTOR; B. G. Lamme, of Pittsburg, Pa. App. filed July 22, 1897. In an alternating current induction motor, a secondary member, comprising a spider, a laminated, slotted core, bar conductors located in the core slots and projecting beyond the ends of the same, and resistance rings provided with ventilating and centreing blades, which are bolted to the inner sides of the projecting ends of the bar conductors, and having shoulders bearing against the adjacent portion of the spider.

610,090. ELECTRIC RAILROAD; B. C. Seaton, of St. Louis, Mo. App. filed April 5, 1897. In an electric railroad, the combination of the cross pieces, the insulating support and housing, the clamping and fastening devices and the conductor.

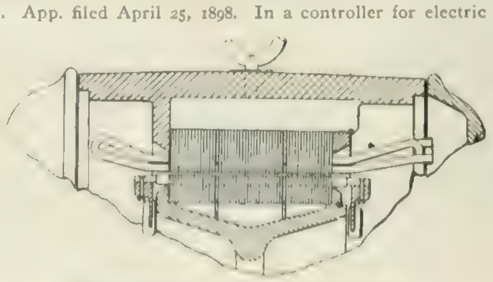
610,091. THIRD RAIL FOR ELECTRIC RAILWAYS; B. C. Seaton, of St. Louis, Mo. App. filed Dec. 7, 1897. In an electric railway, a third rail formed with a channel in the upper side to receive feed-in wires.

610,092. CONTACT DEVICE FOR ELECTRIC RAILWAYS; B. C. Seaton, of St. Louis, Mo. App. filed Feb. 4, 1898. In a contact device for electric railways, a supporting bar, a hanger having a slot and pin connection with the bar, a bracket against which the hanger bears, a spring forcing the hanger against the bracket, and a shoe secured to the lower end of the hanger.

610,093. THIRD RAIL FOR ELECTRIC RAILWAYS; B. C. Seaton, of St. Louis, Mo. App. filed Feb. 4, 1898. In a third rail for electric railways, a conductor having a vertical flange providing an exposed surface for the contact shoes and a lateral flange, providing a guard for the contact shoes.

610,094. ELECTRIC RAILWAY; B. C. Seaton, of St. Louis, Mo. App. filed Feb. 18, 1898. In an electric railway, a third rail in combination with a crossing located in a gap in the third rail and consisting of a hood, bars supporting the hood and a conduit inclosed by the hood and bars.

610,124. CONTROLLER FOR ELECTRIC MOTORS; H. P. Davis, of Pittsburg, Pa. App. filed April 25, 1898. In a controller for electric motors, the combination with a resistance varying switch and a series parallel switch, the shafts of said switches being at right angles to each other, of gearing between said shafts, combined cut out and reversing switches and interlocking mechanism.


No. 610,067.—Induction Motor.

61[illegible]. ELECTRIC CIRCUIT CONTROLLER; J. H. Bowley, of Washington, D. C. App. filed March [illegible], 1898. An automatic regulator for electric circuits, consisting of a receptacle having a base and neck portion, said neck having an upper and lower compartment, a float mounted in the lower compartment of the neck, a standard erected upon said float and in said neck and having fingers designed to engage the ends of the wires forming the circuit.

The Electrical World.

Vol. XXXII. NEW YORK, SEPTEMBER 17, 1898. No. 12.

PUBLISHED EVERY SATURDAY BY

The W. J. JOHNSTON COMPANY,

9 Murray Street, New York.

Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York.

New England Office, 620 Atlantic Ave., Boston.
Western Office, 936 Monadnock Block, Chicago.
Philadelphia Office, 929 Chestnut Street.

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THE ELECTRICAL WORLD,

9 Murray Street, New York.

Vol. XXXII. NEW YORK, SEPTEMBER 17 1893. No. 12.

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THE STREET RAILWAY CONVENTION.

The seventeenth annual convention of the American Street Railway Association, which was held in Boston September 6-9, exemplified again the rapid development of this industry and the healthy growth of the association. The place was most happily chosen. Boston was the birthplace of the association and the scene of more pioneer work, failures and successes in the electric railroad line than any other place, and its system now is perhaps the most interesting one to be found anywhere. While the papers read at the convention did not treat of any of the fascinating new developments, but were devoted to quite time-worn subjects, although subjects of great importance, the chief interest in the street railway conventions attaches to the exhibits, and these were remarkable for their number and value. The most notable feature of the whole convention was the series of charming entertainments, provided by the Massachusetts Street Railway Association, their efforts in this direction being made easy by the number of places of historical interest and facilities for easy entertainment within easy reach of Boston, and by the large number of ladies attending the convention.

A few of the recent developments in street railway development were noticeable in the exhibits. Particular interest was displayed in the running gear of double-truck cars, and the most advanced examples of this part of a railway equipment showed close resemblance to the standards of steam railroad construction, in the use of swing bolsters, series springs and in the general arrangement of the brake rigging and details, combined with the feature peculiar to electric car service—namely, maximum-traction construction, the use of which is becoming almost universal in double-truck electric railway work. The term "maximum traction" is applied to trucks in which but one motor per truck is used and in which the weight upon the motor-driven pair of wheels is greater than that upon the idle pair. As a rule the driving wheels are larger than the others, although this is not always the case. The unequal distribution of the weight is obtained either by overhanging the motor from the driving wheel end of the truck or by placing the bolster nearer that end, or by a combination of these two methods. The purpose of this arrangement is to obtain increased tractive effort, 50 per cent. of the weight of the car apparently being generally considered insufficient for the needs of street railway work, although such cars are ordinarily run without trailers, and this percentage is much higher than that considered necessary in steam railway work. A disadvantage of the maximum-traction truck is the fact that its use largely does away with one of the chief advantages of double trucks over single trucks—namely, the reduction of the weight per wheel and the consequent reduction of rail pounding, wear and tear and the increase of comfort to passengers. The chief advantage of maximum-traction double-truck cars, therefore, over single-truck cars is the greatly shortened wheel base and consequent ability of the truck to take sharp curves without grinding. A general comparison of the advantages and disadvantages of single and double-truck cars was well brought out at the convention in the paper of Mr. Richard McCulloch, which is briefly abstracted in another column. The conclusion of this paper is that double-truck cars are advantageous where the runs are long, the speed is high and stops are comparatively infrequent, while the single-truck car is more suitable for short runs, dense traffic, many stops and low speed. Two disadvantages of the double-truck car often felt in city service and not noticed in this paper are the inability of the conductor to keep track of the large number of passengers carried, and, therefore, to collect his fares, and the more frequent stops of the larger car, owing to the larger number of passengers carried, and the consequently reduced speed.

Convertible cars—that is, cars which can be opened for summer use and closed for winter use—would fill a long-felt want if a satisfactory type could be obtained. Two attempts at a solution of this difficult problem were shown at the convention and excited much interest. Both cars were constructed with panel side walls, parts of which could be slid or rolled into the roof. One was practically cylindrical, the glass windows being curved in such a way that the whole side of the car could be rolled around into the curved roof of the car. The side panels of the other were arranged in leaves, which could be stowed away in the roof one over the other without cutting off the monitor. Both cars, however, required an aisle down the centre, giving room for only four seats across the car, instead of five, as in standard open car work. In winter, too, it might be feared that the construction would give a very cold and draughty car.

In the electrical part of car equipments a most remarkable uniformity has come about in line with the general uniformity and standardization of electric railway systems, which is, although this industry is of more recent growth, much more marked than that of electric lighting systems. Four-pole motor construction, with windings on all poles, cylindrical steel shells, laminated polar projections bolted in, two-path armatures, barrel windings, high density in the armature core under the slots, are features that are now almost universal. The two forms of suspensions, cradle and nose, are about equally in favor. The controllers made by different companies also bear a wonderful resemblance to each other. All use a magnetic blow-out and the differences between them are more due to patent limitations than to engineering preferences. The extremely close uniformity of electric railway apparatus is one of the most remarkable features of this suddenly developed industry, the exacting conditions of which apparently allow in any line no two solutions of the same problem.

AUTOMOBILES.

For weeks past the French technical press has been filled with accounts of a recent exhibition and contest of motor-driven vehicles, among which those operated by electricity particularly distinguish themselves. It appears that the automobile is peculiarly French, having been carried to further development and being in more general use in France than elsewhere, and that the pastime of "automobilism" will soon become a national one with the people [illegible] the interest in automobiles is restricted largely to France.

[illegible] if for nothing else than the influence it would have for the better- [illegible] the automobile vehicle would have an even larger effect for good, especially if vehicles of this sort are not restricted to pleasure carriages, but are built for utilitarian purposes as well. Very few appreciate the enormous importance of the transportation factor in the cost of living, or how much it costs to transport goods or persons on an ordinary country road. A ton of coal can be carried from Chicago to New York for less than it costs to haul it 5 miles on a highway. This is due in part to the badness of the highways, and in part to the high cost of horse traction. The latter is not entirely on account of any inherent difficulty with the horse, but because of the necessity for a man to look after him. One horse hauling 1 ton costs as much for superintendence as would a motor of 50 horse-power hauling 50 tons. Even if horse-power from the horse were as cheap as horse-power from the motor, which it is not, the above fact would place the animal at a great disadvantage.

One of the problems that confront all cities as they increase in size is adequate means of bringing in produce. In the greater part of the United States it costs the producer living 5 miles from the railroad and 50 miles from the city as much or more to haul his goods to the railroad as it does to have them transported to the city from his station. As it is perfectly evident that the light railway, electrically driven, will afford comparatively low-cost transportation only in districts fairly well settled, or where there is a considerable volume of produce to handle, it seems that to some form of the automobile and to better roads we must look for relief from the high cost of horse transportation of the necessities of life. Consequently we should hail the coming of the automobile, in whatever form, with satisfaction, and apply our energies to its betterment. It is true that so far motor vehicles are mostly pleasure carriages with a few timid delivery wagons feeling their way about the streets, but it is likely that the first savage who tamed a horse used him for show and that it took some time to reduce him to be a bearer of burdens.

Convention of the Association of Edison Illuminating Companies.

This association is holding its annual meeting during the present week at Sault Ste. Marie, Mich., commencing on Monday and continuing until Wednesday. Papers on the following-named subjects are down on the programme: "Methods of Charging"; "Developments in Transmission Apparatus"; "Meters"; "What We Saw Abroad," a partial report of the observations of Messrs. J. W. Lieb, Jr.; J. Van Vleck and Arthur Williams, all of the Edison Electric Illuminating Company, of New York, and who are now in Europe studying recent developments in electric science and practice; "Problems of Smaller Stations"; "Report of Lamp Testing Bureau, Including Report of Tests of Non-Edison Lamps."

Meeting of the Old-Time Telegraphers.

During the present week, on September 13, 14 and 15, the Old-Time Telegraphers' Association and the United States Military Telegraph Corps will hold their joint annual meeting in Omaha. The business session of the Old-Time Telegraphers will be called at 9:30 on Tuesday morning in the Bee Building, and on Wednesday morning the United States Military Telegraph Corps will hold its business meeting at the same place. An extensive entertainment programme has been arranged for the members of the two [illegible] and their friends. There will be tally-ho rides around the city; excursions to the exposition; and visits to the different points of interest in and about the city. A novel feature of the entertainment will be a special war dance by the Indians encamped on the North Tract. Another interesting feature will be the ascension of a war balloon with telegraph and telephone apparatus. At [illegible] on Thursday a banquet will be held in the [illegible] on the exposition grounds.

Inspection and Testing of Motors and Car Equipments by Street Railway Companies.*

BY F. B. PERKINS.

In no direction can a railway company save money or increase dividends more rapidly than by having its equipments thoroughly inspected by competent men, working systematically under intelligent direction. Instead of examining cars once in thirty or sixty days a daily inspection is necessary. I have thought it expedient for the purpose of setting forth my views on inspection to describe the work as being carried on in a modern car house containing fifty equipments, and arranged for the easy handling of the cars, so that no extra help will be required for that purpose.

In dealing with the inspection of cars in this car house we believe better results can be obtained by giving to each man some particular branch of the work, rather than assigning to him a certain number of cars and expecting him to do all the work required thereon.

Two men would be required to grease and inspect the motors; one to keep the controllers in repair, one to take care of the trolleys and to assist in the care of trucks and car bodies, one to have charge of the trucks and car bodies.

The most vital parts of the equipments are the different parts of the motor, viz.: armatures, fields, bearings, brushes and brush holders. The care of this part of the equipments should come under the head of greasing, and on the manner in which this part of the work is done depends to a large extent the frequency with which the cars will break down while in service, and also the amount of repair necessary to keep them in operation. Oftentimes the most ignorant and cheapest men are given the place of greaser. On the contrary it is a position where intelligence and thoroughness are imperative.

The car should pass into the greaser's hands the first day after it is on the road and every second day thereafter. He should examine thoroughly brushes, brush holders, gears, pinions, bearings and commutator. Of these parts, the care of the bearings and commutator is the most important, and should therefore receive the greatest amount of attention. The manner of caring for the bearings is very simple. They must be well supplied with grease or oil, and care must be taken that they are kept free from dust and grit, and also that the grease feeds properly.

In the matter of the care of commutators, electricians seem divided in their opinion as to whether they should be sand papered or not; personally I am not in favor of it. Instead of temporizing the commutator by sand papering it, and thereby simply putting it in shape for one more day's work, I would get at the bottom of the trouble, and either make a commutator, by some preparation of mica and copper, which will not spark, or if the trouble lies deeper remedy it by remodeling the entire motor. This may seem to be a heroic measure, but the end will justify the means. I think, however, that usually the trouble is not in the commutator, nor with the motor, but in either the brushes or brush holder, or both, and it is probable that with proper adjustment and with proper care and treatment we should find the trouble obviated and sand papering of commutators unnecessary. When speaking of the treatment of brushes I refer to a treatment of oil or something similar.

The writer has personal knowledge of a large road where common brushes were used without any treatment or care except to replace them as needed, and it seemed as if the man who used the most brushes was given the credit of taking the best care of his motor. The average life of brushes on this road and the above conditions with the commutator sand papered every day was six days. Subsequently the sand papering was stopped entirely, and the brushes were removed every six days and properly treated in oil. The life of brushes under this treatment was increased from six days to from forty to sixty days. The trouble with commutators, which before had been great, was reduced to a minimum, in fact almost entirely averted. It is possible that under some heavy conditions the practice of sand papering must be kept up, but it must be accomplished in a different manner, and, instead of indiscriminate sand paper, it must be applied sparingly.

Not later than every fourth day every controller and switch should come under the notice of the man who has charge of these parts. The main point is to clean thoroughly, using a little vaseline on the contacts. The parts that are worn should be touched up with a file, or should be sand papered, and if badly worn should be replaced, so that at least every fourth day the controllers will be sent out in first-class condition. This man can also examine the car wiring, lamp fixtures, headlight and all similar parts.

The fourth man should have the care of the trolley poles and wheels. These should be carefully looked over each night and oiled if necessary. The man who attends to this part of the equipment will also have considerable time to devote to general inspection of the car bodies and trucks under the direction of the general inspector. Under the scrutiny of these two men should come all the details of the car body, such as grab handles, window catchers, curtain fixtures and similar parts. These should be carefully attended to each day, insomuch as the reputation of the road will suffer in direct proportion as the attention to these small details is neglected.

After having touched upon the subject of the matter of inspection in the car house we have to deal with outside inspection, that is, inspection on the road by inspectors, motormen and conductors. It may be a good plan to have outside inspection, and it is often advantageous if not carried too far, but I do not believe it is desirable to have a large force, for this reason: but very little of the time devoted to this line of inspection is really used in looking over the equipments, but must necessarily be consumed in getting from one car to another and in waiting for opportunities, and most of the trouble located by these inspectors is not of such a nature as to require immediate attention. If it were the inspector could not make the necessary repairs without taking the car to the car house.

Troubles of a serious nature, such as would require immediate attention and taking the car out of service, should be easily detected by the motorman or conductor, and reported at once to the proper official. It may not be entirely irrelevant to speak here of the relation of motormen and conductors to the inspection of cars. It has been proven that it is usually a waste of time, and very little has been accomplished by attempting to instruct motormen and conductors in other than the simplest ideas of electrical problems; for while on some roads there may be a number of old motormen who have a fair idea of electrical equipments, and whom it would probably be safe to allow to locate existing trouble, it would be difficult to draw the line between the men competent in this direction and those wholly lacking in such knowledge.

Next comes the matter of testing. The service which we will obtain from our equipments depends largely upon the manner in which the repairs are made. If the repair work be rushed through with the idea of going over as many cars as possible in a short space of time and with little or no regard for the thoroughness of the work we must expect the necessity for repairs to increase to an alarming extent. If, on the other hand, we make our repairs with the idea that work thoroughly done will have a tendency to greatly decrease the liability to breakdowns while the cars are in service, and correspondingly reduce the amount of work to be done in the repair shops, we shall naturally consider the best means not only of doing the work, but of definitely determining its condition when finished. To do this properly we must resort to our testing, and we use the word "testing" in a broader sense than it usually signifies. For example, all material furnished, such as tape, mica, paper, etc., must be kept up to the standard, and to accomplish this everything used should be carefully examined, or, under our classification, tested.

We must begin testing in the purchasing department. In the purchasing of supplies a great deal of trouble is often occasioned by changing the kind of material furnished. This is probably more noticeable in the case of small roads. Now, while there may be no great difference in the quality of goods furnished, or if any one of the many different kinds were used exclusively, it would give satisfaction, yet the very fact that many different kinds are used has a tendency to produce a lack of care in the details of the work which will almost invariably show in the general result.

If, however, we have to allow only one kind of material in the repair shop the question naturally arises as to how we can avoid being behind the times in the matter of different kinds of supplies, and also in the manner of their use. The answer is we must have an experimental room, and there must be tested samples of all supplies and material before being contracted for by the purchasing agent.

Having now provided for our testing department and established its relation to the purchasing of supplies and to the employees of the repair shop what machines and instruments shall we need in its equipment?

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*Paper read before the American Street Railway Association, Boston, September, 1898. Abstracted.

A high and low reading direct-current voltmeter, one having a double scale reading from 1 to 750 and from 1 to 15.

A direct current ammeter reading from 1 to 100.

A low reading ammeter would be very convenient many times, but is not absolutely necessary.

A 50,000-ohm magneto bell.

An alternating current voltmeter and some handy testing set will make an outfit of instruments with which we can do all the testing required.

If the alternating current is not within reach of the car house we must procure a small dynamo. A very small machine, say 2 horse-power, would be sufficient for all the needs of the testing department. If this machine is designed for about 100 volts it would be most convenient for our use. With a few small transformers wound for 2000 volts primary and for either 50 or 100 volts secondary, we are prepared to furnish any voltage within a range of from 5000 to 10,000 volts.

The man who has this part of the work in charge can very easily and cheaply arrange the details of installation of the wiring, etc. He can also make some resistance coils and many other pieces of apparatus which will greatly facilitate the quick testing of whatever may be sent to this department.

What shall we test? First, everything that goes into the repair shop. By doing this we shall be sure of keeping all material up to the standard, which means an absolute guarantee against breakdowns caused by poor material. In this way we raise the standard of workmanship.

Second, all supplies which go to the foreman of the car houses. In connection with this matter we are of the opinion that in the testing room should be decided the manner of treating brushes, the length of time they should be used before being removed from the motor, the manner in which they should then be cared for, their final disposition, the proper attention to be given the trolley poles, the length of time they ought to remain in service, their condition when removed, and many other similar questions should not be left to work out their own solution or be dependent upon the feelings or judgment of the various employees and workmen, but should be definitely determined and decided in our testing department.

Many may be of the opinion that we are carrying system beyond necessary limits in thus definitely and positively arranging these details, but why should we allow several different men to use material in whatever manner they may individually see fit, to treat brushes as their fancy may dictate, to regulate the tension of trolley poles in accordance with their own feeling at the time rather than by any fixed standard, and various other matters which might be mentioned along these lines.

Third, all finished material, such as armature coils, insulation for controllers, commutators and brush holders. We do not necessarily need to test every piece, but enough to satisfy ourselves that the general order of work is kept up to the standard.

Fourth, all armatures, fields, commutators and controllers, as they are being made or repaired. One illustration will be sufficient to show how the testing may be carried on in this branch of work.

An armature is wound and ready to be connected to the commutator. With a small wire we connect all of the top leads together, with the bottom leads each separate from the other. With a magneto or testing set we find the insulation of the complete armature is not right. First, we cut the small connecting wire on the top leads in several places, then by testing each of these parts we know that portion of the armature which is bad; then by removing the wire we will test each coil separately until we find the weak one. Then, by the use of our transformers, we obtain [illegible] or [illegible] volts, which we apply to the weak coil. If it stands the test we [illegible] [illegible] through, and if not it can be repaired. If we should find [illegible] [illegible] [illegible] a large portion of the armature [illegible] [illegible] [illegible] by the use of this same [illegible] [illegible] [illegible] and by [illegible] the armature [illegible] [illegible] [illegible] with the exception of one end of one lead, then connecting one side of the 25-volt circuit to this end, and the other side of the circuit to the [illegible] [illegible] we may apply the current for the purpose of drying the armature. With this arrangement the heat will be generated in the coils, and the armature will dry from the inside instead of from the outside.

The Equipment and Maintenance of Electric Cars.*

BY M. S. HOPKINS.

CAR BODIES.

For years car builders have attempted to devise a car body which would be equally durable in both summer and winter, but judging from the character of equipment now in use on the majority of roads such a car has not yet been produced. The combination car with movable parts is not satisfactory for winter use, is troublesome, noisy and cold, and is lacking in many of the essential features of the open car for summer service. The open cross seat car of the barge type with running boards on the side seems by far the most desirable type of car for summer service, offering the largest seating capacity and the best facilities for receiving and discharging passengers, which is a great advantage in city service. Considering all features, the box car with side seats, large windows, wide end door to the side of a roomy platform and vestibules closed on one side, seems best adapted to the average conditions of winter service.

The long car body seems to be growing in favor with the railway manager, due to the comparatively small increase in operating expenses, in comparison to increased carrying capacity, and its allowing of the increase of headway or decrease in number of cars run, resulting in a large decrease in operating expense per passenger carried.

TRUCKS.

Under the average conditions a 22-foot closed car or eight reversible seat open car body should be the limit for a single truck. Although there are single trucks which will carry a longer body fairly well, yet the increase in maintenance will in most cases warrant the use of double trucks. The local conditions should govern the type of double truck used, the bolster type in most cases being preferable for long cars on high speed, suburban service, while for city service, where heavy grades and quick starts demand maximum traction, and short curves make it necessary for the wheel to turn under sill, the bicycle type must necessarily be used. This type of truck is no longer an experiment, and while they possibly require more careful inspection and adjustment very efficient service can be secured from trucks of this type.

Trucks should be made up of a small number of parts; cast and malleable pieces should be the lightest consistent with strength. Springs should be so arranged as to prevent oscillation, and give an easy riding car under all conditions from no load to full load, and when style of truck is of such design as to prevent the use of an under truss, spring base must be exceptionally long and end springs so arranged as to relieve strain on car sill.

ELECTRICAL EQUIPMENT.

In the selection of electrical equipment the main point is to secure equipment of ample capacity and proper design for service required. In a railway motor, the mechanical and electrical features which influence its maintenance should receive very careful consideration. The bearings should be large and lubricated by oil from below and cup grease from above, and so designed that drip from bearings will fall outside of frame; the armature so constructed as to permit shaft being pushed out without disturbing commutator and winding.

I am glad to note that the importance of light weight and slow peripheral speed of armature has been recognized in recent design of railway motors. The inertia or flywheel capacity of armature should be the smallest possible consistent with the work required. Engineers differ as to the best method of suspension. From a theoretical standpoint, the cradle or side bar suspension has the lead. The dead weight is largely removed from axle, thereby eliminating to some extent the hammer blow on rail-joints, decreasing the wear on axle brasses and securing the better alignment of gears; yet, in practice, the nose suspension is still preferred by the writer, as the car starts more smoothly—the weight of motor on spring supports overcoming the jerk and quiver so common in other methods of support. The specification for railway motors as drawn up by leading manufacturers of to-day amount to practically nothing, and would suggest that the purchaser of motors in his specifications clearly define the rating, heat limit and efficiency.

The series parallel controller is in most respects a satisfactory device, the chief objection being the narrow range of speed on running notches. Specifications for resistance should provide that the last two points of resistance be of sufficient capacity to allow of their continued use as running notches, especially where cars are operated in city service.

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*Paper read before the American Street Railway Association, Boston, September, [illegible]. Abstracted.

There are several types of magazine fuse boxes or cut-outs and single cut-outs using a special fuse which possesses a number of points of merit. Without going into detail, it is the opinion of the writer that, under average conditions, the standard magnetic blow-out fuse box, using a link fuse, is preferable.

Each car should be equipped with a thoroughly reliable lightning arrester. Points to be noted in selecting this device are as follows: The kicking coil should always be installed; the air gap should be as small as possible; a positive and quick device for interrupting the current after discharge, and which will not be injured by discharge; a non-inductive resistance in circuit which will limit the flow of current and thereby prevent the opening of circuit breaker at station when several arresters operate at the same time.

MAINTENANCE OF EQUIPMENT.

The cost of maintaining equipment depends on various complex conditions, some of which are beyond control of the manager, and others for which he should be directly responsible. Heavy grades, numerous railway crossings, sharp curves, dirty and unpaved streets, imperfect and poorly constructed equipment, long and severe winters—all affect cost of maintenance unfavorably and are beyond control of the manager. But the character of the men who operate the cars, the manner of operation, the way in which repairs are made, and the character of men engaged in repairs, and the material used, are the controllable elements and in most instances the chief features affecting cost of maintenance.

CARE OF EQUIPMENT IN CAR HOUSES.

Generally one of the following three methods are used for daily inspection of our equipment, namely: inspection of cars each trip; inspection of equipment at night by motor inspectors; and inspection of equipment during the day by motor inspectors and repair men.

In regard to the first case, that of the trip inspection, I would say that in the present degree of perfection attained by manufacturers of railway equipment trip inspection should not be necessary, and excepting in interurban lines operating at high speed over long runs is of doubtful value. It is expensive, requiring the services of an inspector who is necessarily a man of some ability for each line of cars. The period of time for making this inspection is necessarily very short, and the entire time is taken up in mere inspection—little or no opportunity being afforded in which to make repairs.

In regard to night inspection, the experience of the writer has been such as to absolutely condemn such a method as expensive, slovenly and unsatisfactory. It is impossible to make a thorough inspection of cars at night, no matter how well lighted the car house may be, and the efficiency of the work done by the men is very far below that of the work during the day. Therefore, when local conditions will admit, inspection of cars during the day seems by far the most advantageous.

For making inspection and running repairs such as should be made in car houses, it is a safe rule to have one man to seven cars. It is, however, important to have a man in all car stations, known as chief inspector of that division, who is thoroughly conversant with practical electrical and mechanical matters.

Bearings should be run "close" at all times, the time of their renewal being determined by the effect of the wear on the gear and pinion, as the wear on these parts is largely affected by the wear of the bearings.

After a series of tests covering quite a period of time, as to the wear of various materials used in motor bearings, the writer feels warranted in making the statement that either the best grade of babbitt or brass bearings should under the ordinary condition give a longer life than six months, and when a bronze bearing of the proper mixture is used and properly lubricated a life of twelve months can safely be expected. The method of lubrication largely influences the life of brasses. The writer has, after long tests with various lubricants, discontinued the use of grease entirely on armature brasses, and in most cases on axle brasses, a good grade of engine oil, supplied through wicks, being more satisfactory and economical.

In order to reduce the maintenance of brasses to a minimum the use of phosphor bronze is strongly recommended. Street railways operating twenty-five or more cars will find it economical to cast and machine their own brasses. This may be discouraging to the supply men, but it means money on the right side of the ledger when the expenses are footed up. A small brass furnace can be cheaply erected, and after suitable jigs which can be attached to any lathe have been provided for boring and turning the cost of casting and boring is very little more than the cost of re-babbitting, especially where babbitted brasses are machined after boring, while the life of the bronze bearing is far in excess of that of any babbitt yet tried.

Rough and burnt commutators are too frequently the cause of expensive motor repairs and usually indicate imperfect motor design or inexcusable neglect. Well designed motors in good condition, even under the hardest service, provided, of course, the average work is within the rated capacity of the motor, should not require turning oftener than once in eight months. There is nothing that so well indicates to the practical man the condition of the motor as the condition of the commutator. Whenever the commutator shows signs of burning or blackening, steps should be at once taken to prevent it. It is not advisable to try to prevent this by the continual sanding of commutator by motor inspectors, though the occasional cleaning up of the commutator with sandpaper is necessary with all motors. The causes of trouble of this character are so numerous that mention is made of only a few of the more important.

The kind of brush used is an important factor. Brushes should be soft, close-grained carbon treated with a good lubricating compound—one which does not flow too freely from the heat from the motor, and which will not burn and carbonize on commutator. The price of brush is not a material consideration, as a brush which is slightly superior to another will prove economical even at quite a large increase in first cost. The tension on the brushes is as a rule too light on railway motors. It is a common belief that heavy tension causes wear of commutator, but experience has shown that the actual wear of commutator due to friction of the brush is very small, and that increased tension will in some cases materially decrease the sparking which causes the greatest wear. Improper alignment of brush-holders frequently causes sparking. In recent practice the use of side contact springs on brushes has been generally abandoned. On motors carrying heavy currents this spring is quite essential, as excessive heating of brush is caused by limited contact in the holder.

Commutator insulation should be made of what is known as the build up mica segments of the very softest grade of amber mica. A hard, clear mica should never be used in commutator, as this mica will not wear away as fast as the copper and there is nothing so disastrous to the life of the commutator as high mica insulation.

In some motors it may be necessary to change the winding of armature and field coils in order to avoid the burning of the commutator. First, determine by actual experiment what change in winding is necessary, and then equip with the new winding every armature or field that comes in burned out. This will permit of change being made without any great expense, as the greatest part will be borne by the maintenance charge.

THE ELECTRICAL TESTING OF RAILWAY EQUIPMENT.

Elaborate systems for the periodical testing of insulation on railway equipment seem to be growing in favor with some electrical engineers, but the practical value of these elaborate tests is not fully demonstrated. Experience has shown that tests of this kind are very misleading and frequently cause the tearing down of equipment which under ordinary conditions, had no tests been made, would have continued in service for a long time.

Judging from my own experience, it is neither necessary nor advisable to periodically test the insulation on the equipment, but to make such tests only in cases where motors are not working properly. The proper training of motor inspectors as to the little points about railway equipment which clearly indicate trouble with motor will in nearly all cases locate trouble due to weak insulation so that it can be remedied before any serious damage has resulted to any other part of the equipment.

All armature and field coils repaired should be carefully tested as to resistance and insulation to ground, and on all armatures having coils repaired, new commutator put on or commutator turned, resistance between commutator bars should be very carefully measured; using preferably a portable Wheatstone bridge testing-set, capable of showing clearly a variation in resistance of 1-1000 of an ohm. This is one of the most important tests to be made in the care of railway equipment, as more burn-outs of armatures are caused by the slight short circuiting coils, due to solder, acids or copper turnings bridging over insulation between bars under leads, than from any other cause, which can only be located by a test of this kind. Any mistake in connecting up the leads or a bad joint will at once be detected before any damage has been done. For testing insulation to ground, I consider a first-class magneto of 10,000 ohms resistance all that is necessary.

CONVENTION OF THE AMERICAN STREET RAILWAY ASSOCIATION

No fault could be found with the choice of a location for the street-railway convention of 1898. Boston for this purpose proved ideal. The building of the Massachusetts Charitable Mechanics Association provided an admirable convention chamber, an excellent amphitheatre just large enough to hold the exhibits without overcrowding and without appearing too large, and admirable facilities for the evening entertainment. The attendance was large and the interest shown, especially in the exhibits, was enthusiastic. The exhibits were unusually complete and interesting, in spite of the fact that there were shown but few of the real novelties recently brought out by the introduction of electric traction into larger fields than street-railway practice. The most prominent company in electrical construction work made this year a rather disappointing exhibit. Instead of showing as customarily its newest and best it erected a spectacular non-electrical display, better suited for a popular fair than for the gathering of technical men who could appreciate its engineering work, and depended on Boston installations for its technical display. Rival companies, however, more than made up for this deficiency in the exhibit hall.

TUESDAY, SEPTEMBER 6.

President A. E. Lang called the meeting to order at 11 A. M., in Paul Revere Hall, and introduced Mayor Josiah Quincy, of Boston, who delivered an address of welcome, outlining the advance of modern civilization and showing the importance to this advance of the development of improved means of transportation.

After thanking Mayor Quincy for his cordial welcome President Lang announced that the roll would be considered called by the registration at the door, and the minutes of the last meeting would be considered approved unless some objection were made to them as printed. Several new companies were admitted to membership.

The action of the Executive Committee since the last meeting of the association was approved by resolution and the president then read his annual address. In this he traced the history of the association from its inception, commending the work of its founders in the constitution and touching briefly and entertainingly on the various meetings. Coming down to the present, he stated that the association had now reached home, not only the birthplace of the association, but the home of the electrical industries in a larger sense perhaps than any other locality in the world. The people of Boston not only furnished money with a lavish hand to carry forward the work of electrical development, but also much of the brains and energy needed to make its use practical. After thanking the technical press, the supply men and the Executive Committee for their efforts on behalf of the work of the association, President Lang suggested a few subjects suitable for future papers and discussion. In closing he called attention to the convention of the Street Railway Accountants' Association occurring simultaneously in another part of the same building, and thanked the secretary and the Executive Committee for their work and the association for the honor of being called to the office of president.

[illegible] tendered to the mayor of Boston for his welcome, following which the report of the Executive Committee was read by the secretary and approved. The secretary and treasurer's report showed the financial condition of the association to be as follows:

Balance, October 18, 1897	$3,031 48
Receipts	6,276 17
	$9,307 65
Expenses	3,061 37
Balance, September 1, 1898	$6,246 28

Mr. [illegible] read his paper entitled "Comparative [illegible] and Economy of Operation Between Single and Double Truck Cars for City Use." The purpose of the double truck car enabling the use of a longer car body was pointed out, the [illegible] base of [illegible] being limited to 7 feet in order to round curves without serious binding. This, with a 20-foot body and 4 foot platforms, gives an overhang of over 10 feet, which is about as great as can be used without rocking uncomfortable to passengers and disastrous to car and track. The question involved the comparative advantages of long and short cars, and on account of the customary use of cross seats in longer cars the relative advantages of longitudinal and cross seats were also involved. The beneficial results of larger units and fewer of them were shown to be largely due to the reduced cost per passenger of the wages of conductors and motormen. The disadvantage of increasing the headway of small roads where it is already long was pointed out, and a careful comparative analysis of the relative advantages of single truck cars with trailers and double truck cars without trailers was worked out with data derived from actual service tests on the author's road. The cost per passenger of wear and tear on trucks and motors and of power required was shown by these tests to be about the same with either style of truck. The recent improvements in lowering the sills of double truck cars and the preference of passengers for these more comfortable vehicles were also pointed out. The general conclusion was that the double truck car is more suitable for long hauls, high speed, pleasure travel and lines competing with other systems, while the single truck car is more suitable for dense traffic, many stops and low speed.

In the discussion Mr. Beggs, of Milwaukee, described the use of double truck cars in that city and spoke most favorably of them, stating that the single truck cars on his line have been allowed to wear out and be scrapped and replaced by double truck cars instead of repaired and kept in service. In answer to a question asked by Mr. Sloan, of Chicago, as to double truck cars with four motor equipments, Mr. Beggs stated that the line between Milwaukee and Waukesha Beach, 26 miles in length, had been equipped with double truck cars weighing 35,000 pounds, fitted with four G. E. 1000 motors geared to make 26 miles per hour. The improved action on heavy loads and in times of bad weather is so pronounced that Mr. Beggs considers that it may be advisable to equip all double truck cars with four motors.

Following the discussion it was suggested that the members of the association who were present at the organization in Boston in 1882 should rise. Messrs. W. W. Bean, of St. Joseph, Mich.; George B. Kerper, of Dayton, Ohio, and Julius E. Rugg, of Boston, complied with this suggestion, after which the meeting adjourned.

In the afternooon the first entertainment provided by the Massachusetts Charitable Mechanics Association was carried out in a trip to Lexington and Concord. On Lexington Common a description of the historic events of the Revolutionary War which took place at that point was given by the historian of the Lexington Historical Society. After a hasty visit to the Hancock House the party proceeded to Concord. The houses once occupied by Longfellow, Emerson and Thoreau were noted, as were many points of Revolutionary interest. In the evening a reception and dance, arranged by the Ladies' Committee of the Massachusetts Street Railway Association, was held in Paul Revere Hall.

WEDNESDAY, SEPTEMBER 7.

The meeting was called to order by President Lang at 10:30 A. M. and the first paper read was that by W. S. Dimmock on "The Carrying of United States Mail Matter on Street Railways." The paper brought out the extreme importance of the saving of time in the distribution and collection of mail matter, which is undoubtedly the most potent argument in favor of the electric car service. As a general thing interferences and delays with electric mail cars have been found to be fewer than with wagons over the same route. Another great advantage of the electric car transmission is the more frequent service obtainable between post offices, depots and substations. The transmission between Omaha and Council Bluffs and Omaha and South Omaha was described in detail by Mr. Dimmock, who is well acquainted with this service, owing to the fact that he is general superintendent of the Omaha & Council Bluffs

Railway & Bridge Company. Before the electrical car service was installed the mails were necessarily carried by wagon from one post office to the railroad, by rail across the river and by wagon again to the other post office. The number of trips per day was much smaller than desirable, owing to the lack of a sufficiently frequent train service. The electric service took the mail from office to office in the same time that was formerly required to take it by wagon to the train. On the subject of compensation for this service, the author of the paper considered it a mistake that the electric railroads counted too much on the protection granted against the interference of strikers and had consequently taken the mails at most any price. The running of one mail car on a steam road gives an opportunity for carrying some twelve or fifteen passenger cars on the same train, which clears up the traffic for some time, but an occasional mail car train on an electric road does not serve to keep the system in anything like satisfactory operation or accommodate more than a very small fraction of the traffic. The result is that electric railroads are carrying mails for the bare cost of giving the service and are not getting the protection which they had hoped for. The present flat rates paid by the Government of 3 cents per mile for pouch service and 16 cents per mile for 16-foot cars is considered too low, and it was suggested that the members use what influence they could toward getting the Government to increase these rates.

In the discussion of this paper, Mr. C. S. Sergeant, of Boston, gave some interesting details of the mail system there in use, from which the following points have been abstracted:

Mail service on the street-car lines began in 1895, with seven mail cars, which we equipped, and which originally made forty-three trips daily.

In 1893 the mileage will be upward of 170,000 miles.

There were originally twelve stations, to which two have been added. Connections have always been made with the Boston & Albany and Providence depots, and the Union station. Sixteen men are constantly employed, eight conductors and eight motormen.

Out of about 45,000 trips run (to January 1, 1898) there were 360 failures or irregularities, or about 8-100ths of 1 per cent., and those were almost wholly due to the snow and the consequent blockading of teams in the narrowest streets.

Seven cars handle 100,000 pieces of mail daily. The system is under the supervision of the New England superintendent of railway mail. In other cities the trolley and cable service is under control of the local postmaster. The General Superintendent of Railway Mail of the United States in his report for 1895 says: "In Boston, by reason of the fact that the street-car lines are all under one management, we are able to move mail from one suburb to another, as, for instance, from North Cambridge and Cambridgeport to Brookline, by direct transit, the mail not being compelled to pass through the main office. There is probably no city in the country where the benefits of this service will be as great as in Boston, with its densely populated suburban districts, all of which have heretofore been more or less restricted in their mail accommodations by reason of their mail having to go through the city post office. By the present system, the railway post offices centering at Boston can "pouch" to the street-car lines all mails for suburban points reached by them; and the street-car lines in turn can gather up all the mail from suburban points and pouch it direct to the departing trains at the various depots.

The first practical illustration of a street-railway post office was in Boston. Other cities had street-railway mail cars first—St. Louis and Brooklyn, where the mail was simply carried in bulk and delivered the same as by wagon, not being worked in transit; but Boston street-railway cars were the first to be patterned after steam railway cars, with racks and all appliances for working the mails in transit—transferring, so to speak, so much working space, and clerks, from the main post office to the post office on wheels, thereby losing absolutely no time in handling matter, and enabling the business man to get his mail early in the morning rather than late in the afternoon, with nearly a whole day saved for him. One car is equipped with an electric canceling machine, with a capacity of 2000 cancellations an hour.

Let us follow a car to North Cambridge, and touching Park Square, Cambridgeport and Cambridge post offices en route. Take the first trip in the morning, where the postal clerk receives from the general office all the accumulations of mail which arrive during the previous evening from all parts of the country. Upon arriving at Park Square station (the train from New York with all mail from the South and New York State arrives at 5:30) this mail is delivered direct to the postal car, and the contents opened by the clerk and assorted for the carriers. Upon the arrival of the car at Cambridgeport, a fifteen-minute run, the mail for that station is about all ready for delivery to the carrier. This also applies to Cambridge and North Cambridge. Now this car receives all mails collected at the various stations and assorts it in the car, inward, for all outgoing trains, so that when it reaches stations en route or Boston, the mail is all ready for immediate dispatch.

Each car handles nearly five and a quarter million pieces of mail, or a total of 36,561,170 pieces for the seven cars in a single year.

After a further discussion it was moved and seconded that a committee of five be appointed by the chair to act under the Executive Committee and communicate with the different members of the association and get all the facts before them and keep the association advised of their proceedings, and that they have authority to confer with the post office authorities. The motion was carried.

The next paper was that of Mr. M. S. Hopkins on "The Maintenance and Equipment of Electric Cars for Street Railways," which was read by the secretary. An abstract of this paper will be found in another column.

In the discussion, Mr. H. M. Sloan, of Chicago, stated that on his roads night inspection worked very satisfactorily, and that it was the custom there to change the motor brushes every night, which he stated effected considerable saving on the commutators. The usual practice is to take the entire truck out of service whenever an armature burns out, this frequent inspection giving improved results.

A vote of thanks was tendered to Mr. Hopkins for his paper, after which Mr. W. Caryl Ely, first vice-president of the Street Railway Association of the State of New York, extended an invitation to the members of the National Association to attend the annual convention of the New York State Street Railway Association at Manhattan Beach, Tuesday and Wednesday, September 13 and 14.

Letters were then read inviting the association to meet in various cities next year and other invitations were presented by delegates. The president then appointed a committee on nominations, the members of which were Mr. W. W. Bean, chairman; Mr. D. G. Hamilton, Mr. E. C. Foster, Mr. W. F. Kelly, Mr. J. R. Chapman, Mr. H. C. Payne and Mr. E. H. Davis.

The meeting then adjourned.

In the afternoon the delegates quite generally attended an excursion to Nantasket Beach. The usual beach diversions were enjoyed, after which the excursionists sat down to a Massachusetts clambake.

THURSDAY, SEPTEMBER 8.

The meeting was called to order by the president at 10:30 A. M. The first paper read was that by Mr. W. H. Holmes on "To What Extent Should Railway Companies Engage in the Amusement Business?" The paper pointed out the expending ideas of the duties of a city government to its inhabitants and the fact that the cities themselves now often provide entertainment in public parks and squares, in which case the street-railway companies find this particular occupation taken out of their hands, and the writer of the paper considered that this tendency should be encouraged, the street-railway companies confining themselves to the provision of ample means of communication with these public places of amusement. The maintenance of these enterprises by the street railway itself has generally been found to be ill-advised and unprofitable, except in locations such as warrant more than the five-cent fare. The losses attendant on unfavorable weather, the difficulty and expense of carrying away large numbers of people at one time and the time of the managing officers of the street railway necessarily given over to this auxiliary work were given as potent reasons why the companies themselves should not engage in the amusement business. The author's experience in this line in Kansas City was described, the sum spent by the railway company itself being regarded as a doubtful investment. The company has therefore abandoned this line of work and serves only parks maintained by independent corporations, the company paying these corporations a fixed sum for giving its patrons the free privileges of the parks. The company has given financial aid to various festivities which have occurred in Kansas City, and the author stated his confidence that these sums were wisely spent.

The question was quite generally discussed, the opinions being very closely divided for and against the establishment of places of amusement by the companies. At the conclusion of this discussion the report of the Nominating Committee was made as follows:

For president, Charles S. Sergeant, second vice-president Boston Elevated Railway Company, Boston.

For first vice-president, Henry C. Moore, president Trenton Street Railway Company, Trenton, N. J.

For second vice-president, Ernest Woodruff, president Atlanta Consolidated Street Railway Company, Atlanta, Ga.

Third vice-president, Walton N. Holmes, general manager Kansas City Railway Company, Kansas City, Mo.

Secretary and treasurer, Thomas C. Penington, treasurer Chicago City Railway Company, Chicago, Ill.

Executive Committee:

Albion E. Lang, president Toledo Traction Company, Toledo, Ohio.

George E. Yuille, second vice-president of the West Chicago Street Railroad Company, Chicago, Ill.

Frank Jones, president Memphis Street Railway Company, Memphis, Tenn.

John I. Beggs, general manager Milwaukee Railway & Light Company, Milwaukee, Wis.

Ira McCormack, general superintendent Brooklyn Heights Railway Company, Brooklyn, N. Y.

A unanimous ballot was then cast for the gentlemen nominated and it was voted that the next place of meeting be Chicago, Ill.

The president then appointed a committee to report on the question of the carrying of mails by street railways, consisting of the following gentlemen: John T. Burnett, Boston; Henry C. Payne, Milwaukee; Ira A. McCormack, New York; D. G. Hamilton, Chicago; and W. S. Dimmock, Council Bluffs.

An invitation was read from the Boston Elevated Railway Company, inviting the delegates to visit any of the power houses, shops or car houses of the company, saying that special instructions had been issued to have particular attention shown visitors.

The privileges of the floor were then granted to Mr. T. Y. Dzushi, Chief of Finance and Manager of Stores of the Imperial Government Railways of Japan, and Mr. K. Sugahara, chief engineer of several street railroads soon to be built in Japan. The latter thanked the association for the hospitality extended. The street railways systems of Japan he stated to be in a primitive stage as yet. There are only about 60 miles of track in use, and most of this trackage is operated by horse power. Several electric railways, however, have been proposed. In Tokyo there are about 40,000 jinrikisha and 90,000 wagons drawn by men, which greatly interfere with the progress of street railways.

A resolution thanking the Massachusetts Street Railway Association and the local committees for the entertainments provided was made and carried, as was one expressing appreciation of the work of the officers of the association for the last year.

A paper by Mr. Fred D. Perkins was then read by the secretary on "The Inspection and Testing of Motors and Car Equipments by Street Railway Companies." An abstract of this paper may be found in another column. Owing to lack of time there was no discussion of this paper.

The meeting then adjourned.

During the afternoon the delegates attended a special excursion to Plymouth, where they visited Plymouth Rock, Plymouth Hall and the national monument to the Pilgrim Fathers. At the latter point the secretary of the Pilgrim Society gave a brief history of [illegible] and the building of the monument. The party stopped at the Samoset House for refreshments and returned to Boston by special train in time to prepare for the banquet. This was held at the Brunswick, and was attended by nearly 350 people, including many ladies.

At the banquet the [illegible] responding to [illegible] were as follows: "The Commonwealth" was responded to in the absence of Governor Wolcott by his private secretary, Mr. J. M. Perkins; "[illegible] Transit in Boston," Hon. George G. Crocker, chairman of the Boston Transit Commission; "The New England Bar," Hon. Samuel J. Elder; "[illegible]," Hon. P. A. Collins; "The New England Press," Mr. Stephen O'Meara, Boston "Journal."

FRIDAY, SEPTEMBER 9.

The meeting was called to order at [illegible] A. M. The first paper read was that by Mr. [illegible] on the "[illegible] of Feeder Power for Street Railways at the Switchboard." An abstract of this paper will appear later.

After a brief discussion the report of the Committee on Standard Rules for Government of Conductors and Motormen was requested, but the committee wished more time and an appropriation, which were granted.

The newly appointed president was then escorted to the chair and introduced by the retiring president, Mr. Sergeant responding and thanking the association for his appointment and promising to do everything in his power to further the interests of the association and to benefit the street railways.

The association then adjourned.

In the afternoon a trip was taken to Norumbega Park in Auburndale, which was reached over a trolley line extending through several of the most beautiful of Boston's suburbs.

Charles Spencer Sergeant.

C. S. Sergeant, the newly elected president of the American Street Railway Association, was born in Northampton, Mass., in 1852. His father, George Sergeant, was born in Stockbridge, Mass., which has been the family home since the settlement there in 1735 of his great-great-grandfather as a missionary to the Stockbridge Indians.

CHARLES SPENCER SERGEANT.

He was educated in the public schools of Northampton, where he graduated from the high school in 1868, in which year began his business career in the employment of the First National Bank of Easthampton. In 1872 he entered the steam railroad business as paymaster and cashier of the Marquette, Houghton & Ontonagon Railroad Company, in Michigan, and was later associated with various iron companies and engaged in the iron smelting business.

In 1876 he moved to Boston to take the position of chief clerk of the Eastern Railroad Company, and was subsequently appointed general auditor. In December, 1887, when the West End Street Railway Company came into possession of the several street railways operating in Boston, he was offered and accepted the position of general auditor of the company, subsequently being made second vice-president, and in November, 1892, being appointed general manager, which position he held until the lease to the Boston Elevated Railway Company, of which company he is now second vice-president.

Objections to Electrical Signs in London.

It appears that the London County Council has proposed regulations to prevent the use of what are called flash light lamps, this term signifying electric signs intermittently illuminated. It is said to be a nuisance to the traffic and a source of danger to pedestrians, owing to the variations in lighting of the principal highways of "commerce," as one of the English electrical journals terms them.

DIGEST OF CURRENT ELECTRICAL LITERATURE AMERICAN AND FOREIGN

By Carl Hering

Dynamos, Motors and Transformers.

DYNAMOS. Guilbert. "L'Eclairage Elec.," August 6.—Illustrated descriptions of various recent improvements, taken from patent specifications.

Lights and Lighting.

SERIES ARC LAMP.—Lond. "Elec. Eng.," August 26.—Answers to a request to give the principal essentials of an arc lamp for series connection.

SERIES INCANDESCENT LIGHTING. Hood. "Elec. Eng.," September 1.—A short article describing the system used at the Pitman Grove camp meeting grounds, which plant is run during only three months of the year. The lines are run on the trees; the main part of the grove is laid out like a wheel, and is lighted by a three-wire 208-volt system supplied from a large transformer at the centre, but the larger part of the extensive grounds is lighted with the series incandescent system, which, in this case, differs from any other in having no street fixtures, shunt boxes or cut-outs. The primary voltage is 1080, the lamps being of 106 volts; each circuit has about 4000 feet of No. 10 wire. At the beginning of each circuit there is a signal lamp, which burns when the circuit is opened, and when this is the case the attendant starts over the circuit and is provided with a short-circuiting hook, which is provided with a lamp the leads to which form two hooks, and with this he bridges the insulating joint in the wire, across which a lamp is connected; the lamp on his hook will then light when the bad lamp is reached. These circuits have been running a total of 400 hours, and only three lamps have burned out, the total number of lamps being 160. The average cost of erection has been but $3.60 per lamp, against $20 for the standard series system, and it has given equally good service.

Power.

GAS POWER ON SHIPS. Booth. Lond. "Elec. Rev.," August 26.—An article in which he recommends the use of gas power on board ship, converting the power into electrical energy and thence back to mechanical energy through motors. He claims that in this way the largest ships could be readily manœuvred from the bridge. The objections to using gas power are overcome by this combination; when once started the engines would continue to revolve; gas power could thus be applied at sea with a less total weight of plant and with less fuel consumption than when high-class steam engines are used. The difficulty in connection with gas engines is the starting, stopping and reversing at short intervals; with the aid of electricity these mechanical defects are removed. He recommends the use of several smaller units, so that any injury to one would not cripple the vessel. There is no such economy in gas engines of increased size as there is in steam engines, and therefore the same objection does not apply to sub-dividing the units. All gas pipes are to be kept down to the keel level, where the danger of a shot reaching them is very small.

POWER PLANT FOR LIGHTING STATIONS. Appelbee. Lond. "Elec. Eng.," August 26.—A reprint of a short paper on the designing of the mechanical portions of steam-driven central stations.

ELECTRIC ELEVATORS. Hawtayne. Lond. "Elec.," August 26.—A long abstract of his recent paper, which was noticed in the "Digest" June 18.

ELECTRICAL TRANSMISSION OF ENERGY. Blondel. "Eng. Mag.," September.—A brief abstract of a report to the French Government in the "Ann. Ponts et Chaus." The report was made preparatory to the formulating of a law concerning the transmission of energy in France; it seems to be general in character, discussing the various sources of power, its generation and transmission, and the numerous application of electrical energy; much valuable information is said to be given concerning existing installations. In the course of the report he states that the Seine along its whole course represents 25,000 horse-power; the total water power available in France is estimated at 10,000,000 horse-power; the total power of the Rhine at the falls is 1,750,000 horse-power; the total water power in Switzerland, which is already utilized, is 200,000 horse-power. He does not think water power is destined to supersede coal, as electrical transmission may make some coal mines available. One hundred and twenty-five tons of silver are electrically deposited every year.

COMPARATIVE COSTS OF STEAM AND WATER POWER. Webber. "Eng. Mag.," September.—An article analyzing the cost of power and comparing the present cost with that twenty-five years ago; an analysis of the estimated cost of developing a small water power is also given.

WATER POWER.—"Eng. News," September 1.—A note stating that the plan to develop the power of the Shawinigan Falls, about one hundred miles from Montreal, has taken definite form; the head obtainable is 165 feet, and the supply of water is capable of developing 200,000 horse-power, about half of which is to be used.

TRANSMISSION OF POWER.—"Eng. Mag.," September; abstracted from the "Jour. of the Western Society of Engineers."—A topical discussion in which electric, pneumatic and mechanical methods were considered; the abstract appears to contain nothing of importance.

STARTING GAS ENGINES. Leroy. "Prog. Age," September 1.—A translation, with both illustrations, of the article noticed in the "Digest" June 11 (see also last week).

NEW POWER PLANT AT AKRON, O.—"St. R'y Jour.," September.—An illustrated description of a new combination electric light and railway plant recently erected at Akron. The boilers are all fitted with mechanical stokers and forced draft. There is at present one 400-kw unit, and another will be installed soon.

Traction.

THREE-PHASE TRACTION PLANT.—Lond. "Elec.," August 26.—A brief, illustrated description of a short line recently opened at Evian-les-bains on Lake of Geneva; it leads from a hotel to the springs. The line rises 67 feet in a length of about 330 yards, the mean grade being 6.8 per cent. and the maximum 10.2. There is a three-phase station 8 miles distant, the current from which is transmitted at 5200 volts and a frequency of 50; it is transformed down to 200 volts. The small single car weighs 3.8 tons and seats eight passengers; it has one three-phase motor for 15 horse-power, whose speed is 750; it drives a countershaft, which drives the axle by means of chain gearing; the field is stationary, and the armature revolves, being connected to starting resistances by means of brushes; on the descent the motor acts as a brake, running at slightly greater velocity than the speed of synchronism; if one of the trolleys gets off the wire the motor continues to run as a single-phase motor, but if both trolleys fail the hand brake must be used. The car makes sixty double journeys per day at a speed of 6¼ miles per hour.

TRACTION BY ELECTRIC POWER. Elliott. Lond. "Elec. Eng.," August 26.—A reprint of a short paper, which is chiefly of a historical nature, and appears to contain nothing of importance.

ELECTRIC RAILWAYS IN AUSTRIA.—"Zeit. fuer Elek.," August 14.—Statistics for the second quarter of the present year for the electric railways in Austria.

TRACTION IN BERLIN.—"Elek. Zeit.," August 25.—A full-page map containing the various electric lines which will exist in Berlin when the present project has been carried out; this will be accomplished in four or five years, and Berlin will then have the largest and densest network of street railways of any city in Europe.

LONDON CENTRAL UNDERGROUND RAILWAY. Tripier. "L'Eclairage Elec.," August 13.—The first part of a long, illustrated description of this new underground electric railway; it includes many illustrations.

ELBEUF.—"L'Eclairage Elec.," August 6.—An illustrated description of this system of lines, which was opened last May; the total length is 6 miles, and there are twelve motor cars and six trailers.

BRADFORD.—London. "Elec. Eng.," August 26; more briefly in Lond. "Elec. Rev."—An illustrated description of the system of trolley lines in that city.

MOTOR CARRIAGES.—Lond. "Elec.," August 26.—Brief descriptions of the electric vehicles at the Agricultural Hall exhibition.

THE ROTARY CONVERTER IN STREET RAILWAY WORK. Bell. "St. R'y Jour.," September.—He first discusses the design and illustrates the connections of the ordinary types of single, three and four-phase generators, motors and converters and of motor generators. The use of rotary converters for distributing power for large city railway lines is discussed; the advantages here lie in the generation of all the power in a large station, and hence more economically than in a number of small stations, and also in having the load more uniform; the cost of installation, however, will usually be greater than where small stations are used, and the cost of labor will be higher. The average electrical efficiency of the system for city distribution with converters will be from 75 to 50 per cent.; depreciation is also greater, so that, unless power can be generated 30 per cent. cheaper in one large station than in several small stations, the latter are cheaper. The writer then proceeds to discuss the possibility of this, and shows the approximate cost in cents per kw hour of producing power in stations of from 100 kw to 2500-kw capacity, working with load factors of 40, 50 and 70 per cent.; the curves are based on coal at $3 per ton. From this diagram he concludes that if the sub-stations have as large as 1000-kw capacity there will be no economy in a city system in alternate current distribution with rotary converters, unless the main station will have a capacity of 10,000 kw or more.

POWER CONSUMPTION IN RAPID-TRANSIT SERVICE. Armstrong. "St. R'y Jour.," September.—A reply to a criticism by Carus-Wilson in the last issue of an article by Armstrong in the June issue, upon the relative economy of rapid and slow acceleration of electric cars. Armstrong states that Carus-Wilson's criticism, that the first article did not compare the electrical losses in the motors in the two methods, is not pertinent, as the article was intended to cover only mechanical losses, and was thus applicable to all motive powers; electrical terms were used in some cases only for the convenience of the reader. For electrical work, however, he does not accept Carus-Wilson's conclusions, as the latter, in computing the losses, considered the resistance losses only; the losses in the armature core and in the gearing should also be considered, and these are greater in the slow-acceleration method. Taking all things into consideration, the author reaffirms his original position and refers to his June paper before the American Institute of Electrical Engineers for further details.

POWER CONSUMPTION IN ELECTRICAL RAILROADING. Dodd. "St. R'y Jour.," September.—A reprint in full of the paper noticed in the "Digest."

METERS ON CARS. Connette. "St. R'y Jour.," September.—The Nashville street railway, which operates from forty-five to sixty cars, buys its power from the local electric light company at a certain price per kw hour, and recently equipped each of its cars with a wattmeter; the objects were to check up the amount of power consumed, and also to keep individual records of the current used on each car as a test of the skill of the motorman. The company has found the practice very successful, particularly in making the motormen careful of power, as their records are compared, due allowance being made for grades, etc. The power was thus reduced from between 1.75 and 1.90 kw hours per car mile to 1.10 and 1.15, or about 35 to 40 per cent. Car meters also aid in detecting defects in motors, for if the records show that one car takes more current than another under the same conditions the motormen are first changed; then if the excess continues a careful examination of the motors is made.

ELECTRIC RAILWAY MOTORS. Hanchett. "St. R'y Jour.," September.—The concluding article of his series; he discusses general practice. In regard to the motor casing, the preferred form is a four-pole machine, all the poles being excited; consequent pole motors usually produce sparking at the commutator, and have other drawbacks. The bearings on motors are being made long, and a length of 8 inches on a 30-hp motor is not uncommon. While an inclosed motor is used for tramway work, the best practice for elevated railway and heavy electric railways tends toward leaving the motor case open as much as possible to ventilate the motor by cooling. The universal method of opening street railway motors is now to swing the lower half downward and provide means by which the armature may be retained in either half at pleasure. Strenuous efforts have been made by modern designers to increase the efficiency of railway motors, but it remains at about 85 per cent., though in some cases as high as 92 per cent. has been claimed. The preferred practice in armature coils winding is to have separate coils capable of being slipped on the core. While this makes rather a long armature, it reduces the amount of useless wire on the armature and makes it easy to insert new coils. Practically all armature cores are now toothed, and modern practice seems to tend to reducing the armature diameter and the number of slots, and increasing the number of conductors per slot. Spur gearing is used exclusively, but the author states that worm gearing has never received a fair trial. The table accompanying the article gives the chief dimensions, weights, etc., of the principal American railway motors.

TRACTION MOTOR.—"St. R'y Jour.," September.—A description of the G. E. 55 motor. It is of 175 horse-power, and is designed for elevated and underground railroads, as well as high-speed interurban lines. As it is not intended for surface service, it is less protected from dust than the usual type, and is consequently better ventilated. The magnet frame is cast in one piece, and at each end is a bored-out opening large enough to allow the removal of the armature, field coils and magnet pole pieces, which are bolted [illegible] the frame. The weight of the motor is approximately [illegible] pounds. [illegible] ELECTRICAL WORLD, September 10, [illegible]

LARGE RAILWAY GENERATOR.—"St. R'y Jour.," September.—Side and end elevations and full descriptions with main dimensions of a generator built for Boston of 2700 kw nominal capacity, but capable of working up to a much greater amount if [illegible]. Its [illegible] weight without engine shaft is 300,[illegible] [illegible] the [illegible] weight [illegible] pounds; the shaft is 27 [illegible] in diameter; the field magnet has twenty-four poles and is [illegible] feet 8 inches in height; it is of steel and hollow; the armature is [illegible] in diameter. (See page [illegible] this issue.)

DOUBLE TRUCK CARS IN NEW YORK.—"St. R'y Jour.," [illegible] plan, end and side [illegible] of the type of long [illegible] by Metropolitan Street Railway Company of New York for use on its [illegible] conduit lines. [illegible] feet over all.

RAIL BONDS.—"St. R'y Jour.," September.—An extended description, with illustrations, of the principal rail bonds on the [illegible]. Twenty forms are described and illustrated.

STREET RAILWAY CONDITIONS AND FINANCIAL RESULTS IN METROPOLITAN BOSTON.—"St. R'y Jour.," September.—Statistics of the cost of operation and construction, with an analysis of some of the operating expenses of the different street railway systems in metropolitan Boston; the figures in the tables are arranged according to the magnitude of the companies' operations. The article is illustrated with a large number of maps.

NEW YORK, NEW HAVEN & HARTFORD R. R. CO. Heft. "St. R'y Jour.," September.—He mentions the electric extensions made by this company during the past year at Hartford, New Britain and Nantasket; all of these extensions use the third-rail system. The company has also equipped with the trolley system a branch line 8 miles in length near Stamford; this line was formerly operated by steam power, and the trolley system is used principally because the company wanted to make it possible to run the cars over the tracks of the Stamford street railway system for a short distance in Stamford; the article is devoted chiefly to this new Stamford installation. The car bodies are 37 feet over all, and equipped with two 175-hp motors each; the cars make a speed of 50 miles per hour on level track; the chief feature of the novelty in the railway is the truck; by moving four bolts the upper half of the truck, with the car body, can be raised, allowing the four wheels, with the motors, to be run out from below. The spring suspension for the motors is entirely separate from the spring suspension for the car bodies; this enables the latter to be graduated to any extent desired, making a very easy riding car. The axles are hollow and of open hearth steel; they have a diameter of from 5.5 to 8 inches; the diameter of the bore extending through the axle is 1.5 inches. Two bonds are used at each joint; the bond terminals are of the "crown" type, but the steel pins by which they are attached to the rail are forced through by a special tool and not driven through by a hammer, as usual.

LONG-DISTANCE POWER TRANSMISSION PLANT AT MONTPELIER, VT., WITH BATTERY AUXILIARY.—"St. R'y Jour.," September.—Barre and Montpelier are 9 miles apart, and are connected by an electric railway, operating five cars; the running time between the two cities is forty-five minutes. Current is supplied from water power 8 miles from the nearest point on the line, and is transmitted to a sub-station near the middle point of the railway by the three-phase system at 6300 volts and a frequency of 120; two 150-kw step-up transformers are used at the water power station, and are connected with the sub-station transformers by three No. 6 rubber-covered wires. At the sub-station the current is reduced from 6300 volts three-phase to 480 volts two-phase by step-down transformers, and then to 550-volt direct-current by a 150-kw rotary converter for the line. The direct-current side of the rotary converter is compound wound to suit the working voltage of the battery under the widely fluctuating loads, so that the battery will keep up the fluctuations without the aid of a booster; as a result no feeders are required on the trolley line. This line has just been put in operation, and is said to be the first example in the United States of an electric railway operated exclusively from rotary converters with storage battery auxiliaries.

THE TRAMWAY SYSTEM OF BRISBANE, AUSTRALIA. Brown. "St. R'y Jour.," September.—This system is about 25.5 miles in length, and has recently been built. The power station contains three 450-hp compound-condensing engines, each directly connected to a 400-hp generator. The article is fully illustrated.

BOSTON ELEVATED RAILWAY COMPANY.—"St. R'y Rev.," August 15.—A long, illustrated article on the lines of this company, which controls all the street railway lines in Boston and ten other cities and towns in the suburbs.

NEW ELEVATED RAILWAY IN BOSTON.—"St. R'y Jour.," September.—A brief article outlining the engineering features of the proposed electric elevated railway in Boston.

BOSTON SUBWAY.—"St. R'y Rev.," August 15.—A brief, illustrated article on this subway.

THE BOSTON SUBWAY.—"St. R'y Jour.," September.—An extended article on this subway.

Installations, Systems and Appliances.

TIME SWITCH METHOD OF CHARGING. Gibbings. Lond. "Elec.," August 19.—In this continuation of his serial on the commercial and business aspects of municipal electrical supply (see "Digest" June 25), he describes and discusses the time switch method of charging and the Manchester system. In the latter city the five-wire system is used; there are two alternative methods of charging, one a uniform rate of 12 cents per unit and the other a fixed charge per annum per lamp installed in addition to a charge per unit as registered on the meter; tables are given comparing the two systems.

COMMON RETURN FOR TWO PHASE SYSTEM.—Lond. "Elec. Eng.," August 26.—Brief discussions of the advantages and disadvantages of a common return in the two-phase system for supplying power and light.

RHEOSTATS. "L'Eclairage Elec.," August 6.—Brief, illustrated description of motor starting and arc lamp rheostats and [illegible] made by a French company.

Wires, Wiring and Conduits.

WIRING ACCESSORIES. Hundhausen. "Elek. Zeit.," August 25.—A reprint of a long paper, containing many illustrations, read at the recent annual meeting of the Union of German Electricians; it refers to the various accessories developed and used by the Siemens & Halske Company, some of which are not new. The greater portion of the paper refers to the illustrations, and cannot, therefore, be abstracted. In referring to fuse wires he mentioned the fact that his company had used silver wires in place of lead, but that for certain practical considerations this has again been abandoned in favor of a more suitable metal. For currents up to 30 amperes and voltages from 250 to 500 the lead fuses of his company can be used by putting two in series; with a short circuit both will then fuse simultaneously, each taking care of half of the energy; with an overload, however, generally only one will blow, as it is practically impossible to have them both exactly alike, and in these cases the fusing of one is sufficient; this was found to answer well at 500 volts. Materials used for inclosing the fuses differ considerably in their properties; many of those that are quite refractory, such as porcelain, glass, etc., are not suitable because they not only fuse but even become conductors in that condition; on the other hand, materials such as wood, paper, hard rubber, etc., which are not fireproof, are especially well adapted to resist the effects of a short-circuiting arc, but they are not suitable when there is a more prolonged generation of heat; the materials which answer both requirements best appear to be plaster of-paris and cement, the latter being given the preference. He then discusses the question of non-interchangeable fuses, illustrating the devices used. The other illustration refers chiefly to branch connections.

Electro-Physics and Magnetism.

CURRENT RUSHES IN TRANSFORMERS. Hay. Lond. "Elec. Rev.," August 26.—The initial stages of any forced periodic disturbance are known to differ, sometimes very materially, from the ultimate steady state; when an alternating voltage, for instance, is introduced into an inductive circuit there will in general be highly distorted initial waves, the amount of distortion depending on the phase of the voltage at the closing of the circuit; the insulation of a transformer, for instance, is in danger of being broken down by this initial current rush at the instant of switching on. In the present article he develops a theory of the impulsive current rushes in transformers, after a brief reference to other articles on the subject. No conclusions are drawn in the present portion.

NEW RADIO-ACTIVE SUBSTANCES. P. and S. Curie. "L'Eclairage Elec.," August 6.—A reprint of an Academy paper. They found that certain minerals containing uranium and thorium are very active in the emission of Becquerel rays, the activity being even greater than that of uranium or thorium, and it was thought that this was due to some other very active substance included in these minerals, as, for instance, in pitch-blende, the protoxide of uranium. They suggest that this may be a new element, and if its existence can be confirmed the discovery of it was due to its production of Becquerel rays.

CATHODE RAYS. Villard. "L'Eclairage Elec.," August 6.—A reprint of an Academy paper on the emission and propagation of these rays.

COLORED PHOTOGRAPHS BY ACTINO ELECTRICITY. Delvalez. "L'Eclairage Elec.," August 13.—A short Academy note describing the following process: If a plate of brass forming a parasitic electrode is immersed in a mixture of the acetate of copper and lead and a current be passed through the liquid colored images will be produced, due to the deposition of the peroxide of lead; if different points of a plate of brass are unequally illuminated, local currents will circulate in the liquid, the circuits of which are closed through the plate; these currents produce electrolysis—that is, will deposit peroxide of lead at certain parts and those points which are equally illuminated will have identical colors; the colors vary with the amount of illumination. Experiments verified this deduction. The deposits observed were not caused by differences of temperature.

RESISTANCE OF ALLOYS.—Lond. "Elec. Rev.," August 26. —An editorial reference to a recent article by Shaw in "Nature," August 11, in which he discusses the behavior of alloys with regard to their resistances at low temperatures, the subject being treated theoretically; he considers the subject in the light of the microstructure of alloys.

PROPERTIES OF THE VAPORS FROM THE CARBON ARC. Merritt and Stewart. "El'ty," September 7.—A brief abstract of an A. A. A. S. paper. They found that the vapors from an arc light behaved almost exactly like gases which have been acted on by X-rays, with respect to their power of discharging an electrified body, the only difference being that these gases retain their discharging power longer. When the vapors are drawn from the arc through a tube and caused to pass between a charged body and one which is grounded the former will gradually lose its charge, but the discharging current is not proportional to the voltage, as it increases less rapidly than the latter and approaches a limiting value. The discharging property is greatly increased if the vapor of water is introduced into the arc. The phenomena observed may be explained on the assumption that the air is ionized by passing through the arc—that is, the molecules of the air are to some extent torn apart so as to form positive and negative ions like in electrolysis. It is thought that the experiments probably have an important bearing on the theory of conduction in the electric arc.

CATHODE RAYS. Merritt. "El'ty," September 7.—A brief abstract of an A. A. A. S. paper on the magnetic deflection of diffusely reflected cathode rays. He measured the deflection of the so-called para-cathodic rays in a given magnetic field and compared it with the magnetic deflection of the direct cathode rays in the same tube, but could detect no difference in the behavior of these two sets of rays. He is therefore of the opinion that the para-cathodic rays are really the same as cathode rays, and result from diffuse reflection.

COHERERS. Arons. "El'ty," September 7.—A reprint of the abstract noticed in the "Digest" August 20.

Electro-Chemistry and Batteries.

ELECTROMETALLURGY. Ashcroft. Lond. "Elec.," August 10.—A long abstract of his recent paper on his method of treating the Broken Hill sulphide ores by the wet extraction process and the electrolytic deposition of zinc; this is the paper referred to in the "Digest" of September 10. His process was tried in Australia at an expense of one and a quarter million dollars, and has finally been abandoned; the paper, however, is of interest as an account of the novel and extensive metallurgical work. The original process consisted in treating the roasted mixed sulphides with a ferric chloride solution; in the electrolysis of the crude zinc chloride thus obtained with the removal of zinc as a metal, and the dissolution of iron and its oxidation to ferric chloride in anode compartments, thus returning the ferric chloride required in the extraction bath; the latter portion was finally abandoned, and the process became one of the simple extraction of zinc from the roasted ore with sulphuric acid, and the electrolysis of the resulting solution of zinc sulphate. Much good work was done in the determination of the conditions necessary for obtaining a good deposit of zinc. Editorially it is thought that at best there would be only a modest margin of profit owing to the decline of the value of silver and the fact that the value of electrolytic zinc is not much greater than that of ordinary zinc.

ELECTROMETALLURGY. Tommasi. Lond. "Elec.," August 26.—An article on a process of extraction, separation and refining of metals, chiefly of silver-lead, in which he endeavors to show that there is a margin of profit in electrolytic refining greater than that in the usual processes; the advantage is proportionately greater the smaller the amount of silver. He describes his process with the aid of illustrations, and makes tabulated estimates of the cost. Editorially it is thought that the figures need considerable revision. His method consists essentially in receiving the refining metal on a revolving disc cathode, from which the spongy deposit is scraped off: an acetate bath is used, which is said to contain certain secret ingredients. The lead is obtained in a finely divided state.

ELECTROLYTIC IRON. Haber. Lond. "Elec. Rev.," August 26.—An abstract of the article noticed in the "Digest" April 2 and June 25.

ELECTROLYTIC DEPOSITION OF GOLD. Wohlwill. Lond. "Elec. Rev.," August 26.—An abstract of the article noticed in the "Digest" April 16.

ELECTROLYSIS OF ALKALINE CHLORIDES. Kellner "Zeit. fuer Elek.," August 14.—A brief abstract of his recent Chemical Congress paper. It seems to be general in character, discussing the various methods, but more particularly the use of the mercury cathode.

AFFINITY OF BASES AND ACIDS. Hollard. "L'Eclairage Elec.," August 13.—A short article on the affinity of bases and acids and the phenomena of electrolytic dissociation. He deduces the following laws: "The accumulation of electro-negative groups in the neighborhood of the hydrogen of an acid increases in general its dissociation constant, and the accumulation of electro-positive groups diminishes it. The accumulation of electro-positive groups in the neighborhood of the group O H of a base increases in general its dissociation constant, and the accumulation of electro-positive groups diminishes it."

IONIC REACTIONS. Kuester. Lond. "Elec. Rev.," August 26.—An abstract of the original article noticed in the "Digest" July 16.

SUGAR REFINING.—"Zeit. fuer Elek.," August 21.—A note on the Say-Gramme process, which is being tried at Piesdorf. The article is not technical in character; for treating daily 250 tons of beets 250 horse-power are said to be required, and the amount of sugar remaining in the liquor is reduced to one-fifth of that in the ordinary process.

OZONE.—Lond. "Elec. Rev.," August 26.—A short, illustrated article on the Andreoli ozonizers, other similar descriptions of which have already been noticed in the "Digest."

CONGRESS OF APPLIED CHEMISTRY.—"Zeit. fuer Elek.," August 14.—A report of the third international congress, which was held in Vienna in July; short abstracts of the papers are given; these are noticed under their respective headings.

JACQUES CARBON BATTERY. Langley. "Jour. Frank. Inst.," September.—An article giving the results of the investigations of Rosewater and Oldham; the article is practically the same as the one which was abstracted in the "Digest" June 4. The tabulated figures have been reduced to curves; the curves of volts and temperatures approach and recede each other—that is, when the temperature goes up the volts drop; the e. m. f. produced by carbon against iron is not materially greater than iron against iron; this is distinctly opposed to Jacques' theory. To again test this theory he put some sodium nitrate into the melted alkali, but obtained a diminished instead of an increased e. m. f. The experiments showed that the cause of the current is thermo-electric.

LEAD-ZINC-CADMIUM STORAGE BATTERY.—"El'ty," September 7.—A reprint of the article noticed in the "Digest" last week.

CYANIDE PROCESS. Richards. "Cassier's Mag.," September.—A short article describing and discussing this process and its application, from a technical standpoint. There are about forty cyanide plants in the Transvaal, twenty-five in the United States and several in Australia and New Zealand; the value of the gold annually extracted by these plants is nearly $15,000,000. A few illustrations are given of various plants. In conclusion he points out the directions in which this process is being improved.

ELECTRO-SYNTHESIS. Mixter. "Am. Jour. of Sc.," September.—A second paper on this subject, describing researches.

Units, Measurements and Instruments.

ALTERNATING CURVE RECORDER. Callendar. Lond. "Elec.," August 26.—A description of a new apparatus, which is intended to reduce the labor of the determination of such curves, as it draws these quite automatically in the form of a continuous pen and ink curve; it can be set to record the curve every half hour throughout the day, and may be left entirely to itself; it is capable of very accurate work. It consists essentially of a recording potentiometer, working in conjunction with a cycle contact maker; by means of a simple worm gearing the contact brushes are revolved slowly, and the point of the cycle which is to be determined is continuously varied with the motion of the record sheet, so as to form a continuous curve. The recording pen, which is of the usual kind, is attached to the sliding contact of a delicate relay on the potentiometer bridge wire; this relay is made to actuate a pair of motors in such a way as to keep the sliding contact always at the balancing point. The drum is of the usual kind, and may be made to revolve once an hour. (No illustrations are given other than some samples of curves). The recording potentiometer is briefly described; it was found that a very delicate relay was required and had to be constructed especially for this purpose. He hopes to exhibit the apparatus at the next British Association meeting at Bristol. The cycle contact maker and the synchronous motor are both briefly described; he found that the resistance of the cycle contact was a matter of considerable importance. The curves shown were drawn with a rough, experimental apparatus, and do not show the capabilities of the method; one pair shows the volt and current curves on the primary of a transformer; these were verified indirectly by comparison with curves determined in other ways, and were found to be at least as accurate as those obtained by a much more laborious method. Another curve shows the discharge of a small storage battery through a constant resistance; another shows the kilowatt output of a large 1500-kw street railway generator, in which quite rapid fluctuations were recorded. It could be made much more sensitive by increasing the sensitiveness of the relay.

THE GALVANOMETER IN THE BRIDGE SYSTEM. Murphy. Lond. "Elec.," August 26.—He describes some experiments made to get an idea of the current necessary when comparing resistances by the bridge method, in order to secure a certain power of appreciation under different conditions of resistance and galvanometer efficiency; the results are said to be rather remarkable and noteworthy. Two Thomson and one Sullivan marine galvanometers were used, and the results are plotted in curves, which are reproduced and which show a departure from what would have been expected; he found that whatever the resistance and the galvanometer characteristic, the higher the ratio arm resistance, the less the battery current required; also that the suspended coil galvanometer (like the Sullivan) occupies a position in the order of merit which is not justified by either its resistance or its figure of merit, in which two respects it is lower than either of the other instruments, while it practically holds the first place in the order of efficiency in question. These apparent anomalies led to an in- [illegible] were cleared up most satisfactorily, the principal outcome is an addition and important reason for the use of [illegible] of galvanometer for bridge work. The measurement of the testing power in terms of current instead of voltage, which latter was the condition under which Kempe investigated the bridge problem, leads to the first departure from pre- [illegible] from the Kempe formula is to be [illegible] of [illegible] of the curves which he obtained is a measure of the rate at which the testing current must be [illegible] of appreciation as the [illegible]. The results obtained by experiments [illegible]. The curves are practically straight lines, and [illegible] galvanometer. He [illegible] that the ideal bridge galvanometer will be such [illegible] of merit is infinitely high; these are antagonistic requirements in the fixed coil type, but not in the suspended coil type. Could a galvanometer be constructed with a figure of merit [illegible] and a resistance of [illegible] the battery current required [illegible] up to 10000 [illegible] with one ratio, and the sensitivity of the bridge with higher currents would be proportionately great. The heating of the bridge coils with currents, at present necessary, seriously interferes with the accuracy of tests.

COMPARISON OF LOW RESISTANCES. Fisher. Lond. "Elec.," August 26.—A communication in reply to that of Callendar, noticed in the "Digest" August 27. Callendar claimed that thermo-electric effects existed when resistances are compared by means of the potentiometer; Fisher claims that with the Crompton standards of resistances these thermo-electric effects do not arise. The rest is not of general interest.

NEW POST OFFICE BRIDGE.—Lond. "Elec." and "Elec. Rev.," August 26.—A brief, illustrated description of an improved form of this instrument, which has been a Government standard for about twenty years; the improvements are chiefly in detail.

STANDARD CELL. Jaeger. "L'Eclairage Elec.," August 13.—Abstracts of two papers, one from the "Wied. Ann.," 63, page 354, on the modification of the sulphate of zinc in the Clark cell, and the other from Vol. 65, April, on the e. m. f. of the cadmium amalgam cell, both of which articles have already been referred to.

DETERMINING THE FREQUENCY OF ALTERNATING CURRENTS. Kinsley. "El'ty," September 7.—A brief abstract of an A. A. A. S. paper, in which he mentions the various methods depending on the vibration of a wire acted upon by a magnet in circuit, the tension on the wire being varied; also of making the air in a tube vibrate in unison with a telephone connected with the circuit, the effective length of the tube being varied.

Telegraphy, Telephony and Signals.

SUBMARINE TELEGRAPHY. Fahie. Lond. "Elec. Eng.," August 26.—The beginning of an article on the archæology of submarine telegraphy, which is supplementary to the recent book by Bright, which gave very few references to the pre-practical history of submarine telegraphy. He begins with the date 1795.

SIGNALLING IN THE GERMAN NAVY. Pontifex. Lond. "Elec. Eng.," August 26.—A brief, illustrated description of the system of signalling with incandescent lights, devised by Kaselovski. It is operated by various combinations of the lamps, and has been adopted by the German Navy. The principal features are that only one switch key is used; that the movement of the key breaks both poles of the circuit; that it is mechanically rigid, and that it is not affected by dampness. A key moves around a centre like a crank, and may be depressed into any of a number of different notches; the various combinations are determined by the position of the key, and the circuit is made and broken by depressing and raising it. It appears that six lamps are used.

TELEPHONE SYSTEM. Bechtold. "Zeit. fuer Elek.," August 14.—An illustrated description of his method of connecting a succession of telephones to a single line for railroad services, so that each operator can talk only with the two neighboring stations; the result is accomplished by means of induction coils.

TELEPHONY IN ROME. Battandier. "Cosmos," August 6. A brief, illustrated description of the telephone station in that city.

WURTEMBURG.—"Elek. Zeit.," August 25.—Extracts from the telephone statistics for that country up to the end of last year.

TELEPHONE STATISTICS OF EUROPE.—"Eng. News," September 1.—A short table from a consular report, giving the number of lines, instruments, and the number of inhabitants per telephone. In the latter Sweden heads the list with 115; then comes Switzerland with 129; in Germany it is 397, and in France 1216.

INDEPENDENT TELEPHONY FOR LARGE CITIES. Fisk. "West Elec.," September 3.—A short article proposing an ideal exchange for a city like Chicago, to be operated in connection with the independent telephone companies. The chief drawback of these companies is their inability to furnish long-distance service to the large cities.

RELAY RESISTANCE.—"Teleg. Age," September 1.—A discussion of Hewett's article (see "Digest" September 3), followed by a reply by the original author.

Miscellaneous.

FOG DISSIPATOR.—"El'ty," September 7.—An editorial reference to a recent article by McAdie, in which he expresses the belief that fogs at sea may be dissipated by the method suggested some years ago by Lodge, who recommends the use of very powerful influence machines, one pole of which is connected to the mast, thus coagulating the fog, which then falls as rain. He thinks the time has now come when this suggestion should be tried. It is hardly to be expected that the fog will be dissipated at any considerable distance from the vessel.

MEETING OF AMER. ASSN. FOR ADVANCEMENT OF SCIENCE.—"Science," September 2.—The beginning of a report of the proceedings, including the presidential address. None of the papers reprinted are on electrical subjects.

LEAGUE OF MUNICIPALITIES.—"Prog. Age," September 1.—The continuation of the report, including reprints of the papers of the proceedings of the second annual convention of the League of American Municipalities.

BOSTON.—"St. R'y Rev.," August 15.—A long article, with numerous good illustrations, giving an historical sketch of this city. This is followed by another long and profusely illustrated article by Whiting on the story of Boston.

Three Large Exhibits at the Street Railway Convention.

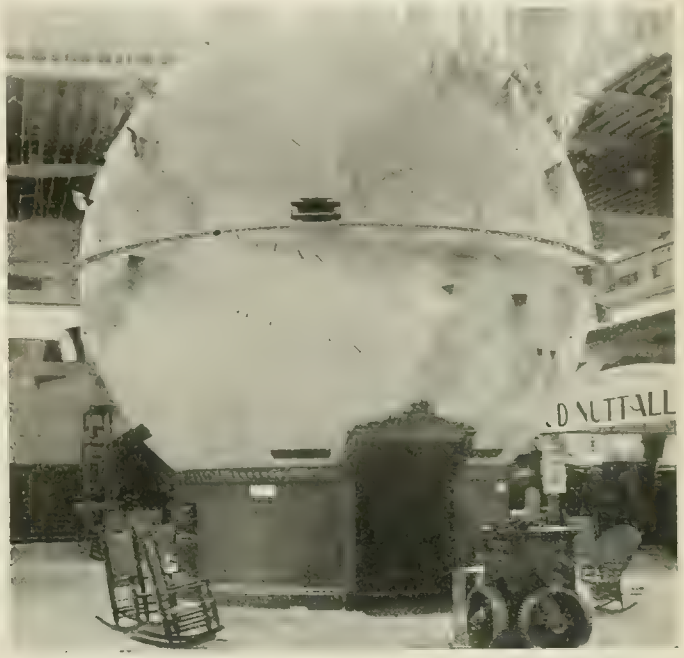
THE EXHIBIT OF THE WALKER COMPANY.

A piece of apparatus which street railway men from large cities looked at with considerable interest as foreshadowing what they may be obliged to come to some time was a section of the Love open-conduit electric road, shown in the Walker Company's exhibit. This full-sized section is the same that was shown at the Electrical Exhibition in New York, and described in The Electrical World of May 14, 1898, the only different feature being the omission of the car body. Two 15-L motors, similar to those now being supplied to the Brooklyn elevated road, were shown, as well as two of the new 33-S street railway type. One of the latter was shown in operation, and the other open to show the construction. The main features of construction are the use of laminated poles bolted to a cast-steel shell, polar extensions holding the field coils in place. The features of the armature were shown by four in different stages of construction, showing how the band wires are sunk below the level of the ends of the teeth, by making the teeth beneath them shorter than the others. This absolutely prevents any possibility of stripping action if the armatures rub against the fields, since the only part of the armature that can strike is the core teeth. The commutator of this motor was shown assembled and the wires soldered in before it was turned up. A panel mounted on an easel in the exhibit showed all parts of the 33-S motor complete from the keys and set screws to the connectors. In another part of the exhibit was the standard 3-A trolley and base, which is notable for the ingenuity displayed in the avoidance of patents owned by competitors. Two of the eleven styles now made of the Type S controller were on exhibition as well as a model connected up with a short circuiting switch around the solenoids to show the reduction in the arcing when the solenoids are in action. The controller itself shows one recent change, namely, the elimination of special positions of the reversing switch for cutting out either one or the other of the motors, this being effected in the new model by hooking back the contact fingers so that they will not bear on the reversing switch segments. A new style of this controller, fitted for an emergency brake, is now being developed by the Walker Company, but unfortunately was not far enough along to be shown at the convention. A switchboard of polished slate, showing one generator and two feeder panels of the Standard Walker construction, stood at one end of the space, and was connected up with the motors in operation and also with seven of the Walker inclosed arcs. A large amount of printed matter, circulars and photographs completed the exhibit, which was looked after by Mr. H. McL. Harding, J. S. Anthony, M. D. Law, J. D. Moore and others.

Exhibit of the Walker Company.

THE ELECTRIC RAILWAY AROUND THE WORLD.

The General Electric Company made rather a new departure in its exhibit at this convention, showing very little apparatus of interest, but making a spectacular display in the line of a globe laid out to represent the world, with a miniature electric railway running around the equator. The globe itself was 26 feet in diameter, covered with papier-maché, accurately mapped out and studded with miniature incandescent lamps at all points where General Electric plants are located. The various countries and colonies were distinguished by the national flags, and the stars and stripes appeared prominently over the Philippines, the Ladrones, Hawaii and Porto Rico. The miniature lamps were naturally most dense in the United States of America, but wherever land appeared above the ocean there was almost certain to be a lamp. A miniature car electrically lighted ran rapidly on a narrow platform built horizontally around the equator. The interior of the globe was handsomely furnished and used as a reception room. In the line of apparatus the General Electric Company showed very little. Naturally with the convention at the headquarters of Mr. Caryl D. Haskins, the street railway integrating wattmeter was well to the front, and was shown wired up to a controller, and motor fitted with a brake to show the operation of the meter. The only new apparatus the company showed, but a line which will probably come into wide use, were the new indicating measuring instruments for switchboard service. These are intended to give as accurate results as the highest grade switchboard instruments now on the market, and combine in their design several new features. The deflection is obtained by a Deprez-d'Arsonval movement, but the magnetic field, instead of being that of a permanent magnet, is that of an electromagnet, excited by current taken across the bus bars. To prevent the fluctuations of the voltage in this exciting circuit affecting the accuracy of the instrument, the restoring force is also magnetic and dependent on the same excitation, so that any variation of the voltage in the exciting circuit affects both alike and leaves the indication unchanged. This electromagnetic feature prevents the instruments being affected by any permanent demagnetizing effect of heavy bus bars in the immediate neighborhood, an action which frequently occurs with instruments of the permanent magnet type. The instruments are also rendered independent of any immediate disturbance from the neighboring bus bars by a construction which renders them static. Dead-beat movements are obtained by means of a foucault current brake in the same magnetic field that gives the deflection. With no permanent magnets to demagnetize or restoring springs to weaken, these instruments should be about as unchanging as it is possible to make them. Mr. F. M. Kimball and C. D. Haskins were in charge of the installation of the exhibit at the hall. The General Electric Company's strongest feature at the convention was what it termed its operative exhibits, consisting of the many railway and other electrical plants in Boston and the immediate vicinity, to which it was intended to personally conduct parties by the many representatives of the company attending the convention. This plan could not be carried out in full, however, owing to the counter attractions provided by the association and its entertainers. The company distributed a neat brochure entitled "The General Electric Company at Boston," giving handsome views of various power stations, the subway and the Lynn works of the company, as well as an illustrated guide to the city. The company also entertained its friends at the headquarters at the Brunswick Hotel.



The General Electric Company's Exhibit.

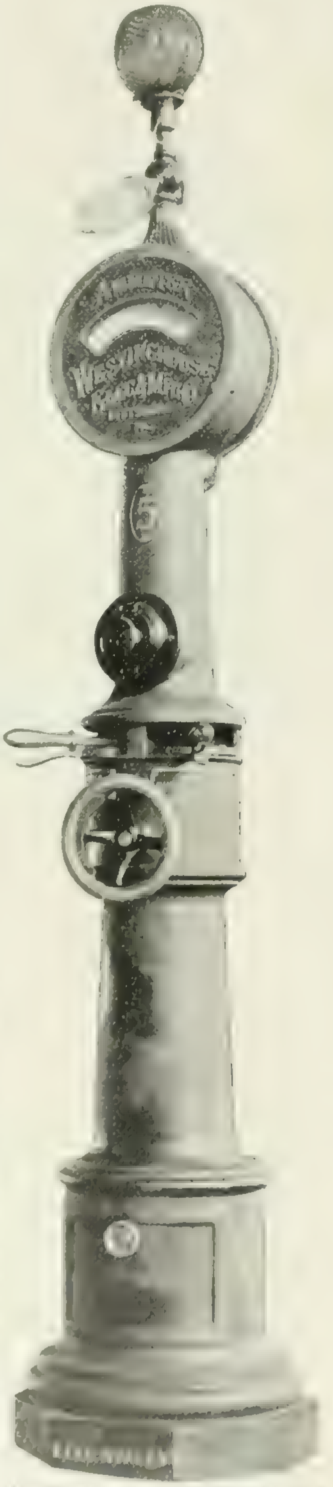
NOVELTIES SHOWN BY THE WESTINGHOUSE ELECTRIC COMPANY.

No one with ears to hear could escape having his attention called to the exhibit of the Westinghouse Company, whenever the lightning was played on the slogan of the Westinghouse Company, "The Name of Westinghouse is a Guarantee," which was mounted in metal letters on large plate-glass panels, and

A Part of the Westinghouse Exhibit.

connected up with a [illegible] volt transformer, the disruptive discharges from which had a most impressive audible and visible effect. The most interesting part of the Westinghouse exhibit and perhaps the most interesting feature of all the exhibits to street railway men was the new switchboard arrangement, but more properly the switchboard substitute, one equipment of which was shown in operation. A system of this kind is now being installed for the Consolidated Traction Company, of Pittsburg, and part of this system was borrowed for the exhibition. In this new arrangement the current switching and circuit breaking apparatus, instead of being mounted on panels of the switchboard, may be mounted at any convenient location, whether directly accessible to the machine attendants or not, and is controlled by compressed air from valves mounted in pedestals conveniently placed near the machines themselves. These handsome cast-iron pedestals, one of which is shown in an accompanying illustration, each control one generator or feeder. The generator pedestal has at the top a Weston round-type ammeter, below this a voltmeter switch, below this two handles operating compressed air valves, one controlling the main generator switch and the other the circuit breaker, and below these handles a rheostat wheel connected by gearing to a field rheostat below the floor. The compressed air valves are interlocking, so that the main switch cannot be opened when the circuit breaker is closed, nor can the circuit breaker be closed except while the main switch is open. The most novel part of the whole system is the circuit breaker itself, which, instead of being fitted with knife contacts, closes the circuit through a lot of copper-leaf springs, the ends of which bear against the opposite terminal. The arc of the opening circuit is taken across carbon terminals and the breaker can be closed either by the compressed air from the pedestal at a distance or by means of a handle located upon it. The triple-pole double-throw main switch has also the same style of contacts, making the switch much more easily opened or closed than those with knives entering tightly binding jaws. The throw-over arrangement will be used in the Consolidated traction work for the two sides of a three-wire system. The equipment shown in the exhibit was rated at 2000 amperes capacity, and has been tested with that current at 2500 volts. The compressed air was supplied for the system by means of a 2½-hp motor, direct coupled to a rotary air compressor of the eccentric cylinder and wing blade type, the starting and stopping of the motor being controlled by an automatic switch. The Westinghouse Company also showed [illegible] alternating [illegible] from [illegible] an alternating current induction motor, which [illegible]

In the line of transformers, besides the [illegible] giving the coil [illegible]


A Westinghouse Generator Controlling Pedestal.

[illegible]

was the engineer in charge. The merits of the apparatus were explained by the following district managers: Mr. C. Townley, Boston; Mr. M. Coster, Chicago; Mr. T. C. Frenyear, Buffalo; Mr. J. R. Gordon, Atlanta; Mr. C. A. Bragg, Philadelphia; also by Mr. F. H. Raylor, general sales manager, of Pittsburg; Mr. N. W. Storer, engineer of the direct current work, and Mr. R. S. Brown.

Supplies and Supply Men at the Convention.

MR. H. E. RUNDLETT represented the E. P. Allis Company, Milwaukee, Wis.

THE NATIONAL ARC LAMP COMPANY, Boston, was represented by Mr. F. B. Smith.

MR. G. M. ANGIER represented the Eddy Electric Manufacturing Company, Windsor, Conn.

THE CHICAGO INSULATED WIRE COMPANY was ably represented by Mr. W. M. Smith.

MR. ROMAINE MACE was the personal representative of the Okonite Company, Ltd., of New York.

THE JANDUS ELECTRIC COMPANY, Cleveland, Ohio, was well represented by Mr. George W. Rowbotham.

MR. W. E. SESSIONS, manager of the Sessions Foundry Company, Bristol, Conn., did not miss the convention.

THE PITTSBURG TROLLEY POLE COMPANY'S interests were judiciously looked after by Mr. H. B. Weaver.

MR. LUTHER STEIRINGER was present, and, as usual, was enthusiastic over any artistic display effects in the exhibits.

MR. GEORGE A. McKINLOCK, president of the Central Electric Company, Chicago, was an attendant at the convention.

THE CREFELD ELECTRICAL WORKS, Saylesville, R. I., were represented by Messrs. L. A. Lockwood and A. S. Montgomery.

THE SIMPLEX ELECTRICAL COMPANY, Boston, had an able representative at the convention in the person of Mr. J. H. Mason.

THE JOHN A. ROEBLING'S SONS COMPANY was represented by Messrs. A. M. Whitaker, G. W. Swan and Robert W. Welch.

THE AMERICAN VITRIFIED CONDUIT COMPANY, of New York, through Mr. C. H. Hill, set forth the advantages of its conduits.

THE PHILLIPS INSULATED WIRE COMPANY, Pawtucket, R. I., was represented by Mr. Henry C. Adams, Jr., secretary of the company.

MR. WALTER S. BARKER, of the Boston office of the New York Insulated Wire Company, took good care of the interests of his company.

MESSRS. ADAM COOK'S SONS, 313 West Street, New York, distributed a pamphlet on Albany grease and its advantages in street railway work.

MR. FRANK RIDLON, of the Frank Ridlon Company, Boston, one of the fathers of the electrical industries, spent much of his time with the visitors.

MR. H. B. KIRKLAND, the New York representative, and Mr. A. T. Clark, took good care to advance the interests of the American Circular Loom Company.

THE STREET RAILWAY LAMPS manufactured by the Bryan-Marsh Company had their merits described to the delegates by Mr. J. M. Hill, of the Chicago office.

MR. W. O. TURNER, New York agent for C. S. Knowles, of Boston, attended the convention and modestly, but nevertheless in a "get-there" manner, made his presence evident.

THE SAMSON CORDAGE WORKS, Boston, was represented by Mr. F. J. Coakley, and displayed samples of its trolley, bell and register cords; also the well-known Samson braid.

THE COLUMBIA MACHINE WORKS, of Brooklyn, made a display of commutators, brush holders, journal boxes, gongs, trolley cars, trolley frogs, trolley wheels and car brasses generally.

THE JOHN STEPHENSON COMPANY, LTD., New York, showed a model of the car bodies it is supplying for the splendid line of the Metropolitan Street Railway Company, of New York City.

THE HOLTZER-CABOT ELECTRIC COMPANY, Boston, delegated Mr. T. W. Ness to look after its affairs at the convention, and that gentleman proved to be an ardent exponent of his house.

THE STANDARD AIR BRAKE COMPANY, of New York, had on the ground two able representatives—Mr. Joseph R. Elliott, of the New York office, and Mr. John I. McAitchen, of the Boston office.

THE AMERICAN WHEELOCK ENGINE COMPANY, Worcester, Mass., had one of its strong features, the Hill valve gear, on exhibit in charge of Mr. James L. Kimball, of Boston, the New England agent.

MR. C. E. FARRINGTON, of the Massachusetts Chemical Company, Boston, [illegible] to all the well-known insulation of this company, [illegible] and electrical engineer.

THE JANDUS ELECTRIC COMPANY, Cleveland, Ohio, exhibited its [illegible] lamps for [illegible] volt, [illegible] volt and alternating circuits, Mr. H. F. [illegible], the New England agent, bringing out their good points.

MR. [illegible] E. CONDIT, manager of E. A. Chase & Co., Boston, was [illegible] at the convention was in especial demand [illegible] widely distributed.

MESSRS. GEORGE W. PROVOST and [illegible] together saw that the [illegible] knowing more about the R. D. Nuttall [illegible] from the [illegible] before the convention met.

MR. GEORGE F. PORTER was an indefatigable worker in the interest of [illegible]. His friends in the electrical world are legion, and [illegible] Electric Light Association he is widely known.

THE ADAMS & WESTLAKE COMPANY, New York and Chicago, made [illegible] display of [illegible], signal lamps, headlights and other [illegible] for the protection and comfort of passengers in street railway cars.

MR. A. L. DANIELS, a convention veteran, told the street railway men an interesting story about the H. B. Camp Company's earthenware conduits. The facts as presented by Mr. Daniels furnished his hearers with food for very careful thought.

GEORGE A. PARMENTER, Cambridgeport, Mass., showed a full-sized exhibit of his fenders and track cleaners, which are ingeniously arranged for clearing obstructions rigid enough to carry them away while holding firmly against lighter objects.

THE KEYSTONE ELECTRICAL INSTRUMENT COMPANY, Philadelphia, showed a railroad switchboard consisting of one generator and eight feeder panels equipped with Keystone instruments. On another board were various other styles of instruments, consisting of potential indicator, arc ground detector, constant potential ground detector, portable direct-current and alternating-current voltmeters, pocket polarity indicator, etc., the equipment being in charge of Mr. J. F. Stevens.

Exhibit of the Keystone Electrical Instrument Company.

MR. A. L. REGISTER, of Pepper & Register, consulting engineers, Philadelphia, attended the convention to keep railway men advised of the fact that his firm does railway engineering work and to see that nothing new in the supply line escaped his attention.

THE DEARBORN DRUG & CHEMICAL WORKS, Chicago, were represented by their vice-president and general manager, Mr. Robert F. Carr, who is after street railway people as well as everybody else that uses boilers, and aims to do business wherever he sees a smokestack.

MESSRS. WHITMAN & COUCH, the well-known telephone manufacturers of Boston, increased their well-earned reputation through their new telephone apparatus for street railways, exhibited at the booth of Pettingell-Andrews Company, and which apparatus favorably impressed many street railway officials.

MESSRS. L. A. CHASE & CO., Fort Hill Square, Boston, distributed considerable literature concerning the Elden direct and altrnating current circuit breakers. Mr. S. B. Condit, the well-known representative of this firm, was active and energetic in keeping its specialties prominently before the delegates.

MR. JAMES S. SPEER, secretary of the Partridge Carbon Company, Sandusky, Ohio, in his quiet way sounded the praises of Partridge self-lubricating motor brushes. These brushes are so well known that they do not require brass bands or any other artificial means to bring them to the attention of street railway men.

TRUCKS, besides those exhibited by the Peckham and Brill companies, described in other notes, were shown by the McGuire Manufacturing Company, Chicago; the Bemis Car Box Company, Springfield, Mass.; Barney & Smith Car Company, Dayton, Ohio; the Taylor Electric Truck Company, Troy, N. Y., and the Baltimore Car Wheel Company, Baltimore, Md.

MESSRS. NAUGLE, HOLCOMB & CO., 355 Dearborn Street, Chicago, were represented by the manager of the construction department, Mr. George Weston, who made himself popular by the distribution of a convenient morocco-lined notebook, giving programme, officers, committees, etc., of the association, as well as information of interest about Boston.

MR. PERCY HODGES, late of the railway department of the Boston office of the General Electric Company, now New England agent of the John Stephenson Company, Limited, car builder, was kept busy receiving the best wishes of his many friends.

MESSRS. ROSSITER, MacGOVERN & CO., New York, distributed the usual price list of their second-hand standard electrical apparatus. Mr. Frank MacGovern was in attendance. Mr. Rossiter, of this firm, is the son of the well-known Brooklyn street railway manager, and the firm does a large business both with street railways and electrical lighting companies.

THE AMERICAN ELECTRICAL WORKS, Providence, R. I., were represented at the convention by Mr. W. J. Watson, its New England representative, and during the convention General Manager Eugene F. Phillips, President Frank N. Phillips, Secretary C. R. Remington, Jr., Treasurer Waggenseil, New York Agent P. C. Ackerman, and Chicago Agent Frank E. Donohoe dropped in.

MR. H. B. CUTTER, president of the Cutter Electrical & Manufacturing Company, Philadelphia, was present at the convention, and pointed with pardonable pride to his jewels in the exhibit of the Bibber-White Company. He mentioned that the company had lately made some 4000-ampere, double-pole circuit breakers for use in the new works of the Western Electric Company, New York City.

THE STANDARD UNDERGROUND CABLE COMPANY, Pittsburg, showed a line of samples of feeders, overhead, underground and submarine, especially adapted for 500-volt circuits, and paved the way for much new business through the efforts of Mr. G. L. Wiley, the New York manager; Mr. L. E. Hughes, Philadelphia manager, and Mr. F. A. Reinhart, treasurer of the company.

THE INCANDESCENT ELECTRIC LIGHT MANIPULATOR & CLEANER COMPANY, of Hyde Park, Mass., made an exhibit in charge of Mr. J. J. Dunn, manager, the apparatus shown consisting of rubber-lined nippers, designed to fit incandescent lamp globes, and mounted on the end of long poles, with attachments for screwing and unscrewing the bulbs or for cleaning them in place.

THE CREAGHEAD ENGINEERING COMPANY, Cincinnati, made an exhibit of overhead material in general, the most interesting novelty of which was called the Bourbon strain insulator, a peculiarity of which is its resemblance to a barrel, which probably gives it its name. The barrel is corrugated to increase the surface distance between terminals. The display was nicely arranged and in charge of Mr. G. R. Scrugham, superintendent of the company.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, was actively represented by Mr. Charles Blizard, of New York; Mr. F. J. Stone, Boston manager; Mr. F. H. Clark, Chicago manager; J. R. Williams, general agent, and J. L. Woodbridge, of the Boston office. The company had good working exhibits to show those interested in the three stations of the Boston Edison Company.

CAHALL BOILERS were not shown at the convention, but the characteristic detail parts of their construction were shown. One of these was the patent swinging man-hole plate hinged so that it can be opened like a door when unbolted, and another was the flowed steel header for the horizontal type of water tubular boiler. Mr. Winthrop Thayer, of Thayer & Co., Incorporated, Boston, the New England agents for the Aultman & Taylor Company, showed also photographs of many of the large installations of these boilers.

THE BILLINGS & SPENCER COMPANY'S exhibit was in charge of Mr. H. E. Billings, who made it a centre of attraction for old and new friends. Some 200 different designs of drop-forged commutator segments were shown, also drop forgings for Lundell motor cases and samples of its well-known overhead material. The new catalogue of the company, illustrative of the 200 different designs of generators and stationary motor segments, was eagerly sought after, and a neat souvenir key ring was widely distributed.

Exhibit of the Billings & Spencer Company.

THE OHIO BRASS COMPANY, Mansfield, Ohio, had a most bewildering display of overhead equipments, showing all its now well-known standard work, as well as some brand new features. Among the latter were a locking device for cap and cone hangers, consisting of a spring washer bearing against a metal ring moulded into the insulation, also a locking device for insulators of the West End style, consisting of a serrated rim of the protecting bell, the teeth of which can be turned under by a blow and keep the insulators from unscrewing. A new kink in Brooklyn strain insulators is the use of a bronze collar moulded under the head of the central part to prevent the shoulder of the encircling part from cutting into the insulation material. Many devices for use on figure 8 trolley wire were shown, a combination splicer for round wire at one end and figure 8 wire at the other, straight line clamping ear hangers for accommodating two wires within a few inches of each other and electrically connected being the most interesting. Special apparatus for coal mining to protect the insulation against the deteriorating action of the surroundings in these locations, feeder wire splicers, a new trolley splicer in which it is only necessary to poke the wires in and they will catch themselves so tightly that they break off without pulling out, curve pull-overs for suspending and insulating double trolley wire, flexible bracket suspensions, lightning arresters, bell metal bearings, etc., were a few of the items noticed. The exhibit was in charge of Mr. C. K. King, secretary of the company, and Mr. A. L. Wilkinson, special representative.

Exhibit of the Ohio Brass Company.

MR. J. E. EMERY, of Emery & Crump, street railway engineers, 146 Franklin Street, Boston, was on hand to advance the interests of the firm and to get the latest points from the supply men. This firm has recently constructed a road in Webster, Mass., and an extension of another road from Millbury to Northbridge, Mass., and is now doing the field work for the Bergen County Traction Company in New Jersey.

THE GARTON LIGHTNING ARRESTERS were objects of especial attention, and could not be very well missed, distributed as they were in the exhibits of the Pettingell-Andrews Company, Ohio Brass Company, Elmer P. Morris and the Walker Company, the latter company showing five arresters on the back of its standard railway switchboard. In addition to these exhibits Mr. J. V. E. Titus, secretary of the Garton-Daniels Electric Company, was present.

THE WATSON & STILLMAN COMPANY, 204 East Forty-third Street, New York, exhibited a line of long-felt wants in the shape of various hydraulic railway tools. The most convenient of these for street railway construction [illegible] bender capable of taking rail of any weight and size used in practice and bending them promptly and accurately to the required curves. Another device was a quick-acting hydraulic motor lift for pit work, for putting in or taking out motors beneath the car. Hydraulic jacks, punches, wheel presses, etc., were also shown and described by George [illegible]

[illegible] N. J., generally gets out something slick either in the line of materials or exhibits. This [illegible]

[illegible] distributed at the convention an illustrated work on electric illuminated foun- [illegible]

[illegible]

work was well illustrated by pipes eaten through by electrolysis. Mr. Brown distributed to the railway men a first mortgage bond of the Up-To-Date Street Railway Company, signed by Mr. P. Lastic Bond, president, and Mr. Resistance Low, secretary, per Manent.

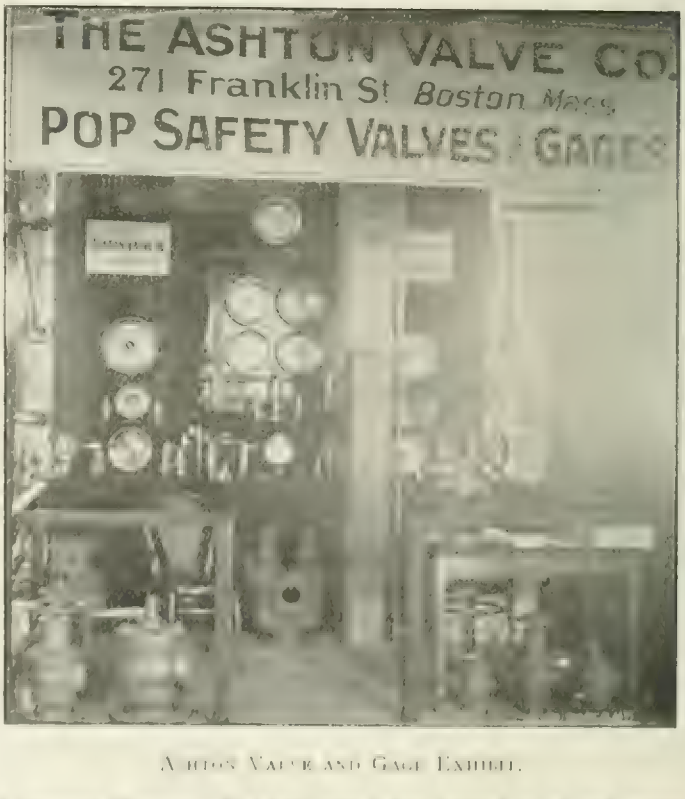
THE METHUEN ELECTRIC COMPANY, Methuen, Mass., exhibited a handy device the advantages of which were so obvious that everyone wondered why it had not been on the market and in use long ago. This is an insulated connector manufactured under the Osgood patent, and consisting of the ordinary brass sleeve connector with square headed set screws and a heavy rubber sleeve slipping over the same, slotted to allow the entrance of the screw heads, also to prevent them from unscrewing, and two rubber caps stretched tightly over either end and fitted closely around the wire insulation, rendering the whole water tight. The handiness of this device as compared with tape is obvious at a glance, and was made more so at the convention by the arguments of Mr. C. D. Holman.

THE NEW YORK SWITCH & CROSSING COMPANY, Hoboken, N. J., had on exhibition a full-sized magnetically operated switch for 9-inch girder rail, the arrangement being such that the switch can be controlled by the motorman of an approaching car by simply turning on his current while passing over a short special section of the track near the switch. The current turned on at this point is forced to pass to the track, return through a magnet which throws the switch over, while if the car drifts over this section the switch remains stationary. In this way the switch can be controlled from the car platform without any special mechanical devices and without stopping the car. Mr. W. C. Wood, president of the company, and Mr. L. E. Robert, sales agent, manipulated the equipment shown, and explained its working.

THE STANDARD THERMOMETER & ELECTRIC COMPANY, of Peabody, Mass., manufacturer of the Midget inclosed arc lamps for all circuits, was not represented with regular display in the main hall at the exhibition, but it had twelve of its lamps in the gallery, where they were used for lighting in the evening. The lamps were all running on 110-volt, direct-current circuit, were fitted with fancy covers of different designs, a few of the lamps having large opal shades, instead of the regular outer globe. A noticeably good effect was obtained by the use of a full ground outer globe on some of the lamps, producing a white, steady and evenly diffused light. Mr. M. L. Livingston, assistant manager of the company, and Mr. J. H. Hallberg, its electrician and designer, were in constant attendance, and looked after its interests.

THE WOODBRIDGE WIRING COMPUTATOR is about to be put upon the market by Mr. J. L. Woodbridge, 60 State Street, Boston, Mass., who attended the convention and interested many street railway men in this handy device. The computator is a set of cardboard circles and scales suitable for carrying in the pocket, which without computation gives from the necessary data the size and weight of wire needed for overhead trolley lines. Having given the load, which is assumed to be uniformly distributed at any given number of points along the line, the maximum allowable drop at the end of the line and the distance to the end of the line, the computator gives at once the cross section in circular mils of the various sections of the line, the cross section being greatest near the source of supply and reduced in steps in accordance with the law of minimum weight to minimum terminal drop. The computator also gives at once the total weight of copper used in the whole line.

THE ASHTON VALVE COMPANY, Boston, Mass., showed the usual line of pop-safety valves, water relief valves for pumps, cylinder relief valves for engines, gauges, etc. A section of the safety valve showed the means [illegible] High-pressure valves working up to 1600 pounds' pressure were shown and some special work, such as torpedo boat pop valves [illegible] pounds' pressure, attracted attention. The exhibit was in charge of Mr. H. H. Ashton, Mr. A. C. Ashton and Mr. Charles Houghton



Ashton Valve and Gage Exhibit.

THE MICA INSULATOR COMPANY, 218 Water Street, New York, was represented by Mr. C. W. Jefferson, the manager of the works in Schenectady. Among the products of this company were shown various samples of insulating board in plates 18x36 in size, some suitably hard for commutator segments, others designed to be softened by heating for moulding purposes, and a large line of mica paper and cloth; that is to say, thin sheets of mica with Japanese paper or some quality of cloth on either side. Various modifications were shown, an extra flexible cloth being obtained by the use of mica, gutta percha and paper. The company also makes a line of oiled silk, linen and asbestos papers, generally designated by the term "Empire," which were also shown at the convention.

THE ALBERT & J. M. ANDERSON MANUFACTURING COMPANY, Boston, filled a large booth with its special railway apparatus, some of which excited no little curiosity owing to its unusual character, since it was built by specifications for foreign roads, the company having built up recently quite a considerable export business. One novelty shown was a practically straight underrunning insulated crossing constructed entirely of sheet steel, which, while considerable longer than heavy cast-brass crossings, was lighter and stiffer than the latter. Third rail supporting insulators are manufactured for elevated railway work also attracted interest, as did special hangers for English side trolley work. The Monarc inclosed arc lamp was the especial pride of Mr. C. B. Pear, who was in charge of the exhibit. It was stated that the company would soon put out a lamp suited for alternating current work. Ajax lightning arresters, figure 8 mechanical clips, section insulators, malleable iron line material, section switches with quick-break cast blades and many other details filled up this exhibit. One neat piece of apparatus worthy of special mention was the Ericsson voltmeter switch, in which the switch handle rotates and makes double pole-knife blade contact when pressed in at the proper rotary positions.

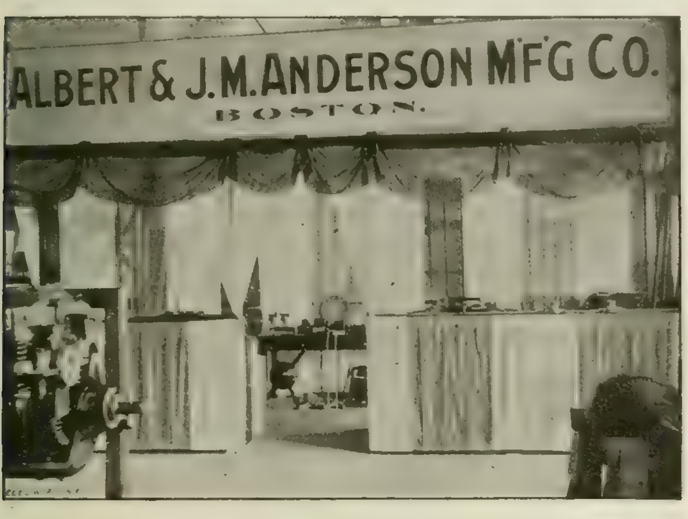


EXHIBIT OF THE ALBERT & J. M. ANDERSON MANUFACTURING COMPANY.

MR. ELMER P. MORRIS had a number of signs extending across the west end of the hall, where he gathered under his wing the exhibits of the many different companies for whom he acts as general agent. Among these companies are the Sterling Arc Lamp Company, of New York; the Keystone Electrical Instrument Company, of Philadelphia, both of whose exhibits are described elsewhere in these notes, and the following: Kosmic Oil Filter Company, Easton, Pa.; the Simonds Manufacturing Company, Pittsburg, Pa., showing gears, pinions and bearings; the Electric Railway Equipment Company, Cincinnati, showing poles, brackets and iron fittings; Harrington Rail Bonding Company, New York; and various instruments and materials, such as the Garton lighting arresters, Partridge self-lubricating motor brush, Monarch insulating paint, etc.

THE CROSBY STEAM GAGE & VALVE COMPANY'S exhibit contained as its most conspicuous feature a 12-inch single bell chime whistle with three chambers. The exhibit space was filled with indicators, steam, hydraulic and recording gauges, throttling calorimeters, lubricators, planimeters, revolution counters, thermometers, etc. The novel features were a new spring-seat valve with tight V-shaped wedge seat; a new indicating and recording steam gauge, the recording dial being within the indicating circle, making a single round type instrument which can be mounted artistically on a gauge board; and a gauge tester without springs, but measuring pressures by scales and dead weights. Mr. Robert Pirie, New England sales manager of the company, was in charge of the exhibit.

THE GOLD STREET CAR HEATING COMPANY, New York, showed in its exhibit some new heaters for cross seats. The construction of these is somewhat modified from older types by the use of a zigzag enameled rod on which the helical wire coil is mounted instead of a twisted rod. This is said to give better ventilation and less cramping of the wire resistance. Three of these zigzag rods instead of one spiral are placed in one heater. The panel equipments are made up with a three-point switch, giving on any heat a uniform distribution between the panels. The company also showed an office heater with a small motor driven blower, the whole using about 30 kilowatts at full output. The representatives of the company stated that they were finding quite an extensive line of business in steamship work.

THE BOARDMAN-TUCKER COMPANY, 97 Oliver Street, Boston, showed a telephone system especially adapted for street railway work, the various stations being mounted in boxes and so arranged that the closing of the door of the box cuts the telephone inside out of circuit, thus eliminating the danger of burn-outs when the 'phone is not in use and preventing the interference effects of a large number of instruments on one line. With two or three instruments permanently connected at the general manager's office, the power station and car barns, for example, any number can be installed on the line without introducing too much impedance if connected in series, or too much leakage if bridged in, as only the instruments in use are in circuit. With instruments located at the switches of long single-track roads, a simple train dispatching system can be established, which is of great assistance in case of interference with the regular schedule. The advantages of such an equipment also in times of storm or other emergencies were described by Mr. A. F. Boardman, who had charge of the exhibit.

THE WAGNER ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., made an exhibit especially of measuring instruments and switchboard work for railway service, and also showed some of the new type F and type G transformers and a new switch which has just been brought out, consisting of an ordinary knife blade arrangement with carbon rollers pivotally mounted on the clips and pressing against the blade, following the latter on opening and taking the spark at a point where burning will not injure the contact between copper and copper. A new quick-break baby switch was also shown, the feature of which is the use of a spring to accelerate the movement of the blades and handle as soon as the pressure of the hand has overcome the friction in the closed position. The booth of this company was decorated with instructive photographs of heavy railroad switchboard work installed by the Wagner Company, and also of the works. Mr. E. H. Abadie, manager of sales, and Mr. H. M. Ney, New England sales agent, were in charge of the company's interests.

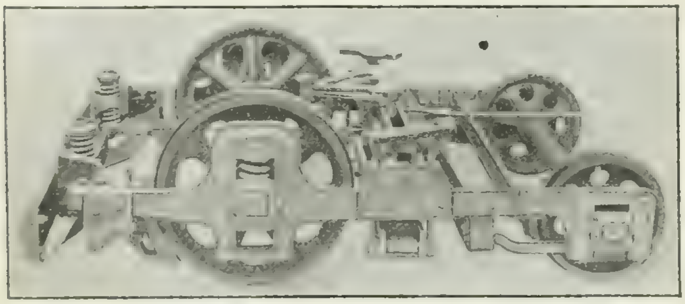
THE CONSOLIDATED CAR HEATING COMPANY, Albany, N. Y., showed its latest types of heater, consisting of galvanized iron wire helices placed in helical grooves on porcelain sleeves mounted with asbestos bushings and washers to prevent breakage, on square iron rods. The method of obtaining a uniform heat throughout the entire length of each heater on each step of the three-point switch is rather ingenious, each panel containing two coils throughout its length of different resistances. The first step of the switch puts the current on to the higher resistance, the second step cuts this out and puts it on to the lower resistance coil and the third step puts the two in multiple. The controllers are arranged with interlocking knife switch and control cylinder and are made so that they can be locked with a padlock in any position, keeping them under control of an inspector when desirable. The panels exhibited at the convention were equipped with lamps to show the various combinations. Two heaters which had seen five years' service were shown, mounted with a voltmeter and ammeter, which showed that they took as closely as could be measured the same current as that at which they were originally rated. The company was represented by Messrs. J. F. McElroy, R. P. Scales, of Chicago, general agent; R. N. Ransom, New York general agent, and W. P. Cosper, St. Louis general agent.

THE STERLING ARC LAMP COMPANY, New York City, showed a large line of inclosed arc lamps, the most interesting of which to street railway men were five in series on a 500-volt circuit. Four alternating-current lamps were shown, as well as two inclosed arcs for series circuits and ten constant potential lamps with various styles of trimmings. In a booth at one end of the exhibit X-rays were kept on ice for the benefit of those in need. Major R. J. Randolph, general sales manager of the company and one of the best known electrical men at the convention, was in charge of the Sterling Company's exhibit.

A LINE OF STERLING ARC LAMPS.

MR. W. R. KERSCHNER representing the Columbia Machine Works (Buehler & Platt), 18 Fulton Street, Brooklyn, N. Y., did some excellent missionary work in behalf of his company. The Columbia Company manufactures a full line of railway supplies, and makes specialties of new and refilled commutators, dropped forged copper bars, trolley wheels, car trimmings, fuse boxes, bearings, adjustable break and controller handles, and other devices.

THE PECKHAM MOTOR TRUCK & WHEEL COMPANY made an extensive exhibit in the basement of full-sized samples of its comprehensive line of trucks, the most interesting feature of which was a new truck made in two weights, respectively known as No. 14 D-2 and No. 14 D-3, the design of which combines so many meritorious points that a description may be of interest. The truck is a centre bearing maximum traction swing bolster type, the maximum traction effect being obtained in two ways, one by offsetting the pivot from the centre of the truck toward the larger wheels, the other by overhanging the motor outside of the truck on the large wheel end. As shown in the accompanying illustration, the bolster is supported from the spring plank by a semi-elliptic and two helical springs, the spring plank hanging from the transom by links giving it a side play of about 3 inches. This swing bolster effect naturally reduces the tendency of the small wheels to jump the track at curves, whereby the weight upon them can be considerably reduced, giving added weight to the traction wheels and consequently greater freedom from slipping. The wheel base of this truck is about 4 feet 6 inches, the larger wheels being 33 inches in diameter and the smaller ones 20 inches. The truck, as may be seen in the illustration, is a remarkably low one. The exhibit at the convention and the parlors occupied by the company at the Hotel Brunswick were looked after by Mr. E. Peckham, Mr. J. A. Hanna, Mr. W. H. Gray and Mr. E. G. Long. The company distributed a handsome convention bulletin describing its trucks and their superior features.



The Peckham Maximum Traction Truck.

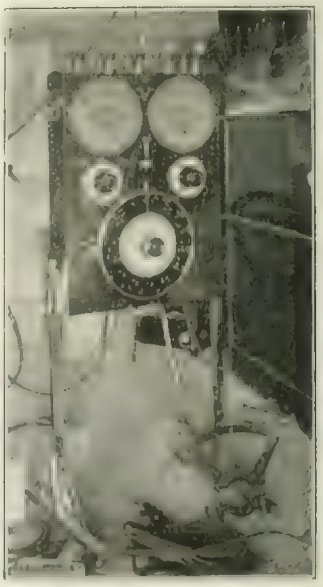
THE BIBBER-WHITE COMPANY, Boston, showed some big things in I-T-E circuit breakers, the largest being one rated at 3000 amperes. The particular pride of this exhibit, however, was agate ware overhead line material, [illegible] The Bibber-White Company [illegible] [illegible] [illegible] [illegible] [illegible] for which it acts [illegible] [illegible] [illegible] [illegible] [illegible] of the Tower City Electric Company, and the switches, etc., of the Hope Electric Appliance Company. The exhibit was looked after by Mr. C. E. Bibber, president of the company; Mr. H. W. Smith, manager of the railway supply department; Mr. E. L. Brown, treasurer, and Mr. D. W. Dunn, manager of the dynamo and motor department. A neat souvenir was a penholder made in a miniature imitation of a new corrugated steel trolley pole, patented by Mr. H. W. Smith. In the basement a convertible open and closed car, built for the Bibber-White Company, was on view.

The Bibber-White Company's Exhibit.

THE SAFETY THIRD-RAIL ELECTRIC COMPANY, Temple Court Building, New York, showed in the basement of the building an operating model on a small scale of its sectional conductor system. A miniature car running on a closed track with switches, crossings, grades, etc., was supplied with current through the automatic cut-out and cut-in switches which are a feature of this system. The inventor, Capt. Murphy, was on hand to explain the operation, and was assisted by Mr. E. V. Baillard, who constructed the apparatus shown. Full-sized switches, with several improvements, were shown in operation on 500-volt circuits, carrying current the equivalent of that of a loaded car.

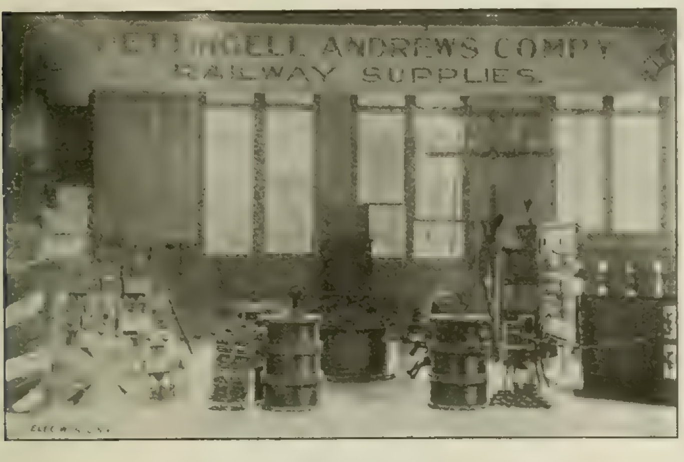
The Safety Third-Rail System.

MR. A. B. HERRICK, 120 Liberty Street, New York, was present in person to explain the merits of his car testing equipment, which was on exhibition. This equipment comprises a Weston round-type ammeter and voltmeter, mounted with a dial circuit-controlling apparatus suitably arranged for making all the tests that may be desired in any street railway service. For ordinary inspectors' tests of car equipment the ammeter serves as a galvanometer in a Wheatstone bridge, giving by means of a zero method direct readings of the resistance of the car equipment in the various positions of the car controller. The voltmeter is arranged to read the insulation of car equipments in megohms direct, and also by means of plugs and the dial switch the resistances and insulation of fields, rheostats, armatures, etc., may be measured. The instruments are arranged with several scales, and the dial switch with constants so that by the multiplication of the latter all measurements are direct reading, and the switch is so arranged that no mistake in connection can be made. The equipment may also be mounted on a car when testing it out for the first time, to test the equalization of current between the motors, and to measure speed and acceleration.



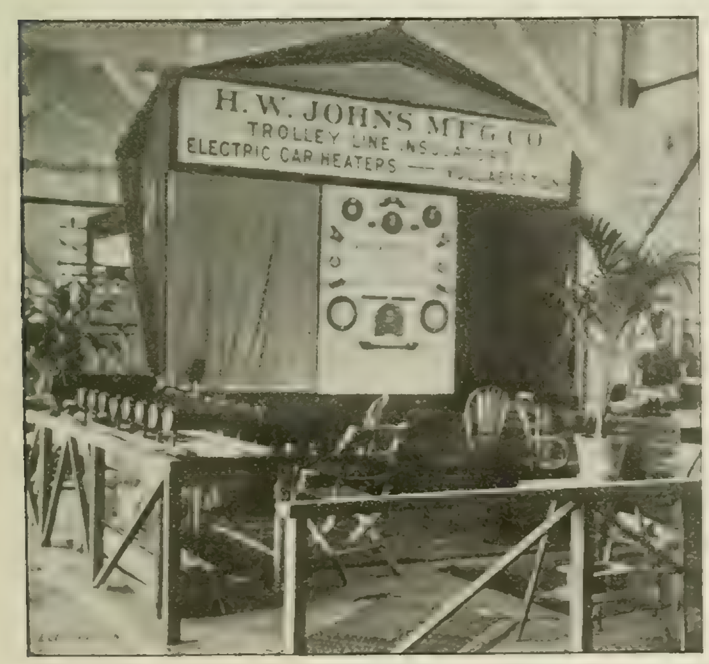
Herrick's Car Testing Equipment.

THE PETTINGELL ANDREWS COMPANY'S exhibit presented neatly and conspicuously the company's various specialties. The entire exhibit was surrounded by a chain of ball strains linked together. Prominent was a handsome marble exhibition switchboard, in the centre of which was a 1000-ampere three-way switch, surrounded by other switches of larger and smaller capacity, and two new single pole quick-make-and-break types, manufactured by the Electric Railway Switch & Supply Company, at Springfield, Mass. In the centre of the exhibit was a large reel of 500,000 c. m. "O. K." feeder wire. In one corner were three large coils of Okonite submarine cable, lead cable and aerial cable. Another corner exposed two handsome sample boards, showing the well-known Garton lightning arresters and the Standard railway signal lamps in operation. The large assortment of overhead material, trolley wheels, construction tools, etc., attracted particular attention, as did also the handsome model of the Kilbourn Sand Feeder, because of its superior features. The exhibit was in charge of President Charles B. Price, Secretary F. S. Price and a staff of salesmen, who distributed to friends and customers a handsome leather cigar receptacle.



THE PETTINGELL ANDREWS COMPANY EXHIBIT.

THE H. W. JOHNS MANUFACTURING COMPANY, of New York, was on hand with its standard system of panel heaters, containing resistance wires woven into an asbestos mat, and also with a new heater for cross-seat cars, containing coils wound on enameled iron rods inclosed in a perforated sheet steel casing. The panel heaters of this company are made with an extremely large surface and heat distribution so that a great volume of moderately heated air is given off instead of a comparatively small volume of highly heated air. The latter is more effective sometimes in making sales to an ignorant customer, but the H. W. Johns Company believes in the better principle regardless of expediency in making sales. The principle is carried so far that the panels are extended the whole length of the car. A full line of vulcabeston and moulded mica insulating parts was also on exhibition, and the company was well represented by Messrs. A. Hall Berry, manager of electrical department, and J. E. and S. G. Meek, of New York; J. W. Perry and D. F. Dickson, of Philadelphia; Mr. E. B. Hatch and H. H. Ruskin, Hartford, and H. C. Spaulding, Boston.



H. W. JOHNS MFG. CO. CAR HEATERS, INSULATORS, ETC.

THE JOHNSON COMPANY, Lorain, Ohio, made an interesting and comprehensive exhibit, as this one company makes rails, special track work, trucks, motors and controllers. In the line of motors two No. 20 machines were shown in operation on a Dupont truck, one fitted with nose suspension and the other with cradle. They are each rated at 30 horse-power, and weigh only 14 pounds, the gear ratio being 5 to 1. The motor details were shown in some No. 28 motors rated at 40 horse-power, which were open for inspection. The shells are of cast steel, with laminated poles bolted in, the armatures wound with straight out-end connections protected both inside and outside by an iron shield put on after the winding is finished, and screwed to the armature spider. A new No. 34 controller was shown with the reverse switch fitted with positions for cutting out either one or the other motor, and also fitted with a magnetic blow-out without iron in the magnetic circuit, the magnetizing coil being one long loop running the whole length of the controlling cylinder. Car rheostats were also shown, as were several samples of rail and track work. The exhibit was in charge of Mr. J. A. Rutherford, Cleveland sales agent; Mr. E. B. Entwistle, chief engineer, Johnstown works, and Mr. R. Clitz.

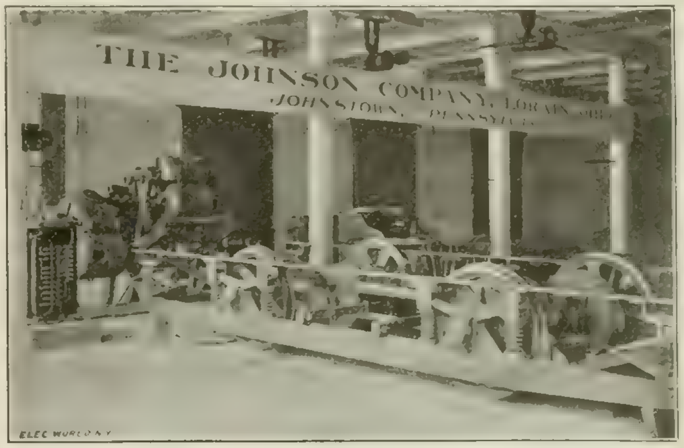
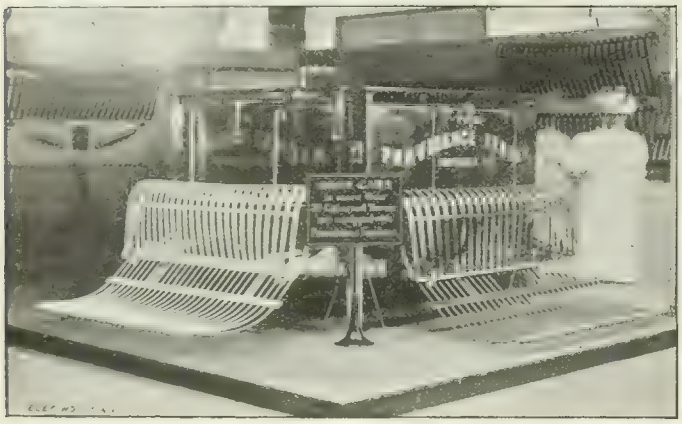


EXHIBIT OF THE JOHNSON COMPANY.

THE CHRISTENSEN ENGINEERING COMPANY, Milwaukee, Wis., was the only exhibitor of air brakes, or in fact of power brakes of any kind. It showed three motor compressors of different sizes, piped and wired up in its own exhibit, besides one which was loaned to E. P. Morris for the manipulation of the latter's whistle. The machines in the Christensen exhibit were connected to 7-inch brake cylinders through straight air engineers' valves, and were equipped with automatic controllers. There was also shown an automatic three-way valve for the direct system with auxiliary pressure tanks. A souvenir especially gotten up for the convention was a most elaborately illustrated pamphlet describing the application of its air braking system on the Milwaukee Electric Railway & Light Company's system, Brooklyn elevated, Metropolitan elevated, South Side Rapid Transit and many other prominent roads.

AIR BRAKE EXHIBIT, CHRISTENSEN ENGINEERING COMPANY.

THE CONSOLIDATED CAR FENDER COMPANY, Providence, R. I., showed a square platform fitted with three fenders mounted on three of its sides, and a view of which is shown in an accompanying illustration. One of these fenders is finished in white enamel, one in black enamel and one all polished brass. These elaborately finished fenders were not made for show purposes only, but are in some use for directors' cars, etc. A complete layout of all the parts of the fenders was shown in the exhibit to illustrate to the practical man the care taken in its construction. Briefly, the fender consists of two parts, the pick-up and the cushion. The former runs close to the track and may be dropped until its rubber rolls run upon the track, by means of a trigger under the motorman's control. It is built up of spring tempered round steel rods. The cushion against which a person standing in front of the car would be thrown is constructed of spring tempered steel strips. The other parts are all high grade malleable iron castings. The total weight of a single fender complete is 136 pounds. Several styles of equipment are made, one contemplating the transfer of the fender proper from one end of the car to the other; another the use of two fenders continuously and the other the use of but one fender at one end, the car always running in the same direction. Col. A. C. Woodworth, general manager of the company, who was in charge of the exhibit, staated that over 6000 cars in this country are now equipped with this fender; 2400 equipments have been ordered by the Metropolitan Street Railway Company, of New York City, alone.



Providence Fenders.

THE LAP JOINT RAILWAY TRACK COMPANY, 11 Broadway, New York, had an exhibit in charge of the designer of the joint, Mr. T. H. Gibbon, formerly assistant engineer of the D. & H. C. Company. By the system being exploited by this company the rail is rolled in two parts, one carrying the head and half the web and one side of the foot; the other interlocking with it and consisting of the other half of the web and the other side of the foot. The joints of the two parts are staggered so that they occur 15 feet apart, giving a more rigid structure at these half joints than if the rail as a whole were discontinuous and joined by tie plates. For street railway work the system is carefully laid out with base plates and tie bars, the whole system being locked together by means of bifurcated wedge-shaped keys which can be driven in and upset, giving no opportunity for loosening by unscrewing of bolts. Girder rails are made up with a box-shaped beam into which a short section of I beam is slipped at the joints. Rails constructed in this way have been in service in Baltimore, New Orleans and Astoria, L. I., for several years with, it is said, no dropping of the joints.

MESSRS. WENDELL & MACDUFFIE, [illegible] Cortlandt Street, New York, distributed a neat catalogue of machinery and supplies dealt in by the firm. The list is a long one, and includes everything in the way of supplies for electric railways and electric lighting, fan motors, tools, engines, boilers, packing, etc., etc. This enterprising firm believes in keeping abreast of the times.

THE CHICAGO RHEOSTAT COMPANY, Chicago, Ill., had a very able [illegible] Mr. F. B. Harding. Catalogues distributed by Mr. Harding briefly outlined the main features of the company's motor rheostats, which de- [illegible] in design. Two types of automatic [illegible] power, and an overload starter of [illegible] the company.

THE AMERICAN ELECTRIC HEATING CORPORATION, Boston, [illegible] of Mr. Charles N. Wood. The [illegible] sizes and forms. They include [illegible] to fasten on front [illegible] All the ticket offices, [illegible] Corporation heaters.

THE RIDGWAY DYNAMO & ENGINE COMPANY, Ridgway, Pa., [illegible]

THE J. G. BRILL COMPANY, Philadelphia, [illegible] for by Mr. John A. Brill, vice-president of the company; Mr. G. M. Hastings, Mr. G. M. Haskell, Mr. W. H. Heulings, Jr., Mr. S. M. Curwen and Mr. W. S. Adams.

THE SHAWMUT FUSE WIRE COMPANY, Boston, had on exhibition no small amount of lead and copper worked into copper terminal fuses suitable for railway work in about all the types, shapes and sizes that a railway man could find use for. A new thing with the Shawmut Company was an inclosed fuse, the inclosure being a fibre tube with asbestos ends, an air space in the centre and a magnesia powder packing to absorb the vaporized lead, the fuse being constructed under the Cartwright patents. The company also showed something new in the way of quick-break switches, a peculiarity of which consists in the use of two blades to each pole bearing on the opposite sides of a single clip instead of two clips bearing on opposite sides of a single blade, as in ordinary switches. The advantage claimed for this arrangement is more radiation on the blades. The switch handle is conveniently arranged below the point of opening so that there is no danger of burning the hands from arcs. The handle when moved first puts tension on a helical spring and then forcibly releases the switch, the spring giving the quick action. The exhibit of the Shawmut Fuse Wire Company was under the direction of Mr. H. P. Moore.

MR. JOHN T. McROY, New York and Chicago, distributed copies of a poem, of which the following is a copy:

BOSTON.

Oh, a queer old town, but a dear old town,
  Is the home of the Bostonese.
So modest and kind one expects to find
  Pantalettes on the limbs of the trees.

There the owls now hoot in a way astute—
  As all well-bred owls should do—
And they plainly say in grammatical way
  "To whom" and not "to who."

Once the Kelley "slide" claimed old Boston's pride—
  John L. can still command it;
But you mustn't insult her Ibsen cult
  By claiming you understand it.

In the paths obscure of freak literature
  Her work is certainly crowning;
Boston's flies wear specks and she now subjects
  All beans to a course of Browning.

The conclusion of which is that a Boston intellect is not required to install the McRoy vitrified clay conduit. Unskilled labor can do it. It is certain that a Boston intellect is not required to appreciate the merits of a McRoy conduit, since there are now being installed 300 carloads of it in New York City for the Metropolitan Street Railway Company.

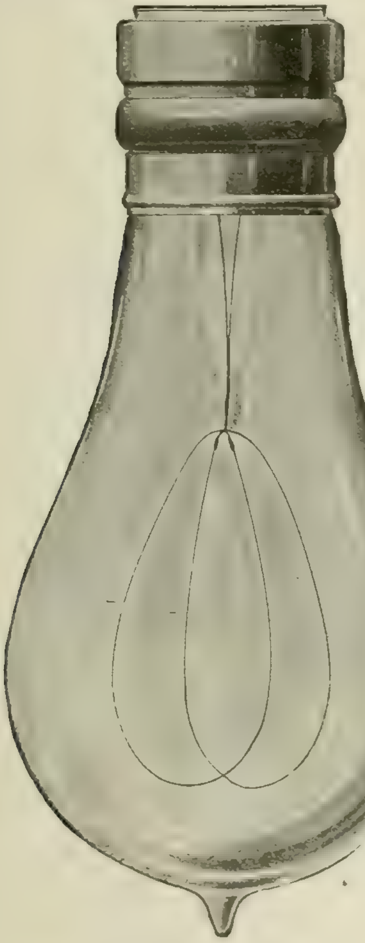
MR. CHARLES N. WOOD, Boston, gathered into his large booth exhibits of the extensive line of railway apparatus and materials for which he has the New England agency. Among these are the products of the American Electric Heating Corporation, Cambridgeport; gears and pinions of the R. D. Nuttall Company, Allegheny, Pa.; commutators and segments of Van Wagoner & Williams Hardware Company, of Cleveland, and many others. A novelty to street railway men in Mr. Wood's exhibit was the Wilson patent trolley catcher, patented by Wilson, Thomson & Co., of Brooklyn, which catches the trolley rope as soon as it gives a quick jerk upward, preventing the trolley whenever it slips off from rising more than [illegible] inches above the trolley wire.

Mr. Charles N. Wood's Exhibit.

THE FALK MANUFACTURING COMPANY, Milwaukee, Wis., was represented by Mr. E. A. Wurster, secretary and treasurer, Mr. Clement C. Smith, chief engineer, and Henry L. Prather, general sales agent, who were loud in their praises of the new compressed air sand blast for cleaning rail ends before joining them by the Falk cast weld process. They claimed that the improved action of this blast rendered the surface so perfectly clean that the weld would never slip and never show any appreciable drop. Several joints were shown which had seen four years' service with no perceptible drop and no sign of creeping, showing that when the conditions are right this joint is a perfect one. With the new sand blast these conditions are said to be always attainable. Railway men with old tracks, dropped joints and corroded bonds were button holed and instructed in the merits of the track renewal process with which the Falk Company can fix up their tracks as good as new. Rails bent down at the ends can be sprung up again, cleaned and cast together across the joints, the surface trued by a grinding car to take out old flats and unevenness, leaving the track as good or better than a new one. A novelty now being introduced to the electric railway market by the same company is the auto-motoneer, which is a device for attachment to a controller whereby the operating lever cannot be advanced more than one notch at a time and a predetermined time must be passed before it can be moved up another notch. This is accomplished by an air piston dashpot and ratchet, and it is intended to prevent waste of current in starting cars. The apparatus is the invention of Mr. G. W. Knox, electrical engineer of the Chicago City Railway Company, and from data worked out by him this machine can save with ordinary motormen making 500 stops a day 28-kw hours in the same time, which at 1½ cents per kilowatt hour amounts to $150 a year per car.

A New Car Lamp.

The Lynn Incandescent Lamp Company, Lynn, Mass., has placed upon the market a car lamp which is claimed to meet every requirement in electric car service and to overcome the many deficiencies of lamps of this class. In many of the lamps now in use the filament is liable to bend over and touch the bulb, resulting in the destruction of the lamp. The form of the filament in the new lamp is such that it will throw the light equally in all directions. Each part of the filament forms a corner of a square. The company claims that it is enabled to make the filament shorter and larger in diameter than those of other make and that by the process of its manufacture it can make the filament of a definite diameter, which insures a uniform consumption of current. This is an important feature in lamps which are placed in series, since there will be continual burn-outs in case one lamp does not carry the same number of amperes as its neighbors.


New Railway Lamp.

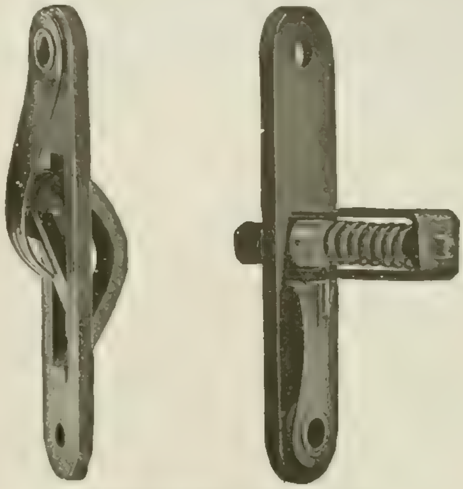
Besides manufacturing this new lamp the company makes a renewed railway lamp, which it sells at about half the price of the new lamp. The lamps are renewed by simply putting a new carbon into the old bulb after the latter has been thoroughly cleaned on the inside. The brass part of the lamp is not disturbed in any way, and the lamp in every respect gives as good satisfaction as a new one, besides being as long lived. The Lynn Company offers very liberal inducements for consumers to test for themselves the value of its renewed lamps, and certainly could do no more to secure for its product a thorough trial in actual use. This company claims to be the pioneer and the largest of the renewal companies.

Improved Burglar Alarm Window and Door Springs.

The devices illustrated herewith, a burglar alarm window spring and a door spring, have just been placed upon the market by Rousseau's Electrical Works, 329 Fourth Avenue, New York City. These springs have been used for a number of years by the inventor, Mr. David Rousseau, in all of his construction work, and on account of the general excellent results obtained by their use there has been quite a demand for them from other contractors.

The Rousseau Company has recently been incorporated, and has purchased all of the patents, tools, plant, etc., belonging to Mr. David Rousseau, and will furnish a full line of his specialties as quickly as it is able to get them in stock.

The springs shown herewith are of a very high grade, being very well finished and made of good heavy brass stock. All the contact springs are made of phosphor-bronze to insure the retention of their springiness, steel and german silver having been found to fail in the course of time. The insulation on the back of the springs is hard rubber and fibre, and that on the face, where the spring is exposed to the weather, is of mica, which, it is claimed, absolutely prevents any short circuiting if the weather beats in through the window frames.


Window and Door Springs.

For the convenience of its customers the company is making arrangements to have all of its products carried in stock by the different leading supply houses.

Improved Trolley Pole.

The Bibber-White Company, Boston, is introducing a new trolley pole, an illustration of which appears herewith. This trolley pole is the invention of Mr. Herbert W. Smith, manager of the street railway department of this company. It is claimed that it is entirely different from all other poles, being made of cold-drawn seamless steel tubing, drawn to a taper and then corrugated, and that by being corrugated it can be made nearly twice as light as the ordinary trolley pole and considerably stronger. It places less tension on the spring of the trolley base, and therefore less pressure on the trolley wire, thus reducing the wear and tear on the trolley wheel and wire. These poles will be made in all sizes.

Corrugated Trolley Pole.

The Largest Direct-Current Dynamo in the World.*

BY PROF. S. H. SHORT

The rapid development of electric power for various purposes has made a demand for larger and larger units in the generating stations where this power is produced. A few years ago generators of 100 to 200 kilowatts capacity were considered enormous machines. There soon appeared, however, direct-driven generators of 750 kilowatts, to be used in large railway plants in such cities as Chicago, Boston, St. Louis and Brooklyn. At the World's Fair, in 1893, the first 1500-kw generator made its appearance in the Intramural Railway station. This machine was then considered a monster. This unit was soon adopted for many of the large street railway stations, notably Chicago and Boston, and finally machines of 1600 kilowatts were placed in the Kent Avenue station in Brooklyn. Still later Louisville, Ky., purchased a 2200-kw generator. The Metropolitan Street Railway Company, of New York,

One Half of the Armature Spider.

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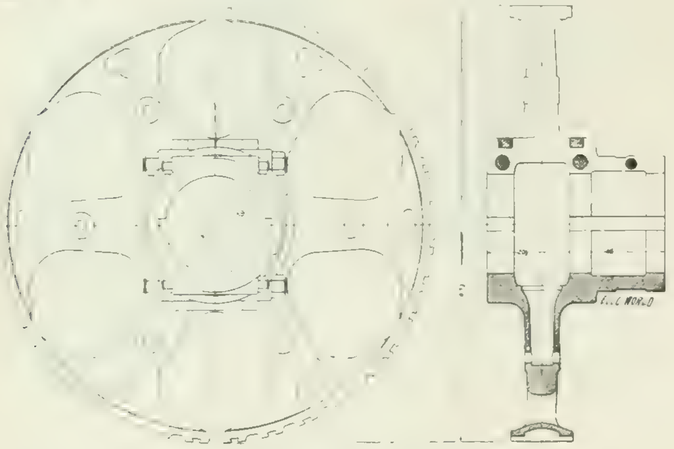
*Reprinted from pamphlet distributed at the Boston Convention of the American Street Railway Association.

has recently placed an order for a number of 2500-kw alternating machines, and but a few months ago the Boston Elevated Railway Company, which succeeded the West End Street Railway Company of that city, gave to the Walker Company, of Cleveland, the order for a 3000-kw machine.

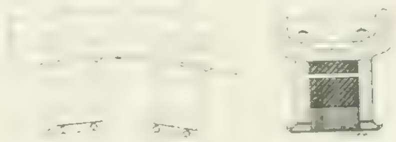
All of these large machines are made to run at the very slow speed of from 75 to 80 r. p. m. It is true that the alternating current machines built for the Cataract Construction Company at Niagara Falls have an output of 5000 horse-power each, while the monster ordered by the Boston Elevated Railway Company has an output of but 4000 horse-power. Nevertheless the 4000-hp machine being built by the Walker Company is much larger than the alternators in use in the Niagara Falls power house, as the speed of the Boston machine is 75 r. p. m., while that of the Niagara machines is somewhere in the neighborhood of 250 r. p. m.



Elevation and Cross Section of Armature Spider.

If the Boston machine were run at the high speed of the Niagara machines its output would be something over three times of the latter, or about 16,000 horse-power.

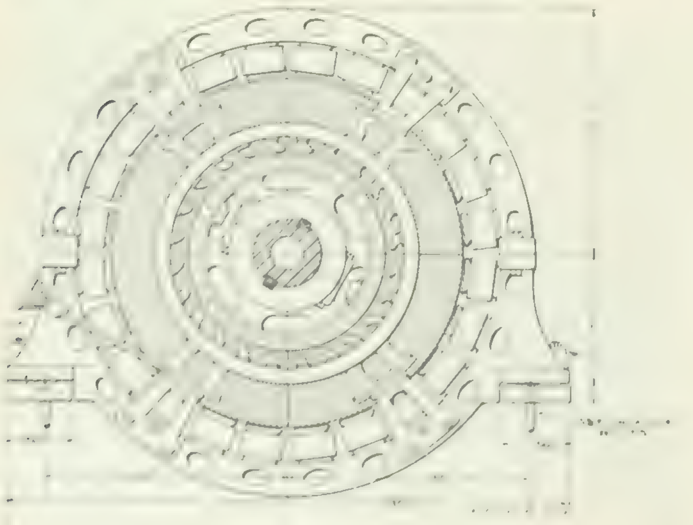
As the construction of this 4000-hp generator marks an era in the development of dynamo-electric machines it may be interesting to electrical engineers and those using electrical apparatus to know its dimensions and general design.



Magnet Cores.

A few illustrations of the Boston generator, together with a short description [illegible] of the various parts, are therefore given.

The total weight of the complete machine is 250,000 pounds. The frame is made of cast steel and is circular in form, the diameter over all being 21 feet 7 inches. The weight of the frame alone, without the field magnet cores for [illegible] the magnetic ring

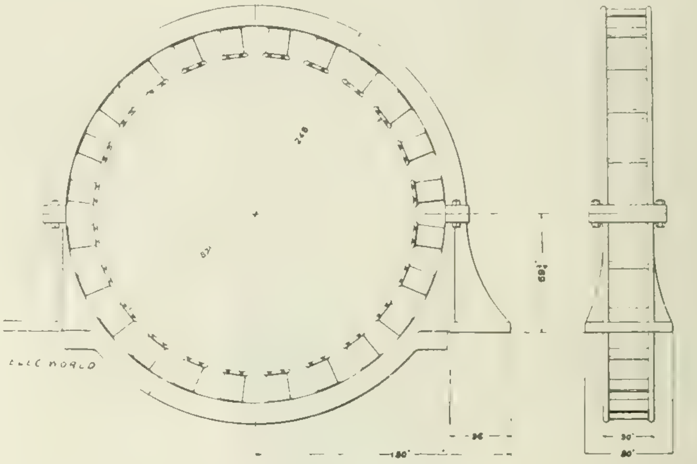


End Elevation of Dynamo.

[illegible]

The magnet frame is divided in halves, on a horizontal plane, and is mounted upon the foundation plates in such a manner that the whole frame may be made to slide lengthwise of the engine shaft far enough to uncover the armature windings, or to allow the individual magnet cores or field spools to be removed without separating the magnet frame.

The armature spider of this machine is an interesting part of its construction. It is made in halves, like the hub of a fly wheel, to be bolted together upon the shaft of the engine after it reaches its destination. If it had been made in one piece no railway car could be found large enough to ship it from Cleveland to Boston. The armature hub weighs 40,000 pounds, or 20 tons, and has an outside diameter before the laminations are in place of 13 feet. After the engine is upon its foundations in Boston this armature spider will be mounted



Cast Steel Field Frame.

upon the engine shaft, which is itself 37 inches in diameter. The laminations which form the armature core, the total weight of which is 30,000 pounds, or 15 tons, will then be built upon the periphery of the armature spider.

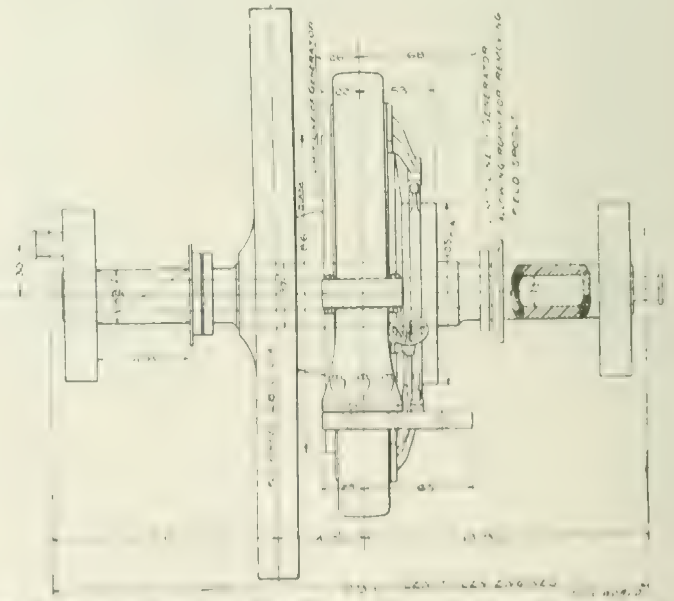
The slotting in the armature laminations will register accurately and provided, when completed, 594 slots. The insulation and windings will then be fitted into the slots and connected with commutator.

The commutator itself is made up of 1188 bars, and is 105 inches in diameter. It is divided into halves for the purpose of shipment and ease of handling, and will be placed upon an extension of the armature hub after the latter is secured to the engine shaft.

The great fly wheel of the engine will be bolted directly to the armature hub near its periphery, in order that the regulating force of the wheel shall not be transmitted wholly through the shaft of the engine. This will relieve the armature shaft and its keys from the enormous strain to which they would otherwise be subjected.

The machine has been most carefully designed, and an unusually large factor of safety provided for every part subjected to mechanical or electrical strain. Because of this the machine will be able to take twice its normal load for short periods of time without injury, and to carry a 50 per cent. overload for several hours.

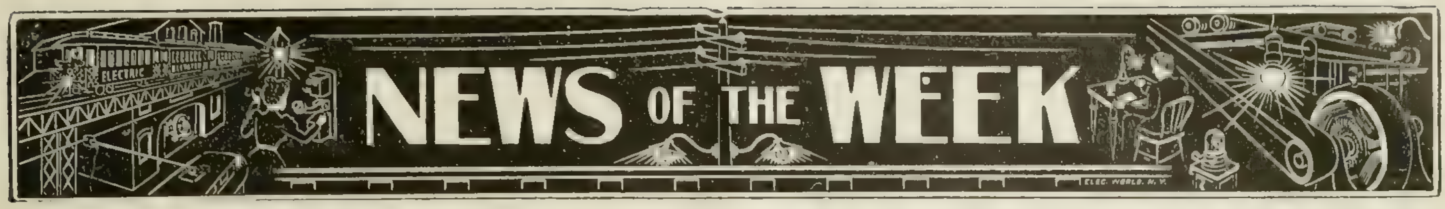
The greatest care has been taken to secure from the generator a higher percentage of efficiency than has thus far been attained in units of large size.



Side Elevation, Showing Fly Wheel, Journals and Crank Discs.

There seems to be no limit to the capacity to which these large generators may be carried. The development that has taken place thus far is an interesting study [illegible] when we are compelled to provide means for transmission of power for those large schemes of propulsion which are awaiting the application of electricity in place of steam.

What will be the limit to the size of machines required when our main line steam railways are operated by electricity?



NEWS OF THE WEEK

Financial Intelligence.

THE BALTIMORE TRUST & GUARANTEE COMPANY is offering $850,000 first mortgage 5 per cent. sinking fund gold bonds of the Knoxville Traction Company, of Knoxville, Tenn. They are coupon bonds of $1000 each, with privilege of registration, and are secured by first mortgage upon all the lines of the Knoxville Traction Company, and are additionally secured by the stock of the Knoxville Electric Light & Power Company and by valuable real estate, power houses, car barns, shops, etc. The bonds are dated April 1, 1898, and mature April 1, 1928.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
9 Murray St., NEW YORK, September 12, 1898.

ELECTRIC TRACTION ON THIRD AVENUE.—It is stated that the plans and specifications for the installation of the underground electric conduit system on the Third Avenue Railway have been decided on, and that the contracts for the work have been drawn. The names of the contractors, however cannot be learned. It is further stated that the electric system will be in operation sixty days after the work of changing over has been commenced. It is the company's purpose to similarly equip the Forty-second Street road, and it expects to have electric cars running on this line before the winter sets in. The 125th Street line will also be changed to the underground conduit system. The Dry Dock line will be changed over in the spring. It is stated that the improvements will entail an expenditure of from $12,000,000 to $15,000,000.

STREET RAILWAY CONVENTION.—During the present week—on Tuesday and Wednesday—the Street Railway Association of the State of New York will meet at Manhattan Beach for the twofold purpose of discussing matters of interest to themselves and the public and inhaling ocean breezes. The first-named object, however, is the primary cause of their invasion of one of New York's most popular seashore resorts. The meeting is the sixteenth of the association, and the executive committee acted wisely in changing the place of meeting from Brooklyn to the seaside. Some excellent papers are down on the programme, and under the stimulating influence of the pure sea air the meetings should be interesting. Among the subjects of papers promised are the following: "Points on the Care of Dynamos," "Low Joints, How to Prevent Them," "The Power Station from an Economic Standpoint," "Track Bonding," "The Most Approved Plan of Long Distance Power Transmission" and "The Effect upon Street Railroads of the Application of Electricity to Steam Roads." "How Can We Increase Our Receipts?" is the suggestive title of another paper. If the author's solution of the problem is capable of universal application his name should be engraved in deep and enduring letters on a solid block of bronze or some other indestructible substance, so that his fame shall be handed down to the millions yet unborn, most of whom will be confronted with the same question at some time of their lives. The association has a live and enterprising president in Mr. G. Tracy Rodgers. This gentleman presides over the destinies of the Binghamton Street Railroad, and he is doing more for the good of Binghamton than any other single factor in its development. He is giving the citizens the best service obtainable from an electric railway, and nothing conduces more to the welfare of an intelligent community than first-class street railway facilities. The Binghamtonians are fortunate in this respect.

HORSE CARS ON BROADWAY.—New Yorkers were treated to a real surprise on Monday morning last, and no doubt many of them rubbed their eyes wondering whether they had been asleep for several years and had just awoke after dreaming that horse cars had been removed from Broadway. The occasion of this exhibition of astonishment was the reappearance of real horse cars, drawn by real horses, trudging up and down the busy thoroughfare, and the cause of this novel spectacle was a peculiar accident at the power station at Broadway and Houston Street. Broadway merchants wondered if the substitution of horse cars for the cable was in the line of progress, and could not understand why the antiquated method of street travel should be so suddenly revived in this enlightened city. Their fears were allayed, however, after a half-day's experience with the new (?) mode of travel, for then the horses and horse cars, for the second time in their careers, were consigned to "innocuous desuetude." As to the accident: It seems that the inner lining of the power house chimney crumbled and fell away from the wall, blocking the outlets of the gases from the fires under the boilers. When Chief Engineer E. A. Pierson looked over the ground he thought that it would be best to take this opportunity to make a general overhauling of the cable plant. Therefore it was decided to suspend operations on the cable system until repairs could be effected to the chimney; meanwhile the engines, etc., were to be overhauled. The plant has been in steady operation for eight years. The machinery was started up again at 1 o'clock in the afternoon, and the cable service on Broadway resumed. The accident to the chimney occurred at 2 o'clock in the morning, and between that time and 1 o'clock in the afternoon all the available horse cars on the company's system were brought into requisition on the Broadway line, and it was during this time that New Yorkers were treated to this glimpse of the past. A great big sigh of relief was given when the cable cars made their reappearance, and a bigger one will be given when electric cars displace the cable cars.

COMMENCEMENT OF WORK ON THE BROADWAY UNDERGROUND CONDUIT SYSTEM.—The Metropolitan Traction Company gave New Yorkers two surprises during the past week. One was a sort of a farewell appearance of horse cars on Broadway and the other was the sudden decision to begin at once the work of installing the underground conduit system on that street. This decision was immediately followed by active work, and at 7 o'clock on Friday morning, September 9, workmen began tearing up the pavement adjacent to the outside rails of the uptown track opposite the Bowling Green Building at the lower end of Broadway. After a narrow strip of pavement had been removed trenches were dug to a certain depth to ascertain what underground obstructions there were to be dealt with. President Vreeland states that the work will be carried on a block or two at a time until the overcrowded portion of the street is reached. It will then be prosecuted at night, when traffic is light and the street is comparatively free of vehicles. The work of installing the improved system of propulsion on the Broadway line will be peculiarly difficult for the reason that the street car service cannot be suspended there as it was on Fourth Avenue, Eighth Avenue, Sixth Avenue and on other streets when similar improvements were made along those thoroughfares. The normal street car traffic on Broadway is extremely heavy, and to interfere with it would be a very serious matter, not only to the public, but to the company as well. The company, however, has never lost sight of the duty it owes to the public, and has always laid its reconstruction plans so as to give the public as little inconvenience as possible. It is stated that the necessary consents of property owners and State and local authorities have been obtained to carry on the work on the Broadway line. It had been the intention of the Metropolitan Company to defer this work until next spring, but the public appreciation of the new electric system, and the fact that the similar work on the Sixth and Eighth Avenues lines has been pushed ahead with so much vigor, induced President Vreeland to have the Broadway work begun at once.

NEW ENGLAND NOTES.

Branch Office of THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., September 10, 1898.

THE SUBWAY.—The third and last section of the subway was opened to the public at 5:45 A. M., September 3, when the first car ran underground through the heart of the city. The actual length of the subway is 1 2-3 miles, with a trackage of about 5 miles. There are three junctions by which the surface cars can enter and leave. The cost of the subway, approximately, to date, including material, work, real estate, etc., is $5,786,000. The work of the Rapid Transit Commission has been pushed with considerable vigor, and as a result they have completed the gigantic undertaking more than ten months under the time limit. The ground was first broken by Governor Greenhalge on March 28, 1894.

THE TWENTIETH ANNUAL clambake of the American Electrical Works, Providence, R. I., held Saturday, September 10, at the Pomham Club, is past, and its memories, like those of all other of these annuals, will be indelibly impressed on the minds and in the hearts of over 300 members of the electrical fraternity present. Following as it did the Boston convention of the American Street Railway Association, there were present, of course, large numbers of street railway officials. In attendance it exceeded all other bakes. It was a regular Phillips day, so far as the weather was concerned, and mine host Phillips was never in better humor or spirits. The genial Eugene, his sons Frank N. and E. Rowland, and his affable lieutenants, Sawyer, Remington, Ackerman, Donohoe, Carroll, Waggenseil and others, welcomed the early contingent at the Narragansett Hotel, from which they were conveyed by electrics to the club. The usual sports were indulged in by both old and young, these including shooting, bowling, baseball and football, others contenting themselves by admiring the magnificent club grounds and views of the Providence River. The dinner passed more than pleasantly, and the souvenirs this year were a pretty and unique pipe, case and pouch of tobacco. Dinner concluded, Mr. Phillips rapped to order, and made the neatest speech of his life, likening the twentieth annual to the stock farm, and humorously introducing as thoroughbreds Mr. E. B. Baker, of the Southern New England Telephone Company; A. L. Suesman, an old telegrapher, and W. H. Sawyer, all of whom have attended the full twenty bakes; as high steppers his sons Frank N. and E. Rowland, and as working horses Messrs. Sawyer, Remington, Ackerman, Donohoe, Carroll, Watson, Waggenseil and others of his business and factory staff, finally announcing as toastmaster Major R. S. Brown, of the Boston office of the Westinghouse Electric & Manufacturing Company, who proved to be the right man in the right place. Responses to toasts were made as follows: By Mr. C. L. Van Shyck for "Providence," Mr. T. C. Pennington for the "American Street Railway Association," Mr. Stephen H. Goddard for the "Electrical Press." Capt. William Brophy in general remarks divided honors with Toastmaster Brown. Master Mechanic Baker, of the Boston elevated road, said a few pleasing words, and Gen. C. H. Barney read a humorous poem replete with wit entitled "Finnigan's Repoort." An orchestra rendered excellent selections during the dinner. The bake was a great success, and every branch of the electrical business was represented.

BUFFALO AND NIAGARA FALLS NOTES.

BUFFALO, N. Y., September 10, 1898.

THE NIAGARA POWER COMPANY will build a station at once on the Buffalo cable line at North Tonawanda, the contract having been let for about $10,000. From this centre all power will be distributed through Tonawanda and sent to Lockport.

THE BUFFALO STREET RAILWAY COMPANY is so well pleased with the new storage batteries, built to bridge over any sudden strain on the power, as well as to take care of the 6 p. m. peak, that it is preparing to increase the capacity of the plant from 1200 to 2000 horse-power. The batteries, working automatically as they do, add much to the life of electrical apparatus.

THE NEW YORK CENTRAL RAILROAD has met the trolley rates from Buffalo to Niagara Falls and Lockport, and a great increase of steam travel has resulted. This means travel for about a cent a mile. It is believed that the move presages the adoption of the trolley on the line, as has been done on the Erie road from Tonawanda to Lockport, at least so far as substituting electric for steam locomotives is concerned. Were the trolley lines strong enough a war of rates would probably result.

MR. EDWARD BOILLEAU, the electrical consulting engineer who came here a short time ago from Milan to examine our recent electrical improvements and installations, has returned home. He does not hesitate to say that we are in advance of Europe in the use of electricity. Most of his time was spent in looking over our trolley systems. Like all European engineers he was astonished at the extent of our use of passenger elevators or "hoists" in buildings. Europe has nothing to compare with it.

THE SMITH LINES, Buffalo to Tonawanda inland, inside Tonawanda, and Buffalo to Tonawanda, via the Niagara, and with extension to Niagara Falls in prospect, have been reorganized with State Comptroller James A. Roberts as president. Many large capitalists have been added to the board of directors. The latest move made by the combination is to cover the resorts on Grand Island with a trolley line, reaching the island by a car ferry till the new bridge is finished. This will insure possession of the island in advance of the bridge.

THE FOURTH electric generator in the Niagara power house stands ready to do duty at a moment's notice, and is operated whenever the load runs high. The Westinghouse authorities state that the average load carried at the tunnel is now 16,000 horse-power. Of this the amount coming to Buffalo and under contract to be brought here as soon as possible is 4600 horse-power. There is a report that new contracts are to be closed very soon. With the tunnel load running up to 17,000 horse-power occasionally it will be necessary to get the fifth 5000-hp machine ready before long to avoid accidents.

THE VISIT, this week, of Secretary W. B. Rankine, of the several Niagara tunnel companies, to Toronto reveals more completely than ever the bluff that certain Canadians were putting up last year against the companies. Mr. Rankine is secretary of the Canadian company also, which has two 500-hp generators in the power house of the Victoria Park & River Railway Company, put in mainly to stop the clamor and threats of agitators to set up a competing plant or annul the Canadian grant to the company. Mr. Rankine states that only a trifle over half of the small amount of power available has been taken. The local lighting plant takes 250 horse-power, the Canadian branch of the Carborundum works 200, and the Carmelite Monastery seventy. So the company is looking to Toronto for an outlet. This city is about 85 miles from the tunnel by land or 50 miles across Lake Ontario.

TROLLEY LINE EXTENSIONS appear to have become epidemic in this vicinity. The latest move is in the interest of a general consolidation of all lines in Niagara County; that is, all of the lines run by power from the Falls. This would form a large system, and if carried through will require a considerable time to perfect arrangements. It is said that President Ely, of the Buffalo & Niagara Falls and the Buffalo & Lockport roads, favors the scheme, and that the Canadian line at the Falls will enter such an alliance, which is probably about all that can be accomplished at present. One obstacle is the State reservation at Niagara Falls. It is an inflexible law of the commissioners not to allow a trolley line to cross the grounds. This separates the Canadian road from the lines on this side of the new bridge by a few rods. It is given out [illegible] the bridge from Lewiston to Queenston is [illegible] the Canadian and the Gorge roads, [illegible]

MILWAUKEE NOTES.

MILWAUKEE, WIS., September 8, 1898.

[illegible]

[illegible]

[illegible]

ST. LOUIS NOTES.

ST. LOUIS, MO., September 8, 1898.

[illegible]

[illegible]

ST. LOUIS TELEGRAPHERS have formed an association known as the St. Louis Telegraphers' Aid Society. The officers are: President, A. E. Van Tyne; vice-president, M. A. Hawley; secretary, W. J. Armstrong; treasurer, R. H. Bohle; executive committee, J. M. Maddox, W. H. Spencer, Charles McNeill, M. Tully, J. B. Magill; auditing board, J. A. Weaver, H. C. Crain, C. W. Groos.

DEFECTIVE FRANCHISE.—The Suburban road, which was granted a franchise to build an extension north on Sarah Street and the St. Louis & Meramec River road, finds that it will require a franchise along a small part of Euston Avenue. The Suburban tried to secure a permit from the Board of Public Improvement, but that body denied it on the ground that the Assembly alone could remedy the defect.

TELEPHONE REMOVAL.—The operating office of the American Telephone & Telegraph Company, better known as the Long-Distance Telephone Company, has been removed to Madison, Ill. Trouble with the underground system of cables in the city is assigned as the reason for the move. A first step was taken last week, when the local offices at 410 Olive Street were vacated and moved into temporary quarters on Ferry Street, at the west end of the Merchants' Bridge.

THE LINDELL RAILWAY COMPANY has completed its arrangements for the wholesale extension of its lines into St. Louis County. Four different extensions are to be built, that will connect at various places and make one immense electric system. The first will be to lay tracks from a point on the Forest Park Highlands line to a junction with the Forest Park & Clayton line. Another will start from the same point, south to Shady Side, near Webster. Two branches will also be built to Creve Cœur Lake.

ELECTRIC ROAD TO JEFFERSON COUNTY.—Within the next few days the St. Louis, Fenton & Southwestern Railroad Company, with a capital stock of $1,000,000, will be incorporated. Thomas F. Sneed, general superintendent of the Suburban Railroad, will be president of the new company. The company will build 44 miles of electric road, to run from the city limits, southwest to Ware, a point four miles south of Morse's Mills,, in Jefferson County. It will parallel the Iron Mountain Railroad the entire distance. Work will begin some time this month. The third-rail system will be used. The line will do both a passenger and freight business.

THE WESTERN ELECTRIC COMPANY, of Chicago, filed suit in the United States Circuit Court Tuesday for an injunction against the Kinloch Telephone Company, enjoining it from using and making a certain multiple switchboard for telephone exchanges. The plaintiff states that Leroy B. Firman, patentee, sold to it the exclusive right to the invention on January 7, 1881, and that it has been manufacturing the switchboard. It claims that the courts authorized a decree of perpetual injunction on March 29, 1898, in the case of the Western Electric Company, against the Capital Telephone & Telegraph Company, of Sacramento, Cal., the latter company being charged with infringement.

PACIFIC COAST NOTES.

SAN FRANCISCO, CAL., September 4, 1898.

A FRANCHISE was recently applied for in Oakland, Cal., which may be taken as meaning that the Southern Pacific Railroad Company is about to change its cable roads on Telegraph Avenue and on San Pablo Avenue to electric car lines. Permission was asked to operate electric street cars on the above thoroughfares.

THE SUPREME COURT recently affirmed the judgment of the lower court in denying a petition of the People's Mutual Telephone Company, of San Francisco, for a writ of review against the Board of Supervisors. The company objected to the board's action in exacting from bidders for the telephone franchise that they should have at least 2000 bona fide subscribers on their books.

THE SUNSET TELEPHONE & TELEGRAPH COMPANY recently completed its northern extension from Spokane, Wash., and will continue construction northward. The Spokane & British Columbia, which was the first company to introduce telephones in that part of the State, contemplates meeting this action by installing an exchange in Spokane and constructing long-distance lines. It is said that the Sunset Company uses annually 175,000 cells of battery.

THE VITAX BATTERY COMPANY, of San Francisco, has been incorporated by Herbert P. Thayer, Edward H. Baxter, Andrew White and Scott Calhoun. The capital stock is placed at $10,000. The factory has been located, with a capacity of 600 cells a day, at the San Francisco Electrical Company's place, at 31 Second Street, but a much larger factory on Mission Street will soon be in operation. The company has on the market a good line of dry batteries of various forms, and as the freight from the East is 6 cents per cell its prospects are good.

THE CITY OF HEALDSBURG, Sonoma County, Cal., has awarded contract for the construction of an electric light and pumping plant to the California Bridge Company. The figures as reported are $31,633 for the electric system and $[illegible] for the water works system. It is understood that Stanley electrical apparatus will be installed for the single transmission at 10,000 volts. The three-phased generator will have a capacity of 120 kilowatts. There will be a [illegible]-hp induction motor, which will drive a triplex pump. City bonds are expected to supply the money required.

THE ELECTRIC LIGHTING AND POWER SYSTEM of the Commercial Light & Power Company, San Francisco, has been quietly transferred to the San Francisco Gas & Electric Company. The former company was organized [illegible] years ago and supplied about [illegible] miles of shaft service from its steam plant on Commercial Street for printing offices, sidewalk elevators, etc. During the past two years electric service has been given, a Stanley two-phase plant being in use. The circuits have been extended of late, resulting in a profitable sale to the larger company. The San Francisco Gas & Electric Company is still [illegible] the electric plant, but will shut down the shaft power system and supply the patrons of the old company with electric motors and current from its own plant. Consumers will be required to buy the motors.

THE BRITISH COLUMBIA ELECTRIC RAILWAY COMPANY'S [illegible]-mile electric transmission, at 10,000 volts, recently went into operation. The generating station is located on Goldstream, where there is an effective head of 640 feet of water. Two 360-kw Canadian General Electric generators are driven by two Pelton wheels, which are directly connected. The load supplied for the use of the tramway company is about 300 horse-power, leaving a surplus for lighting and other purposes. The Esquimault Water Company constructed the pipe line. The electrical construction was from plans prepared by Hasson & Hunt, of San Francisco. The construction work was begun and nearly completed by Mr. Wynn Meredith, of the above firm, and the plant was completed and tested under the personal supervision of Mr. W. F. C. Hasson.

CANADIAN NOTES.

OTTAWA, Ont., September 10, 1898.

MR. L. V. EMERSON, of Baltimore, who has been here for some time making preparations to give a test to his machine for converting sawdust into carbon, from which to manufacture calcium carbide, made a first test last week. The results are said to have exceeded even Mr. Emerson's sanguine expectations, and have proved an unqualified success.

MR. GEORGE JOHNSON, the Dominion statistician, has been looking into the railway statistics of Canada. He has reported that for the year ending December 31, 1897, there were thirty-five electric railways in the different cities of the Dominion, having a total of 583 miles of track. They ran about 26,500,000 car-miles, and carried fully 84,000,000 people during the year. For the year previous the figures were ten millions less, while the steam railways carried only 16,000,000.

THE TWENTIETH CENTURY MOVEMENT has reached Toronto, Ont., in the form of a coach delivery wagon, to be used by the Robert Simpson Company, of that city. The propelling power of this vehicle consists of two 2-hp motors, one geared directly to either hind wheel, which admits of the wagon turning corners, turning around, and performing such functions without causing friction loss by one wheel revolving faster than the other. The current is obtained from storage batteries with sufficient capacity to run the vehicle from 20 to 35 miles, according to weather and roads. The batteries are arranged in four groups, and are so arranged as to allow them to be charged directly from any electric light wire. The peculiar form of gearing on the wagon is made of composite metals and rawhide, rendering the running of the vehicle positively noiseless. This is the first electric delivery wagon in the Dominion of Canada.

MONTREAL, Que., September 10, 1898.

AN EFFORT is being made to organize a new telephone company in London, Ont. A number of local capitalists are interested.

THE METROPOLITAN STREET RAILWAY COMPANY, Toronto, Ont., is reported to be considering the extension of its road to Schomberg.

THE CENTRAL ELECTRIC LIGHT COMPANY, Portage La Prairie, Man., contemplates putting in a telephone exchange in opposition to the present company.

THE DIRECTORS of the Brantford Electric Light Company have instructed their manager, Mr. Wyse, to proceed at once to purchase the necessary plant for the extension of the works.

THE BRANTFORD ELECTRIC & OPERATING COMPANY, Brantford, Ont., will expend the sum of $10,000 in putting in a new plant, having received the contract for street lighting for ten years.

THE CITY ELECTRICIAN of Halifax, N. S., has submitted a report to the Council, showing the probable cost of lighting the city by a municipal plant. The question of installing the same will be considered at an early date.

A LOCAL COMPANY in Winnipeg announces its intention to utilize a part of the water power of the Winnipeg River. The project includes the building of an electric railway from the mouth of the Whitemouth River to points on the Winnipeg River.

THE ELECTRIC LIGHT and Water Works Committee at Barrie, Ont., have reported to the Town Council in favor of installing a municipal electric plant, and recommending that a vote of the ratepayers be taken on a by-law to provide $35,000 for the purpose.

IT IS BELIEVED that the deal for the purchase of the Niagara Central Railway by an American syndicate will be concluded. Messrs. Loss, of Buffalo, and Gibbs, of New York, representatives of the syndicate, were recently in St. Catharines looking over the ground with a view to converting the road into an electric system and extending it to Port Dalhousie and Beamsville.

FRENCH NOTES.

(From Our Own Correspondent

PARIS, August 15, 1898

ELECTRIC LIGHT FOR THE FRENCH ACADEMY.—At last the academy is to be lighted by electricity. For some days the Mazarin Palace has been turned upside down by gangs of workmen, who are removing the gas fixtures from the rooms and corridors. Before long every vestige of the antiquated method of lighting will have disappeared.

AN ELECTRIC RAILWAY FOR THE GREAT ST. BERNARD MOUNTAIN IN SWITZERLAND.—Travelers are soon to be carried to the top of the Great St. Bernard by electric power. It has been estimated that 150,000 persons will travel from Aosta, in Italy, to Marigny, in Switzerland, over this route. When the road reaches the high altitudes, sheds and protective walls will be built to prevent land slides and other accidents. Power will be taken from the numerous mountain streams of the Great St. Bernard. The enterprise is backed by English capital.

ELECTRICAL TRACTION AT THE ORLEANS DEPOT (PARIS).—The Orleans Company has submitted to the Minister of Public Works the plans which it has made for the railway service from the Austerlitz bridge to the Quai d'Orsay. Electrical traction will be used, and the change of engines, which will require two minutes, will take place at the Austerlitz station. The steam locomotive will give place to an electric locomotive of 700 horse-power and weighing 45 tons. These machines ride on eight wheels, driven by four 125-kw motors. One locomotive will drag a train weighing 250 tons at a speed of about 30 miles per hour. The current is to be supplied through a third rail. The power station at Ivry will have two sets of 1000-kw machines, supplying three-phase currents at 5500 volts. The currents will be transformed to direct current at 550 volts at two sub-stations, from which it will be delivered to the line. A special 450-volt circuit will be used for lighting purposes.

THE SMOKE NUISANCE IN PARIS.—The official "Municipal Bulletin" has published an ordinance emanating from M. Blanc, chief of police, requiring proprietors of factories in Paris to make such changes within the next six months in the arrangement of their chimneys as are necessary to prevent the escape into the air of the heavy black smoke which contributes so much to the production of what is so justly complained of under the name of "Paris smells." The ordinance reads as follows: "Article 1. This ordinance, to take effect six months from date of publication, hereby prohibits the production of heavy, black and continuous smoke, capable of reaching neighboring houses or of polluting the atmosphere of the streets of Paris. Article 2. Infractions of this ordinance will be duly reported and brought before the proper court. Article 3. The chief inspector of machinery and power plants of registered establishments, and his assistants, the mining engineers detailed to inspect steam plants, and their assistants, are held responsible for the enforcing of this ordinance, which will be published and posted." The continual increase in the number of furnaces using large amounts of coal has made this measure unavoidable. The committee on hygiene, the committee on odors and the Municipal Council have each notified the chief of police that the great quantity of smoke is polluting the atmosphere and blackening and corroding the exterior of the houses in the factory districts. M. Blanc alludes to this in the preamble to his ordinance, and he also calls attention to the methods whereby factory owners and managers may minimize or even completely suppress the nuisance in question; these are by giving greater height to chimneys, by exercising care in the choice of proper fuels, and the use of smoke-consuming apparatus.

MARSEILLES TRANSMISSION OF POWER PROJECT.—The purpose of the Costa enterprise, which has been engrossing the attention of the Marseilles Municipal Council, is to develop on the Durance a water power of 20,000 horse-power to be transmitted by electricity to the city. A canal along the left bank of the river, between the Mirabeau and the Pertuis bridges, will deliver water to the wheels. Four dams will be built, with a generating station at each. The power will be transmitted electrically to three receiving stations at Saint-Louis Malpasse and Pont-de-Viviaux in Marseilles. The voltage at the receiving stations will be 3000 volts. The receiving stations will be connected with the trunk line of the system by feeders. The latter, as well as the former, will be underground. Branch conduits will connect the lines with the customers. The service taps will be made through transformers, and the pressure reduced to 110 volts for interior use. Motors will be connected in parallel on the branch circuits. The total power distributed will come to 12,500 horse-power, reckoned at the pulleys of the consumer's motors. The Municipal Council when granting M. Costa permission to lay conduits in the streets made him amenable to the conditions and details of the Public Works bill, passed in 1895, which covers in a general way all permits for laying conduits in the public streets for electrical distribution. It follows, therefore, that M. Costa's franchise cannot in any way become a monopoly, and that under it he cannot engage in a lighting business, either directly or indirectly. The concession is for thirty years. Current for power will be sold either by meter or for a contract price, according to the wishes of the customer. The company is obliged to furnish power to any person requesting it who is within a radius of 600 feet of the company's mains. It is also obliged to furnish all persons who are willing to contract for an amount of power to cost double the expense incurred by the company in connecting them. It is estimated that in round numbers 20,000,000 francs will be the cost of the entire installation. The project will be submitted to the Minister of Public Works.

General News.

THE TELEGRAPH AND TELEPHONE.

EDINBURG, IND.—The Citizens' Telephone Company has been organized with a capital of $1500. The incorporators are August W. Winterburg, N. Mowney and W. H. Bowman.

NACOGDOCHES, TEX.—This city is soon to have direct telephone connection with Shreveport, which is about 100 miles northwest. The line is being rapidly constructed from here, and has passed the towns of Appleby, Garrison, Timpson and Teneha, going next to Logansport.

HENDERSON, KY.—Articles of incorporation for the Henderson Telephone & Telegraph Company have been filed. It is capitalized at $15,000. The officers are Aaron Waller, president; O. W. Rash, vice-president; O. P. Dyer, secretary and treasurer. A new exchange is to be built in this city immediately, which will give Henderson two systems of telephone.

SIOUX CITY, IA.—The Iowa Telephone Company has begun improvements on its Sioux City plant, which will not be finished until about January 1, next year. The cost will be over $50,000, and will amount almost to a rebuilding of the exchange. Manager Clark says the Sioux City plant and Minneapolis plant will be twins and the finest west of Chicago.

BOSTON, MASS.—It is reported that the Bell Telephone Company has recently advised its licensees that it will hereafter waive the commission that these licensees have been paying the parent company on long distance telephone and telegraph business. This concession, it is stated, will be equivalent to $30,000 annually to the New England Telephone & Telegraph Company, and $50,000 to the Erie Company.

OTTUMWA, ILL.—Articles of incorporation were filed for the Ottumwa Long Distance Telephone Company, of this city, with Jay C. Goddard, A. H. Cowdery and P. E. Wilcox, all of this city, and who are also interested in the Ottumwa Telephone Company, as incorporators. The capital stock of the new corporation is placed at $60,000. The following named gentlemen are the officers: President, Jay C. Goddard; vice-president, P. E. Wilcox; secretary and treasurer, A. H. [illegible].

ROCHELLE, ILL.—The Lee County Telephone Company has just completed its system by putting in a line from Steward to Lee and from Lee to Paw Paw, which furnishes a complete circuit of the county. It is said that this county has the most complete system of any county in the country outside of large cities—having no less than fourteen exchanges, viz.: Dixon, Eldena, Amboy, Harmon, Shaw, Sublette, West Brooklyn, Lee Centre, Compton, Paw Paw, Lee, Steward, Ashton and Franklin Grove; also toll stations at Grand Detour, Nachusa, Walton, Gap Grove, Prairieville and Flagg; also on the lines between exchanges, making a total of nearly 450 telephones in the county.

BOSTON, MASS.—The Boston News Bureau says that the independent telephone companies in Minnesota have during the past three years constructed a system of long distance lines connecting points not reached by the Northwestern telephone system operating in that State. Notwithstanding the fact that the Northwestern system owned and operated 7000 miles of wire the independents had built to nearly 300 points not reached by the Northwestern, using fully 2200 miles of wire. The Northwestern Company has closed a contract whereby it secures by purchase 900 miles of this line and enters into an operating arrangement with the balance, all of which are to be equipped with Bell instruments, and the lines and stations become a part of the extensive Northwestern system controlled by the Erie Telephone Company. The result of the purchase and agreements increases the Northwestern toll line system to nearly 10,000 miles, and as soon as the new lines can be equipped with Bell instruments 300 stations will be added to the general system. The arrangement, it is stated, saves the Northwestern Company an expenditure of $200,000, representing the cost of lines into a territory already developed, and gives Minnesota, together with the Northwestern Company system, the most complete long-distance telephone system in the United States to date. The lines acquired that are single grounded circuits the Northwestern will make metallic. This transaction gives to the Northwestern Company the entire toll line system in Minnesota.

ELECTRIC LIGHT AND POWER.

WINONA, MISS.—E. R. Blackstone & Co. propose to put in an electric plant.

LONDON, ONT.—Fire destroyed the London General Electric Company's power house. The loss will be $25,000.

LITTLE FALLS, MINN.—A committee has been appointed to secure plans and estimates for a municipal lighting plant.

WEST BAY CITY, MICH.—At the Council meeting it was decided to purchase a 1500 dynamo light for incandescent lighting to add to the present city [illegible].

MINNEAPOLIS, MINN.—A resolution was referred to the ways and means committee of the Council providing for the sale of $300,000 in bonds for the establishment of a municipal lighting plant.

RICHLAND CENTRE, WIS.—The City Council is contemplating the erection of an electric plant for the purpose of lighting the streets of the city, and a committee, consiting of T. Breedon, W. A. Breedon and H. B. Stevens, has been appointed to receive proposals.

CHEYENNE, WYO.—The Buffalo Manufacturing Company, capital stock $30,000, has filed articles of incorporation, and will engage in the manufacture of flour and put up electric light works at Buffalo, Wyo. The incorporators are C. J. Hogerson, W. J. Thom and E. D. Metcalf.

KOKOMO, IND.—On the application of Frank E. Snow, of Indianapolis, a receiver was appointed for the Citizens' Light & Power Company of this city, the petitioner being president of the corporation. Mr. Snow holds a [illegible] Charles Walling, of Kokomo, was made receiver. The company is capitalized at $75,000, and was supplying street electric light at $70 per [illegible].

FOSTORIA, OHIO.—[illegible] R. [illegible], of Philadelphia, has purchased [illegible] Fostoria Light & Power Company and the Northwestern Ohio [illegible] Company. He proposes to erect a plant in the southern part of [illegible] and illuminating gas and electric light, [illegible] to that location on completion of the new [illegible].

FORT WORTH, TEX.—The property and effects of the Standard Light & Power Company of Fort Worth have been placed in the hands of a receiver, [illegible] receiver. The company has been [illegible] plant is valued at [illegible].

[illegible]

[illegible]

than for the best interests of the stockholders, by allowing some of them to remain idle, and entering into contracts by which the control of the other conduits was given to the Edison Electric Light Company, the Pennsylvania Heat, Light and Power Company and the Pennsylvania Manufacturing Light and Power Company.

THE ELECTRIC RAILWAY.

BANGOR, ME.—The management of the Lewiston, Brunswick & Bath electric road has purchased the extensive property in Bath known as the old Patten Car Works, more recently the Addison oil-cloth factory. The buildings will be fitted up as general car barns and also repair shops for the road. All the mechanical work in the way of reconstruction and repairs will be attended to at Bath.

PITTSBURG, PA.—R. L. Mayfield, of New York, representing a syndicate of New York, Philadelphia and Pittsburg capital, organized for the purpose of building electric roads in Porto Rico, was in Pittsburg a few days ago. He was on his way to St. Louis to consult with the manufacturers of street cars, and will return to Pittsburg to look after material for the construction of the line. He said that the syndicate had ample capital, but as yet had not secured a charter. Mr. Mayfield declined to give the names of the men in the syndicate.

HARRISBURG, PA.—A charter was issued by the State Department to a party of Philadelphia capitalists to build a trolley line from Hatboro to Horsham, a distance of 1¾ miles. The company is capitalized at $6000, and expects to begin operations this fall. Magnes Hellstrom, of Philadelphia, is president of the concern. The directors are James Crawford, Alfred R. Gandy and Magnes Hellstrom, Philadelphia; S. Edward Hagar, Doylestown, and John B. Peddle, Woodbury, N. J.

NEW YORK, N. Y.—The Brooklyn Heights Railroad Company will soon apply for a franchise for Sixteenth Avenue from Forty-ninth Street to Eighty-sixth Street in Brooklyn. This will be the first application for a right of way in Brooklyn made under the new city charter. The Municipal Assembly will, according to the restriction of the charter, be able to grant a franchise for only twenty-five years, and will have to exact from the Heights Company a suitable compensation for the privilege of using the street. The Brooklyn Heights Company needs a right of way through this part of Sixteenth Avenue to complete its route from the Greenpoint and Eastern District ferries to Bensonhurst. It evidently has confidence that it can get the desired right of way, as it is proceeding to lay tracks in Avenue C, which is the eastern part of the new connection.

PLAINFIELD, N. J.—The New Brunswick Traction Company, which obtained a franchise some time ago to extend its line from Bound Brook to Dunellen, saved the franchise at the last moment by a close call. The franchise required that the line should be running by August 30, but the track is not yet all laid, and one of the bridges is only partly finished. The two miles of track that is anyway passable is the part in Dunellen, where it joins the Plainfield trolley tracks. The New Brunswick Company had no cars, and borrowed an old flat car from the Jersey Central Railroad. It was "launched," a team of horses attached, and the New Market Band and Borough Council got on board. Borough Councilman Snyder, of Dunellen, wore the conductor's cap, and Constable Wyhnsky was the "motorman" who drove the horses. The two miles were made in two hours, finishing just before the fatal hour of midnight. Part of the time the car was off the track, but all hands turned to and set it on again.

LEGAL NOTES.

THE THOMSON-HOUSTON ELECTRIC COMPANY V. THE UNION RAILWAY COMPANY.—An injunction was filed August 19, 1898, in the Circuit Court for the Southern District of New York, restraining the Union Railway Company, of New York City, from using overhead underrunning switches, infringing the claims of the Van Depoele patent No. 424,695.

THE TRIUMPH ELECTRIC COMPANY, Cincinnati, Ohio, writes that the Westinghouse Electric & Manufacturing Company brought suit against it for alleged infringement of patents, but that Judge Clark, of the United States Court for the Southern District of Ohio, not only rendered a decision in favor of the Triumph Company but declared as void the patent on which the Westinghouse Company based its claim.

THE SPRAGUE ELECTRIC RAILWAY & MOTOR COMPANY V. THE CAMDEN & SUBURBAN RAILWAY COMPANY.—An injunction was filed August 17, 1898, in the Circuit Court of the United States, Newark, N. J., restraining the Camden & Suburban Railway Company, Camden, N. J., from using Walker motors, infringing the second and sixth claims of the Sprague patent on spring suspension, No. 324,892. The injunction was suspended for thirty days to give time for replacement of the motors.

PERSONAL NOTE.

MR. W. D. WEAVER, who was an ex-naval officer before entering the electrical field and who entered the service during the recent war, expects to return to his electrical duties about October 1. He is now chief engineer of the refrigerating supply ship "Glacier," which is at present distributing a [illegible] supply to the various camps in Porto Rico and Eastern Cuba. When [illegible] entirely discharged the ship will return north, and Mr. Weaver [illegible] then leave the service.

Trade and Industrial Notes.

THE [illegible] W. [illegible] enclosed arc lamp, manufactured by the Western Electric Company, is now made in three styles, plain and ornamental, [illegible] and plain, with metal shades, for factory and outdoor use.

THE [illegible] COMPANY, Milwaukee, have just issued a revised price list of An hac incandescent lamps. A copy will be mailed to anyone interested upon request. The new telephone catalogue will be ready for distribution within a fortnight.

THE WESTERN ELECTRIC COMPANY has recently issued a very neat forty-page pocket catalogue on linemen's construction tools. A large supply of tools is always carried in stock, and orders can be filled promptly. A copy of this catalogue will be mailed upon request.

THE EMPIRE, one of Milwaukee's finest restaurants and cafés, is being equipped throughout with Lundell electric fan motors by the Julius Andrae & Sons Company. The Sprague goods are very popular in the Cream City, nearly all large and first-class hotels being equipped with Lundell fans.

THE CENTRAL ELECTRIC COMPANY, Chicago, is headquarters for all of the mica products, including mica, mica segments, micanite segments, micanite cloth, empire cloth and M. I. C. compounds. These goods in all the various forms are carried in Chicago stock, and can be supplied immediately.

MESSRS. MEYSENBURG & BADT, 1504 Monadnock Block, Chicago, report a large increase in the sale of Ward Leonard Electric Company's circuit breakers, rheostats and dimmers in their territory. High-grade material and the best of workmanship are principal factors in the production of these goods.

THE GOULDS MANUFACTURING COMPANY, 16 Murray Street, New York, has issued a partial catalogue of Goulds triplex electric power pumps. It is well illustrated with cuts, showing views of actual installations and machines of different capacities. Complete and special catalogues can be had on application.

THE PEERLESS RUBBER MANUFACTURING COMPANY, 16 Warren Street, New York, has just issued a handsome colored lithograph of the United States battleship "Oregon," calling attention to the fact that this ship was fitted in all her joints with "Rainbow Packing," "Eclipse" gaskets, and that her piston and valve rods were packed with Peerless packing.

THE FRANCO-AMERICAN COMPANY, Incorporated, 163 Washington Street, Chicago, is prepared to represent American firms at the Paris Exposition of 1900. It has secured a portion of the American section for its own patrons. An experienced staff of engineers and electricians will take charge of and care for machinery exhibits, electrical appliances, etc.

THE WALKER COMPANY has recently issued seven circulars, numbered from 1080 to 1086, both inclusive. The subjects of these circulars, taken in their numerical order, are type "S" solenoid blow-out controllers, steel lighting generators, electric railway generators, the Love underground conduit, alternating current apparatus, Walker car motors for street lines, elevated or suburban traffic, and "boosters."

THE CUTLER-HAMMER MANUFACTURING COMPANY, of Chicago, reports that its sales for the month of August were much larger than for any preceding month in the history of that company. This certainly indicates an increase in the business of the motor manufacturers to whom most of this company's goods are sold. The Cutler-Hammer Company is preparing for a large fall business, and is constantly increasing its facilities for its rapidly increasing orders, so that they may be gotten out in the usual prompt manner.

THE WESTINGHOUSE NO. 49 MOTORS seem to meet with success, judging from a recent letter written by Mr. Horace E. Andrews, president of the Elevated Electric Railway Company, Cleveland, Ohio, to the Westinghouse Electric & Manufacturing Company, Pittsburg. Mr. Andrews states that his company is delighted with the operation of the No. 49 motors, and is having better success with them than with any other motor it has ever operated. This motor, it should be stated, embodies all of the best features of previous types of Westinghouse motors, which have an established reputation throughout the world for excellence.

THE GENERAL ELECTRIC COMPANY AT OMAHA.—For distribution at the Trans-Mississippi Exposition at Omaha the General Electric Company issued from its press a neat little brochure, very fully illustrated. As all the machinery used to light the grounds and buildings of the exposition and to supply the power was furnished by the General Electric Company, the types of apparatus shown in the book enable the visitor readily to identify each type as he meets with it in the exhibit or in any part of the working plant itself. Many thousands of these little books have been printed, and the demand for them at the exhibition has kept the company's presses fully occupied.

THE WARREN-MEDBERY COMPANY, Sandy Hill, N. Y., manufacturer of inductor alternators, reports a very large increase in sales for the month of August. Among its sales are the following named: Two in Canada, two in New York, one in San Francisco, one in Manitoba, three in Pennsylvania, one in New Jersey, two in New England, three in Texas, one in South Carolina and one in Tennessee. The sales of this company are said to be increasing rapidly, which would seem to indicate that the popularity of its machines is greater than ever. These alternators are reported to be rapidly growing in favor with engineers and station superintendents.

THE LUDEWIG-THURBER MANUFACTURING COMPANY, Pittsburg, Pa., which does business in repair work and the sale of electric light and power apparatus, reports such an increase of business as to warrant its moving into larger and more commodious quarters. The new shops will be more fully equipped to handle the large amount of electrical repair work, especially in armature and field winding, refilling of commutators, etc. The reasonable prices charged by this company for the excellent class of work turned out is the secret of its rapidly increasing business. The officers of the company are Mr. J. Ludewig, president; Mr. William Ludewig, vice-president; Mr. J. M. McGinley, general manager, and Mr. G. P. Thurber, secretary and treasurer.

THE HARRISON SAFETY BOILER WORKS, Philadelphia, Pa., reports a long list of recent sales of Cochrane separators and Cochrane feed water heaters and purifiers. Among the sales of separators we find the following: Warren Electric Light Company, Warren, Pa., one 6-inch horizontal separator; University of Kansas, Lawrence, Kan., 3-inch and 5-inch horizontal separators; the Homestead & Hilands Street Railway Company, Pittsburg, Pa., one 5-inch vertical separator; Harrisburg Foundry & Machine Company, Harrisburg, Pa., one 6-inch vertical separator, besides orders from Russia and South Africa. Among the sales of feed water heaters are the following: The Electric Storage Battery Company, Philadelphia, 500 horse-power; St. Louis Car Company, St. Louis, Mo., 500 horse-power, and Westinghouse, Church, Kerr & Co., Chicago, 100 horse-power.

WESTINGHOUSE DAY.—During the seventeenth annual convention of the National Association of Stationary Engineers, which was held in Pittsburg on September 5, 6, 7, 8, 9 and 10, one day—September 7—was set apart for a visit to the works of the various Westinghouse companies. This day was distinguished from the others by being called "Westinghouse Day." In the afternoon the delegates and friends, to the number of 600, visited the works of the Westinghouse Electric & Manufacturing Company and the Westinghouse Machine Company. Their train was drawn over the Turtle Creek Valley branch of the Pennsylvania Railroad to the Westinghouse Company's shops at East Pittsburg by a Westinghouse-Baldwin electric locomotive. After the shops were inspected a banquet was tendered to the visitors by the Westinghouse Machine Company, over 700 persons participating. The party were the guests of the Westinghouse Machine Company and Westinghouse, Church, Kerr & Co.

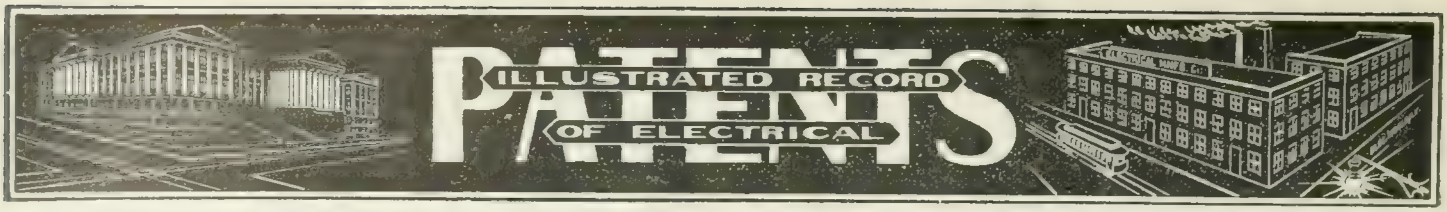
THE WESTERN ELECTRIC COMPANY has recently issued Bulletin No. 7-RS, giving detailed description of the Russell & Officer automatic switch. The object of this switch is to allow the turning on or off of one or any number of lights from two or more points by means of push buttons. Its advantages are that a large number of lights can be controlled by means of a push-button switch without having to bring the main wire supplying these lights to the switch itself, a No. 16 B. & S. gauge wire answering the purpose of any size of switch; that a group of lights may be controlled from any number of points independently of each other, and that lights in large rooms or buildings may be controlled from a central point. This switch is also designed as an underload or overload switch when provided with a special relay. The magnets operating the switch depend upon the electric light circuit, and there are no batteries to get out of order or cause trouble. This switch is manufactured by the Western Electric Company, and further details can be obtained by writing for a copy of Bulletin 7-RS.

RUSHED WITH GOVERNMENT WORK.—Mr. Campbell Scott, general sales agent of the C & C Electric Company, New York, states that his company is securing its full share of government orders for electrical apparatus. From the list of such sales the following may be mentioned: The lighting and power plant at Fort Delaware, Pa., including one 100-hp boiler, two 9x10 Ames engines and all the usual accessories, two 20-kw direct-connected generators, one switchboard, one electric blower combination and one 2-hp motor. This plant, it is stated, was promptly accepted by the authorities, and is giving the utmost satisfaction. For the Pittsburg post office plant the C & C Company supplied three 30-kw direct-connected generators. A duplicate of this plant is on order for the Louisville post office. For the Washington Navy Yard the company recently shipped nine closed-type ironclad motors, aggregating over 55 horse-power in capacity. The motors are for direct connection to wood-working machinery, and most of them were designed to run at very slow speeds. Ironclad motors of a capacity of 40 horse-power have also been supplied to the Brooklyn Navy Yard. The company has just shipped closed-type ironclad motors for operating ammunition lifts at the fortifications at the following named places: Great Gull Island, for 5-hp motors; Pensacola, Fla., two 5-hp motors, and Wilmington, Del., two 7½-hp motors. An order was received a few days ago for two generating plants for Fort Pickens, near Pensacola, Fla., each plant consisting of a 15-kw dynamo direct connected to a Case engine, and a switchboard. Besides the orders above mentioned the company has received others from different departments of the government for single machines and switchboards. The C & C Company continues to run its factory night and day, as it has for the past year.

ANOTHER LONG DISTANCE TRANSMISSION PLANT.—Contracts involving 10,000 horse-power are not common. Especially is this true when the agreement is to transmit this enormous amount of power over a distance of 45 miles. And when the contract further stipulates that the losses in generators, transformers and line shall remain normal, notwithstanding the difficulties involved, the agreement then becomes of still greater interest. Such a contract has just been executed by the Westinghouse Electric & Manufacturing Company, in which it agrees to comply with the above conditions. The plant is for the Snoqualmie Falls Electric Power Company, of Snoqualmie Falls, Wash. The power station is to be located at Snoqualmie Falls, 45 miles from Tacoma and 31 miles from Seattle, to which places the current is to be transmitted and then utilized by Westinghouse motors. The contract involves the building and delivery, at the above-named points, of four three-phase, rotary armature generators, having a normal aggregate capacity of 6000 kilowatts, and which are to be direct connected to water wheels; two 75-kw kodak exciter dynamos, also to be direct connected to water wheels; high and low potential switchboards, for main power station and sub-stations at Seattle and Tacoma, involving seventy-six marble panels with all necessary instruments, switches, etc.; high tension oil insulated static transformers, having an aggregate capacity of 10,875 kilowatts; rotary transformers with a total output of 2700 kilowatts and six type "C" motors developing 1600 horse-power, with adequate lightning protection at both ends of the line. These machines when installed will make available for industrial, railway and lighting purposes the power of Snoqualmie Falls. The line potential will be 25,000 volts, and its current will be carried over bare aluminum wires to sub-stations, where lowering transformers will sufficiently reduce the voltage for safe transmission within the corporate limits of the two cities.

Business Notice.

THE ILLUSTRATIONS in this issue were made by the Photo-Engraving Company, 9-15 Murray Street, New York City.



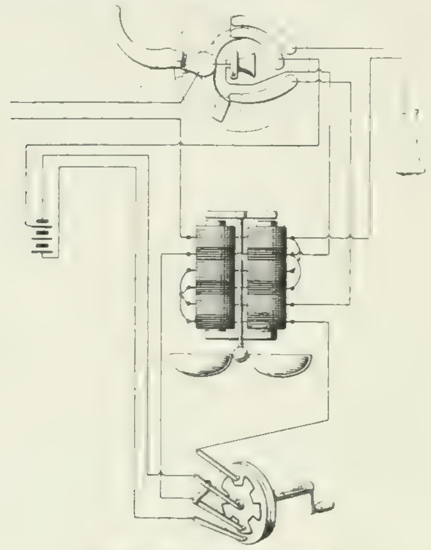
ILLUSTRATED RECORD OF ELECTRICAL PATENTS

UNITED STATES PATENTS ISSUED SEPTEMBER 6, 1898.

[Prepared by Wm. A. Rosenbaum, 177 Times Building, New York.]

610,190. SECONDARY BATTERY; G. J. Miller, of Kenton, Ohio. App. filed April 13, 1897. In a secondary battery, the combination of an insulating box, positive and negative electrodes within said box, composed of active materials mounted within and conductive connection to a perforated metallic lead case, a surrounding space between said active material and surrounding case except where attached, means for preserving said space, and means for connecting conducting feed and discharge wires, substantially as described.

610,197. CONTROLLING DEVICE FOR ELECTRIC ELEVATORS; N. P. Otis and R. C. Smith, of Yonkers, N. Y. App. filed April 4, 1892. The combination with an elevator car and starting mechanism, of a/floor switch governing the circuit for operating the mechanism to elevate and lower the car, and means for holding the floor switch at an intermediate position with the circuits broken when the car is opposite a landing, substantially as described.

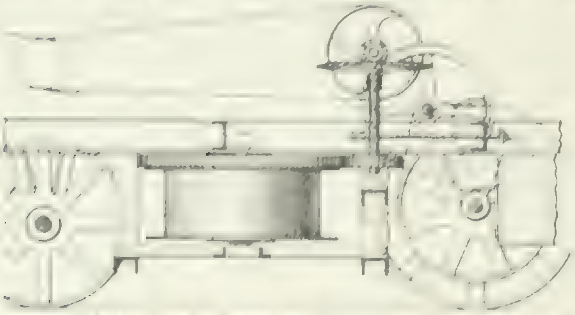


No. 610,347.—TELEPHONE.

[illegible] COLLECTOR FOR ELECTRIC RAILROADS; F. S. Pierson, of Boston, Mass. App. filed March 31, 1897. In a collector for electric railroads, in combination, a contact plate arranged and adapted to convey the electricity from the collector; and an ice dissolving material carried by the plate whereby the ice is removed from the conductor, substantially as described.

610,274. TELAUTOGRAPH; L. O. McPherson, of Highland Park, Ill. App. filed March 13, 1897. In a telautographic system, a receiving pen, electrically operated devices for controlling the extent and direction of the movements of progression thereof, a commutator for controlling the circuit of said devices, [illegible] actuated by the [illegible] of the paper for actuating said commutator.

610,278. TELEGRAM TRANSMITTER; E. Porter, of Sydney, N. S. Wales. [illegible]



No. [illegible].—Means for Supplying Electric Currents to Agricultural Machines.

[illegible]

[illegible] TELEPHONE; [illegible]

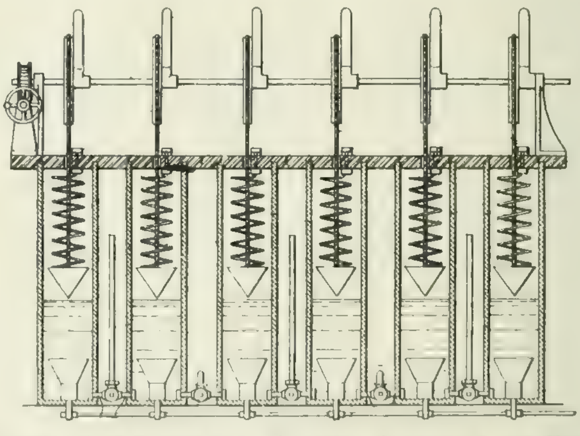
casing, of an automatic switch mounted within said casing, a receiver supporting arm upon said switch extending through said casing, an oscillatory hook upon said arm, and wiring connections for said transmitter and switch within said pivoted casing.

610,350. MEANS FOR SUPPLYING ELECTRIC CURRENTS TO AGRICULTURAL MACHINES; H. Foerster, of Gorsdorf, Germany. App. filed Jan. 8, 1898. In a system of electric supply for electromotors of agricultural machines, the combination with a plow and its draft rope, of a primary generating dynamo, and two electromotors for operating the plow or other machine, which electromotors are connected by a single line wire with the dynamo, and which are placed in electrical connection with each other by the draft rope of the plow.

610,393. TELEPHONE; S. S. Fisher, of San Francisco, Cal. App. filed Jan. 14, 1897. In a telephone system, two stations connected by a line wire whose ends are in electrical connection with switch points, each station having a grounded instrument circuit terminating in a contact point, a grounded signaling circuit terminating in a contact point and embracing a main battery, and a relay wound to a resistance adapted to the line-wire circuit, a local circuit embracing a contact point, the armature of the relay, a local battery and a signal, and a normally open ringing-up circuit leading from the grounded signaling circuit, terminating in a contact point and containing a circuit closer, the three contact points of the instrument, signaling and ringing-up circuits lying within the path of movement of the switch points.

610,402. ELECTRIC SWITCH; R. L. L. Hundhausen, of Wilmersdorf, Germany. App. filed Dec. 31, 1897. In an electric switch, the combination with a movable contact part, of a second contact part with which it is adapted to engage, the relatively movable actuating part having an inclined face, the coacting roller engaging said face and a spring associated with said movable contact part and adapted to secure its sudden engagement with and its disengagement from the second contact part, substantially as described.

610,406. RESISTANCE AND CONTACT APPARATUS FOR ELECTRIC CURRENTS; H. Lyon, of Glasgow, Scotland. App. filed July 6, 1898. In electric contact and resistance apparatus, combining two jars partly filled with a resistance liquid, and having at the bottom metal cups connected to a main conductor, with two cones, one in each jar, suspended from opposite sides of a pulley, the turning of which raises one cone and lowers the other, the cones being connected by wire coils to separate conductors, substantially as described.



No. 610,406.—RESISTANCE AND CONTACT APPARATUS FOR ELECTRIC CURRENTS.

[illegible] DIRECT CURRENT REGULATOR; F. H. Ramsay, of Walsenburg, Col. App. filed Jan. [illegible]. In a portable direct current regulator, the combination with a pair of insulated blocks, a socket and tap extending oppositely from said blocks, of a resistance circuit spirally arranged upon one of the blocks, a series of contact plates constituting portions of the resistance circuit, one of said plates being in direct electrical connection with one of the terminals of the socket, and a longitudinally movable switch [illegible] connection with one of the terminals of the tap and designed to [illegible] of the contact plates in [illegible]

[illegible] ELECTRIC RAILROAD; [illegible], of Denver, Col. App. filed [illegible]. In an electric car having the controller located on the platform [illegible] connection with and [illegible] manipulated from either the inside or outside of the car.

[illegible] MEANS FOR CONTROLLING VOLTAGE AND VOLUME OF ELECTRICAL CURRENTS; H. [illegible], of Cleveland, Ohio. App. filed [illegible]. In an electrical apparatus, a series of cells and resistances interposed between the cells and a line of separate resistances in the circuit between the cells and a switch constructed and arranged to first travel over said cells and then over the outside resistances, substantially as described.

The Electrical World.

VOL. XXXII. NEW YORK, SEPTEMBER 24, 1898. No. 13.

PUBLISHED EVERY SATURDAY BY

THE W. J. JOHNSTON COMPANY,

9 Murray Street, New York.

Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York.

New England Office, 620 Atlantic Ave., Boston.
Western Office, 936 Monadnock Block, Chicago.
Philadelphia Office, 929 Chestnut Street.

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THE ELECTRICAL WORLD,

9 Murray Street, New York.

VOL. XXXII. NEW YORK, SEPTEMBER 24, 1893. No. 13.

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THE PASSING OF THE WALKER COMPANY.

It is officially announced that the Westinghouse Electric & Manufacturing Company has purchased the stocks and bonds of the Walker Company, and will in consequence assume control of the entire business of the latter. The four former owners of the Walker Company—Messrs. Roswell P. Flower, J. W. Hinckley, Anthony N. Brady and Perry Belmont—it is stated take in part payment for their previous holdings an interest in the consolidated company, and will join the board of directors thereof. The Walker Company was bonded at $1,500,000, and was authorized to issue stock to the amount of $2,500,000. The recent sale of $3,000,000 5 per cent. bonds by the Westinghouse Company was in conjunction with this move.

By this change the Walker Company is brought under the terms of the agreement which for two and a half years has existed between the General Electric and Westinghouse Companies, and the fierce patent litigation that has lately been brought by the General Electric against the Walker Company is abruptly terminated. Owing to the connection of the owners of the Walker Company with many large users of electrical apparatus this company has recently been able to secure large contracts coveted by the General Electric and Westinghouse Companies, but the carrying out of these contracts has been seriously impeded by the numerous injunction suits instituted by the latter.

While there are those who deplore such a combination as this, and believe in aggressive competition between the different electrical companies, there are electrical engineers who think that, looking at the matter from the technical standpoint, the general effect of the coming together of these companies will be beneficial. One reason for this opinion is the peculiar patent situation. Where in many cases one of the companies had broad fundamental patents, preventing the others from manufacturing a certain style of apparatus, the others in turn, or one of them, had patents on detail improvements which in effect prevented the first from constructing a modern machine under the original patent, so that in some instances neither one of the companies could manufacture the most suitable apparatus, and each was obliged to resort to makeshifts to avoid the claims of the other. Now all three companies can pick and choose the best combinations of principles and details patented by the designers of any, giving, in many instances, more satisfactory and less expensive construction. The cost of manufacture can also be reduced by proper distribution and differentiation of the combined work between the establishments, while the cost of selling may be much lessened by the elimination of the considerable expenses attendant on competitive struggling for contracts.

There is in all industries where the danger of a monopoly appears a certain number of what may be called "sympathy" orders—orders given to a smaller company with the aim of maintaining competition. At one time the Westinghouse Company obtained these as against the General Electric Company. Of late they have gone to the Walker Company. For this reason, and because of the fact that all the larger companies are likely to remain crowded with work, the other smaller concerns in the field are not likely to be driven out by the combined companies, and may be benefited by the change. The rapid development of the electrical industries makes it certain that, however advantageous it may seem to the stockholders to combine their issues with a view to the reduction of competitive struggling, such combinations are not the result of a falling off in business.

Fortunately in the electrical industries active competition is not essential for rapid development. The enormous fields for the applications of electrical methods, waiting only further improvement of the latter, such for example as suburban and interurban traction, and the active competition of non-electrical rivals, such as gas lighting, are sufficient stimuli and dangers to prevent any cessation of activity in electrical development, even were internal competition entirely removed.

A FASCINATING POSSIBILITY IN A NEW APPLICATION OF ELECTRICITY.

There may be found on another page extracts from the recent presidential address of Sir William Crookes before the British Association, describing the need for some means of "fixing" atmospheric nitrogen. According to this eminent authority, nitrogenous grain foods are coming into greater and greater consumption. The fixed nitrogen in the soil of grain-growing districts is rapidly being exhausted, cutting down the yield per acre, and available new districts for grain production are negligible compared with the increasing demand. The supplies of nitrates and other fertilizers are entirely inadequate. The fixed nitrogen consumed is thrown away in the sewage and drainage delivered to the ocean, the value of such fixed nitrogen being estimated at $80,000,000 per annum. The only hope pointed out is the development of some cheap method of fixation of atmospheric nitrogen. This can be done electrically by high-tension discharges, and figures are given to demonstrate that with extremely cheap power the product can be obtained at a cost comparable with that of fertilizers now used. The world's demand in the near future is estimated at 12,000,000 tons of nitrate of soda per annum.

TRACK RETURNS FOR RAILWAY CIRCUITS.

On other pages of this issue there may be found an interesting account of some novel track bonds in use on the system of the Brooklyn Heights Railroad Company. The peculiarities of these bonds are that they are brazed to the rails and the brazing is effected electrically. As they could not conveniently be brazed in place the bond is divided into two pieces, each half of which is brazed to the proper rail end in the yard, and when the rails are in place the two halves are riveted and soldered together. A valuable feature of these bonds is the fact that they are not, as are many bonds, longer than the tie plate, but make use of the steel of the rail for return current conduction up to within 2 or 3 inches of the rail end, thereby reducing greatly the amount of copper for the same bond resistance.

It is often argued that bonds should be of what is called the equivalent cross section of the rail—that is, the cross section of the bond should be to that of the rail as the resistance per unit volume of the material of the rail is to that of the bond. Just what reasons there are for this argument it is hard to say. The question of the cross section of bonds (outside of the contact section) is the same as that of the cross section of any electrical conductor, its determination being solely dependent on whether any increase in the copper would cost more in the long run than the saving effected, or vice versa. Further consideration shows that the cross section of the bond should be practically the same as that of the conductor which would be used to carry the same current to the station were the steel in the track not utilized for that purpose. This is due to [illegible] of the track return, consisting of [illegible] as would a long return conductor of the same section, and the drop within them is the same per foot of length. The size of long bonds is therefore determinable by the same rule which would be followed in fixing the size of a return feeder, the proper cross section of short bonds being influenced perhaps to a certain extent by that necessary for contact with the rail and structural considerations. The bonds might in certain cases be of more than equivalent cross section of the rails and in any case should increase in size on approaching the power house, or, in other words, be proportioned to the current flowing.

As the rails themselves serve another purpose beside that of supporting the cars, the determination of their cross section becomes influenced thereby. The use of a light rail and a return feeder is in the present state of the art a great mistake. The return copper costs as much or more than the equivalent increase in rail section and by putting the same investment in the latter the resultant mechanical improvement in the roadbed is practically obtained for nothing. Where return currents are extremely heavy, as in the neighborhood of power houses of large systems, rail sections of weights much greater than those now used would be advisable, were such rail sections obtainable without extra expense for their rolling. A 200-pound per yard rail, if it could be obtained at the same cost per ton as a 100-pound rail, would be much more satisfactory when properly bonded up than the 100-pound rail, if with the latter a return feeder costing as much as the extra hundred pounds were necessary.

THERMOPILE ICEBERG ALARMS.

Some of our contemporaries have contained accounts of an iceberg alarm, intended to be mounted on shipboard and to announce the neighborhood of icebergs in a fog, consisting of a thermopile mounted on a revolving vertical axis and furnished with reflectors, etc. The ingenious idea underlying this instrument is that the thermopile is constantly exchanging radiations with its surroundings, and that when confronted with an iceberg the sudden outrush of radiant energy from the front of the instrument to the relatively colder ice causes a current to flow and thus advertises the presence of the invisible berg. All this is very interesting, but a practical difficulty in the way of the instrument is that water vapor and fog are absolutely opaque to radiant energy of low-wave length. Even the enormous energy of the sun is unable to send long waves through an invisible cloud of water vapor in the upper air. One of the most curious and unexpected results of the recent research upon solar radiation at the Smithsonian Institute was the existence of vapor clouds, transparent to ordinary light and entirely invisible, which completely cut off the radiant energy of the sun below certain wave-lengths. A fog at sea is, consequently, as opaque to the radiant energy originating at the front of a thermopile as to visible light.

Patents in Central and South America.

In Bolivia patents are granted for three, six and ten years, and the patents must be worked within one year from the date of granting. To guarantee this working there must be given a deposit when the patent is granted of 100 or 200 or 300 bolivianos, according to whether the patent is granted for three, six or ten years.

In Colombia the patents are granted for five, ten, fifteen or twenty years, with no annuities and no requirements of working.

In Costa Rica patents of non-residents have the same term as the original patent, with a maximum of twenty years. There are no annuities to pay, but the invention must be worked within two years.

In Ecuador, Honduras, Nicaragua and San Salvador there are no established patent offices, but the Government grants rights by special legislation in each case.

In Peru patents are granted for ten years, with no annuities, and the requirement of working is generally within two years.

In Uruguay patents are granted for three, six or nine years, with an annuity equivalent to about $26, and the requirement of working is generally within two years.

Track Bonding in Brooklyn.*

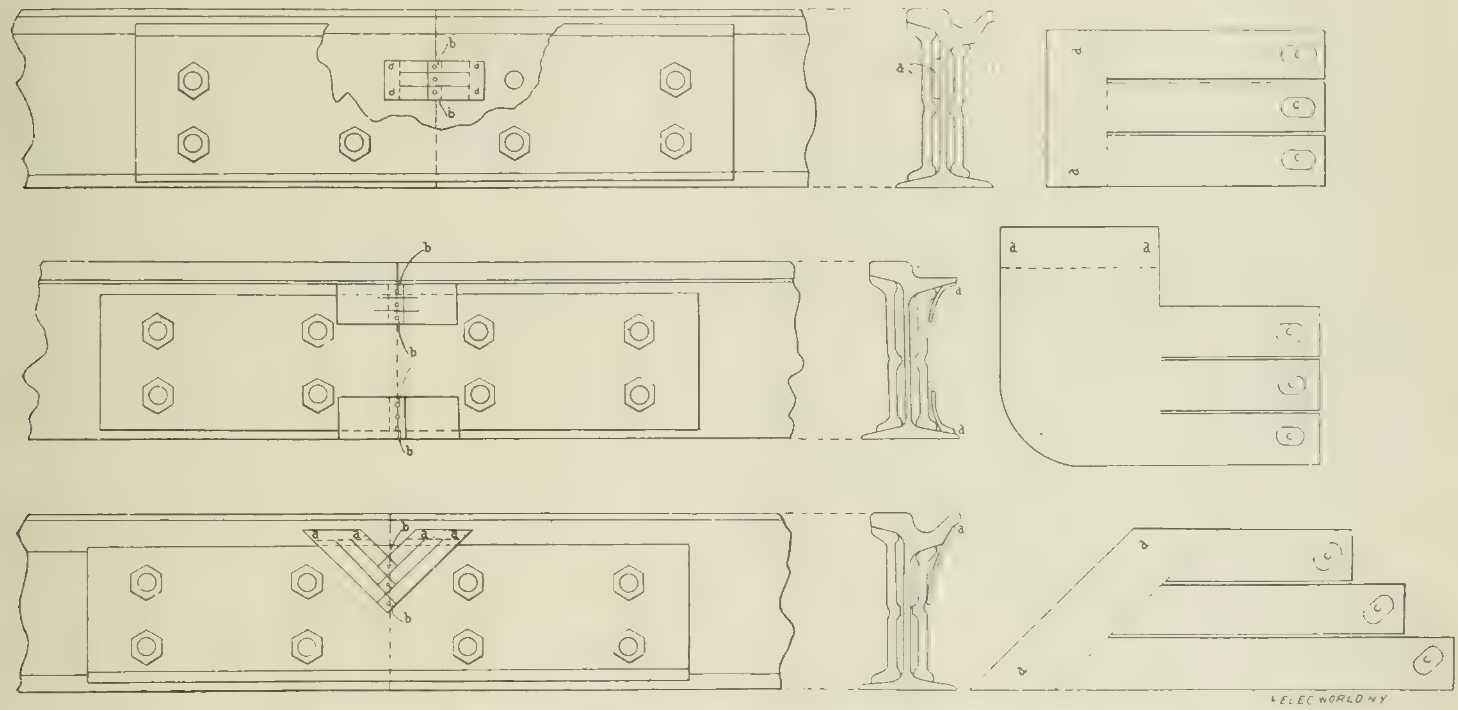
The tracks of the Brooklyn Heights Railroad system were originally bonded with the familiar supplementary wires, the section of the rail being such that it was difficult to use any other method. This wire, as well as the branches leading to the rails, was tinned so as to make good contact with the earth, and large copper plates, also tinned, were placed in the damp soil or water in the vicinity of the power house. These plates soon became corroded and coated with insulating substances, and were practically of no value in collecting the ground current, so return feeder wires were run out to make frequent taps to the supplementary wire. As the traffic of the road increased, the cost of this return copper became a serious matter, and when it became necessary to relay the tracks in 1895 the question of bonding received careful consideration. The rails were practically carrying no current, and it was decided that the new construction of 9-inch girder rails would increase considerably the conductivity of the return circuit, provided they were properly bonded.

To take full advantage of the large amount of metal for the track, a bond of high conductivity, the shortest possible length, and low contact resistance was required. At that time no bond meeting all those conditions could be found, and one was designed by the engineers of the company. As the joints were suspended, there was sufficient space between the ties for inserting bonds underneath the base of the rail, and arrangements were accordingly made to make contacts at that point. The bond decided upon was of cast copper, the full width of the base of the rail, and the connection between bond and rail was obtained by surface contact, about twelve square inches of surface being covered by the bond on the end of each rail. This contact came within three-quarters of an inch of the end of the rail and the connecting metal was left the same size, five inches wide and one-sixth of an inch in thickness, the bond being a trifle thicker at the point of contact. The connecting piece of metal was curved so as to allow for expansion. To secure good connection a reinforcing plate of cast iron was placed underneath the area of contact and the bond pressed firmly against the rail by two and one-half-inch bolts passing through the base of the rail. No machine work is done on those bonds other than girdling the contact face. The scale was removed from the rail where the bond was to be applied by grinding with a portable emery wheel. This was not a very costly operation, as the rails were arranged with bases uppermost as they were unloaded from the lighter and no rehandling was necessary.

To prevent corrosion a shallow groove was formed around the contact space and an attempt made to seal the bond watertight by forcing into this groove a non-hardening pitch, heated until very fluid. Owing to the fact that the groove was necessarily very shallow, the bond plate being only three-sixteenths of an inch thick, this sealing was unsuccessful in practice; but owing to the large area of contact, if rust has formed in the joint, it has in no way affected the conductivity, as recent tests show these bonds to be practically of the same resistance as when first installed, three years ago.

The cost of these bonds was not greater than that of the 0000 bond going completely around the fish-plate, and having two or three times the electrical resistance of this connection. The difficulty of attaching a bond underneath the base of the rail, however, was considerable, and careful supervision was necessary to have the work performed in a proper manner. This trouble led to further investigations, with the result that a bond electrically brazed to the rail was adopted the following year. This bond was somewhat cheaper than the plate bond and good work was more easily obtained on account of the better chance of inspection. The use of such a bond had been discussed the two previous years, but was not developed on account of a doubt whether the contact could be made large enough to prevent heating when considerable current was flowing, that might give rise to thermo-electric effects between the copper and the iron.

A sample of copper brazed to steel was secured, and after careful tests it was found that the contact between copper and steel was of negligible resistance, as compared with the resistance of the copper strip. Owing to patent difficulties it was impossible to make any arrangements with the firm supplying this sample for the use of the bond that year, but a series of experiments demonstrated the possibility of electrical brazing by a process developed by the electricians of the company. There was not sufficient time to obtain special apparatus for doing this work, so the electrical current needed was taken from the railway circuit. To obtain the low voltage required the brazing apparatus was connected in series with a generator between the circuit breaker and the negative bus of the station. The voltage of this dynamo was raised high enough to overcome the added resistance, and the generator run in multiple with the others in the power house. Several brazing contacts were in series so that the resistance could be kept as uniform as possible, and owing to the large output of the stations the variations in the load were slight and no trouble ensued in the regulation of the dynamos used in the welding circuit. Transformers have since been obtained for doing this work, and the brazed bond has been adopted as the standard on all the heavy lines of the system. As no portable brazing apparatus had been obtained the bonds



Views of Rail Joints with Brazed Bonds, and Enlarged Views of the Latter.

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*The report of the Committee on Track Bonding, Messrs. R. P. Brown and G. E. Chapin, electrical engineers of the Brooklyn Heights Railroad Company, Brooklyn, presented to the New York State Street Railway Association, Manhattan Beach, September, 1898.

are made in two parts and brazed on the rail ends before they are removed from the yard.

The shape of the bond depends on whether it is placed on the web of the rail, so as to come underneath the fish-plate, or, as it is now applied, on the base and upper flange of the rail, outside of the joint plate. All forms of the bond, however, are made up of ten and twelve leaves of one-sixty-fourth soft copper, the carrying portion of the bond being one and three-quarters inches wide, and the brazed contact having an area of about one square inch. Soft spelter, with suitable flux, is used in brazing the copper to the steel rail. The bond is divided longitudinally into three parts, so as to give greater flexibility. When the rails are in position the ends of these bond leaves are interlaced and fastened together by rivets and also by solder. The length of the bond between centre of contacts is five inches, and its cross-section is equal to 350,000 circular mils.

All the brazing of the several thousand bonds now installed has been done with a makeshift device, employing processes developed entirely by the electricians of the company. License under the patents of General Payne, of Elmira, and the Thomson Welding Company has been obtained, to guard against any claim of infringement.

On account of the great number of miles of track that are rapidly being relaid it was found to be impossible to braze bonds for all the rails with the inadequate means at hand, so the lighter lines have been bonded with the short bonds of the "horseshoe" type placed underneath the fish-plates. The holes for these bonds are drilled by the makers of the rail, and they are reamed out with emery paper to remove the rust that may have formed during shipment. If care is used in compressing the terminal of those bonds there is no necessity for drilling or reaming of holes on the ground, as any slight irregularity in the drilling fills up when the soft copper is thoroughly upset. The horse shoe bonds are three and one-quarter inches in length of 0000 cross-section, and have three-quarter-inch diameter terminals. As a measure of safety, as well as to lower the resistance of the joints, all rails are double-bonded, whether the brazed or horseshoe bonds are used.

Curved rail, switches, and other special work are often difficult to bond satisfactorily in the yard, and the joint plates are of such section that the bond cannot be placed underneath. In such work long bonds going round the fish-plates are used. On account of the excessive wear on special work the joints are particularly liable to loosen, so that the bond must be extremely flexible. The 0000 bonds are used on this work, and to keep the conductivity the same as the street rail both sides of the special work are cross bonded, and the circuit reinforced by running 500,000 c. m. wires joining these cross connections, the number of wires used depending on the current density of the track in each section. The straight track is cross-connected every 750 feet. Those cross-connections are made of 500,000 c. m. wire, fastened to the rail with a terminal for the contact similar to that of the plate bond mentioned before. These terminals have about six square inches of contact and are soldered to the rail. The terminals have a cast iron reinforcement and are bolted to the web of the rail, so that no mechanical strain can come on the soldered joints. This same terminal is used to connect the return wires in the track adjacent to the power house to the negative bus.

It has been found that if a single bond is used it should be placed at the centre of the web of the rail if sufficient contact can be obtained at that point. If contact is made at either the base or upper flange the length of the circuit is increased by the height of the rail, and in case of the nine-inch girder the increased resistance is equal to a half of the total resistance of the bond itself. On account of the greater depth of metal, it would seem advisable, when two bonds are used, to apply one on the top of the upper flange of the rail and the other on the base. Solid joints are very apt to [illegible], and are consequently never used on special work. Contrary to the former practice of tinning the bonds and supplementary wire, the bonds and their exposed copper surfaces are carefully coated with an [illegible] of the track to the surrounding soil it must leave from the steel and not from the copper. This prevents the bonds being destroyed by electrolysis or other corrosive action.

The Falk cast welded joints make the best possible electrical connection, and if care is used in the installation, conductivity al-[illegible] trically welded rail joint, made by the Johnson Electric Company, [illegible]

To guard against imperfect workmanship a system of testing bonds has been practiced. Usually only the joints on one line of rail are tested, though in sections of high-current density, as in the vicinity of power houses, the resistance of each joint is obtained. The test is a simple comparison of the fall of potential across the joint and on a measured portion of an unbroken rail. Two Weston millivolt meters, with scales ranging from 0.001 to 0.3 of a volt, are used; the readings being taken simultaneously. Contact is obtained by pressing hardened steel points on the surface of the rails. These points are set in wooden blocks and placed six inches apart if used on the joints, and two feet apart for tests on solid rail. The distance on the rail is taken for two feet instead of one foot, on account of the small amount of current flow in the rail on some of the lighter lines. These testing terminals are provided with handles of convenient length so that the person using them can stand upright and apply the necessary pressure with one foot. Two men can test joints very rapidly with this outfit. The current density of some of the rails was too low to give reliable readings with these instruments, so a portable resistance was arranged on a wagon and the necessary current readily obtained from the trolley wire. This resistance allowed about 300 amperes to flow from the line to the rail, and as it could be very quickly applied rendered it a comparatively easy matter to test the joints in any section of the city.

Although the bonds are less than six inches long, that length was selected for the distance between terminals of the voltmeter used in testing joints, because it gives a convenient fraction to subtract from the length of each rail in arriving at the total resistance in line of track. The drop on this six inches was considered as increasing the length of the rail by an amount proportionate to the drop in the rail itself. From this the percentage that the rail of any line approached the conductivity of the solid steel rail could be easily determined.

The following results were obtained from different joints:

Drop.			% of Conductivity.
FALK JOINT.			
1 foot of rail —	1 foot of joint		
.00215	.00355	(30 foot rail)	98
		(60 foot rail)	99
DOUBLE BRAZED BOND.			
1 foot of rail —	1 foot of joint		
.00725	.00758	(30 foot rail)	99.8
		(60 foot rail)	99.9
JOHNSON BOND.			
2 feet of rail —	6 inches of joint		
.00364	.00342	(30 foot rail)	95.6
		(60 foot rail)	97.8
PLATE BOND.			
2 feet of rail —	6 inches of joint		
.0109	.0233	(30 foot rail)	89
		(60 foot rail)	94

It will be seen by the foregoing that it is a comparatively easy matter to get a conductivity of over 90 per cent of a continuous steel rail. As high as 600 amperes can be safely carried on any of the bonds mentioned, and the cost of double bonding in a satisfactory manner should not exceed 75 cents per joint. The conductivity of steel varies with the amount of carbon in its composition, but, generally speaking, it is about one-eighth of the conductivity of commercial copper. Bearing these facts in mind, it will be readily seen that it is much cheaper to make the return circuit wholly of well-bonded steel rails, supplementing the track in the vicinity of the power houses with worn-out rails carefully bonded.

The Peacock Feather for Inventors.

A consular report from Pekin states that an imperial decree calling for the establishment of a patent and copyright system has been promulgated by the Chinese Government. The rewards of genius are widely different from those customary in other lands. For example the decree states that "if it be found that such geniuses have real ability to become officials we will appoint them to posts as a reward, or grant them decorations or fine raiment in [illegible] the [illegible] who have gained honor by their talents and genius."

The Cost at the Switchboard of Electric Power for Street Railways.*

BY R. W. CONANT.

It is my privilege to be able to communicate to you facts and figures bearing on the operation of forty-four power stations located at the important street-railway centres throughout the country.

These figures cover for the most part the operation of the stations during the past year, and were obtained through the kindness of members of this association as well as from experience on the roads in Boston.

The aggregate capacity of power stations represented is 98,387 kilowatts or 131,800 electrical horse-power.

The total cost of operation for the production of power alone from these stations during the past year has been $1,825,000 and *if* the power had been produced by all at as low a cost as it was in a number of the more economical stations the saving for the year would have amounted to $443,300.

It is the chief purpose of this paper to explain the *if* and to obtain some idea of its size.

In what has been published on this subject there are a great variety of opinions as to what should be included in the cost of power and also as to whether the basis of comparison should be the car-mile or kw hour, this latter being due to the fact that up to within a few years there has been no reliable instrument adopted by street railways for the measuring of their output.

The car-mile basis is not a fixed standard. A car-mile up hill takes a great deal of power, while a car-mile down hill should take none and may be made a source of power.

In the analysis of costs of operation of power stations of various sizes and types, it is first necessary to adopt a standard for the unit of power. We have seen that the car-mile is unreliable. Recording wattmeters are at present constructed which will measure the output in kw hours. They can be made to give results which are accurate within a very few per cent. This statement is abundantly verified by actual experience and is gradually becoming universally recognized. It is no doubt difficult for one who has been accustomed to figure cost of power production on a car-mile basis to reconcile himself to the kw hour. It should, however, be very easy for the steam engineer who is accustomed to deal with horse-power, since the kw hour equals 1.34 electrical hp hours.

It was evidently the idea of your executive committee in limiting the title of this paper to cost at the switchboard to abolish the car-mile and adopt the kw hour as the unit of power. And in comparing the costs from the various stations I shall use this unit. For the benefit of those who are accustomed to considering the cost per car-mile, it will be interesting to know that on many roads a car-mile takes just about 1 kw hour. This is not true where grades and equipments are extremely heavy; in such cases two or three times this amount may be required.

In the costs of power, whether it is produced by steam or water, should be included the fixed charges as well as the cost of operation. Under fixed charges are interest, depreciation, insurance and taxes on the capital invested in the land, buildings and machinery of the power station.

Under operating expenses are fuel, labor, supplies, repairs, superintendence and general expense.

In both the fixed charges and operating expenses the component items vary between widely different limits, and it becomes impossible to construct a law that will predict the cost under all circumstances.

On the other hand, for one who has had experience it is comparatively easy to predict what the power ought to cost under a given set of conditions. What it will cost must, of course, depend on management as well.

In view of the variety of the circumstances gverning these costs I have deemed it advisable to establish, for purposes of comparison, a standard plant whose conditions are fixed.

It is not my intention to imply that the performance or equipment of this station, which I shall employ as a standard, is ideal or could not be bettered, but rather to assume equipment and performance based on facts obtained from stations in actual commercial operation during a long period of time.

As this station is described, its performance may seem to border on the ideal, and there is no question but that its performance is consequent on favorable circumstances, very nearly we may say test conditions. It is, however, in my opinion best to err on this side rather than on the other in establishing a station for comparison.

I shall assume the station to be located on the water front; the exact spot is unimportant, but since this association has chosen Boston as its meeting place we can consistently locate the station here as well. I have fixed the capacity at 3600 kilowatts. The building erected on firm ground requiring but little piling or filling, building and chimney of brick.

For equipment three cross-compound condensing engines, cylinders 28 inch and 56 inch by 5 foot stroke, speed 80 revolutions per minute, 150 pounds steam pressure; three 1200-kw direct-connected generators; six water-tube safety boilers, 500 horse-power each; economizers and exhaust feed-water heaters; electrically driven feed pumps and coal-handling apparatus. Such a station would cost to install as follows:

CAPITAL INVESTMENT.

Building, foundations for engines and boilers, chimney, coal-handling apparatus	$120,000
Engines and condensers, heaters, separators and piping	91,800
Feed pumps and economizers	18,000
Boilers and flue connections complete	61,000
Generators and switchboard complete	73,800
Land and docking facilities	17,000
Engineering and sundries	5,000
Total	$386,600

or about $107 per kw capacity.

To obtain the figure for fixed charges, I assume interest at 6 per cent., insurance and taxes 3 per cent., depreciation 2 per cent., total, 11 per cent., which makes an annual fixed charge of $42,520.

I shall assume that this station produces 10,500,000 kw hours per annum. Dividing the annuall charge by this figure gives 0.4 cent per kw hour for the fixed charges. The depreciation is not intended to cover repairs, which will be included under operating expenses. The 2 per cent. assumed for depreciation is to establish a sinking fund against the time when the station will have to be entirely replaced by one of more modern and economical design, time of replacement being taken at fifty years. A few years ago the time of replacement should have been assumed much shorter, owing to the imperfect design of power station apparatus then existing. But with the present advanced state of the art improvements cannot be expected to develop as rapidly.

Before arriving at the cost to produce power from this station, it will be necessary to obtain the operating expenses.

In making comparisons between stations of different sizes and types the cost of labor is the most perplexing item, some stations operating with two shifts, others three. Some have engineers paid at different rates, and men that appear on the records of some are in a capacity which in others is absent or replaced by men of another class and rate of pay. I therefore give the following method of analysis of the labor item, which gives satisfactory results when applied to station operation.

I can illustrate the method and at the same time derive the operating expenses by applying it to our standard station. It is assumed that this station operates with three shifts of men, the duration of each shift being eight hours. This makes the shift hours per day 24, or 8760 for the year. The same number of shift hours would, of course, be obtained by two shifts of twelve hours each, as is the case with some stations. For the three-shift station the first two probably would have the full complement of men, while the third would not, as the station might be shut down on that shift. But as there is considerable inspection, cleaning and overhauling, this shift requires almost as many men, though their rate of pay may be less. The highest rates of pay would be on the shift of heaviest load. The crew to operate the standard plant would be about as follows: two engineers, one oiler, one helper, two firemen, one coal passer; total, seven men per shift.

The average rate of pay per man is taken at 27 cents per hour. This would be calculated from an actual station by dividing the total amount paid for wages, including chief engineer's salary, by the product of the number of men operating with the hours each has worked. The number of men per shift for this station being seven, I will divide this figure by 3.6, which is the figure expressing the capacity in 1000-kw units. This division gives 1.94 as the number of men per shift per 1000-kw capacity. This figure will vary with the type and size of station, as we shall see later. The fractional part of the man, of course, only appears in figuring.

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*Paper read before the American Street Railway Association, Boston, September, 1898.

Multiplying the 1.94 by the rate of pay, 27 cents, gives 52 cents as the cost of labor per hour per 1000-kw capacity. This multiplied by 3.6, the number of 1000-kw capacity, gives $1.87 as the total cost of labor required to operate the station per hour.

It will further aid in the analysis of the labor item to introduce the load factor. As this term is sometimes employed in a different sense from that used in this paper, I shall define it to be that per cent. which when multiplied by the capacity of the station in kilowatts and by the shift hours for the period gives the kw-hours output for the time considered. I take as the load factor for this station 33.3 per cent. average for the year. You may remember that in the consideration of the fixed charges I gave as the kw hours per year 10,500,000, which is 33.3 per cent. of 3600 kilowatts, multiplied by 8760. the shift hours per annum.

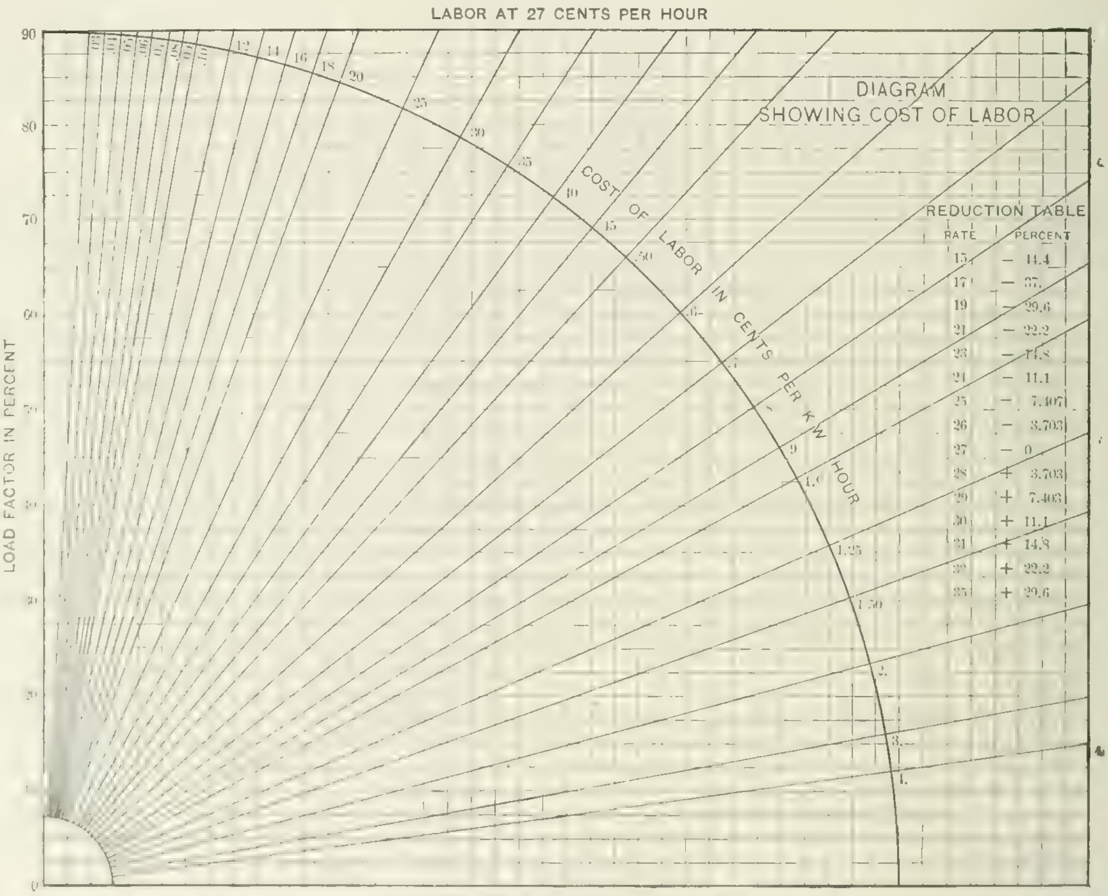
It has been shown above that $1.87 is the average cost of labor to operate the station for one hour, and if we obtain the average kilowatts during the hour, which is kw hours for that period, a simple division will give the figure for the cost of labor per kw-hour.

The load factor gives the means of obtaining the kw hours, and by multiplying 3.6 by 1000 and 33.3 per cent. gives 1200 as the average kilowatts for the hour, or kw hours for that period. Dividing $1.87, cost of labor to operate the station per hour, by 1200 gives 0.157 cent as the cost of labor per kw hour. But 3.6, the figure representing the capacity, was used as a multiplier in obtaining both the cost of labor, $1.87, and 1200 kw hours. It therefore disappears in the division and the expression for the cost of labor per kw hour is made independent of the capacity of the station to that extent. The rule, then, for obtaining the cost of labor per kw hour for any station is to multiply the rate of pay of the men by the number of men per 1000 kw capacity, and divide by the product of the load factor and 1000.

The use of this method will be illustrated if we compare the cost of labor per kw hour in the first two columns of table No. 1. It is 0.157 for the standard and 0.56 cent for station No. 1. It is rather difficult to account for this great increase until we notice that the number of men per 1000 kilowatts is 4.7 as against 1.94. The rate of pay and load factor also [illegible]

I have constructed a diagram which gives the results of this expression for cost of labor for all usual rates of pay, load factors [illegible]. This diagram (see Fig. 1) is based on a rate of 27 cents per hour, and there is also given a reduction table which gives the per cent. to be added or subtracted for other rates than this. To illustrate its use suppose we have a station whose equipment requires five men per shift per 1000-kw capacity. [illegible] it might operate at a 30 per cent. load factor. On the diagram following 5 up to 30 gives cost of [illegible] per kw hour. In a lighter month the station might operate at a [illegible] per cent. load factor. Following 5 up to 15 [illegible] for labor per kw hour.

To further illustrate the use of this diagram, let us consider that [illegible] that [illegible] of labor and load factor being 27 cents and 33.3 per cent. respectively; 3.7 followed on the diagram up to 33.3 per cent. gives [illegible] as a cost as against 0.157 cents for standard.



REDUCTION TABLE

RATE	PERCENT
15	− 44.4
17	− 37.
19	− 29.6
21	− 22.2
23	− 14.8
24	− 11.1
25	− 7.407
26	− 3.703
27	− 0
28	+ 3.703
29	+ 7.403
30	+ 11.1
31	+ 14.8
33	+ 22.2
35	+ 29.6

Fig. 1.

The cost of fuel is the next item to be considered in the operating expenses of the standard station. Considering coal as the fuel used its cost per kw hour depends on the price per ton and on the efficiency of the station, which is best expressed in pounds coal consumption per kw hour. The coal for standard station I have assumed to be clear bituminous, costing $3 per short ton delivered.

As to the efficiency, I am able to quote from tests in which I was personally engaged on a station of the same size and similar equipment. The duration of the test was forty-five hours, made under actual conditions of railroad service during the day, and at night the load was kept on the station by means of a water rheostat. I will say here, however, that the test on the steady night load did not show any great gain in efficiency due to the fact that the day load of the station was steadied by feeding in with others. The average efficiency of transformation, indicated horse-power to electrical horse-power at the switchboard, was 90 per cent. The steam consumption of the engines was 14.5 pounds per indicated hp-hour. This record on a later test has been lowered. The boiler evaporation was 9.4 pounds water per pound of coal from actual conditions. The coal used was New River bituminous. The economy of the station, represented by the coal consumption in pounds per kw hour, was 2.3. I have assumed 2.2 for this figure for the standard station.

Reducing price per ton to price per pound and multiplying by 2.2 gives 0.33 cent as the cost of coal per kw hour. This appears in table No. 1 under cost of fuel. As an illustration of what the cost would have been had the engines required more steam, say 26.6 pounds per indicated hp hour, as might be the case with a non-condensing engine. Referring to the fuel diagram and considering the electrical efficiency, boiler evaporation and price of coal to remain the same, 26.6 to 9.4 pounds water per pound of coal gives 3.8 pounds coal per kw hour. Following this line down to horizontal $3 coal line and vertically upward from this point to cost of fuel in cents per kw hour we obtain 0.57 cent, were the efficiency of transformation 100 per cent., but since it is assumed to be but 90 per cent., 11 per cent. has to be added to this cost, as shown in the reduction table. This gives the cost of coal per kw hour 0.63 cent as against 0.33 for the condensing engine.

There remain to be included in the operating expenses for this station, water, oil, small supplies, repairs, superintendence and general expense, which I have estimated at 0.093 cent per kw hour. The total operating expense foots up to 0.58 cent, which, added to the fixed charge of 0.4 cent, makes the total cost of power from the standard 0.98 cent, or very nearly 1 cent per kw hour.

Before comparing the costs from the various steam plants I will review briefly the circumstances governing the production of power by water.

The application of water power to street railways has the following points of advantage. In plants operated under any but very low heads the generating machinery may be installed at a less cost than for steam. Also the fuel expense disappears as well as a portion of the cost of repairs. A part of the labor expense will be saved, inasmuch as no engineers, firemen or coal handlers are required.

The main disadvantage in the application of water power to street-railway operation lies in the fact that generally railroad power stations are quite distant from water falls, and that it is very expensive to transmit the electrical energy to any considerable distance, the distance of transmission being hundreds of miles for the majority of street railways. That it may be made more profitable to employ water power when its location is near by the road and the price of coal is high also there can be no doubt.

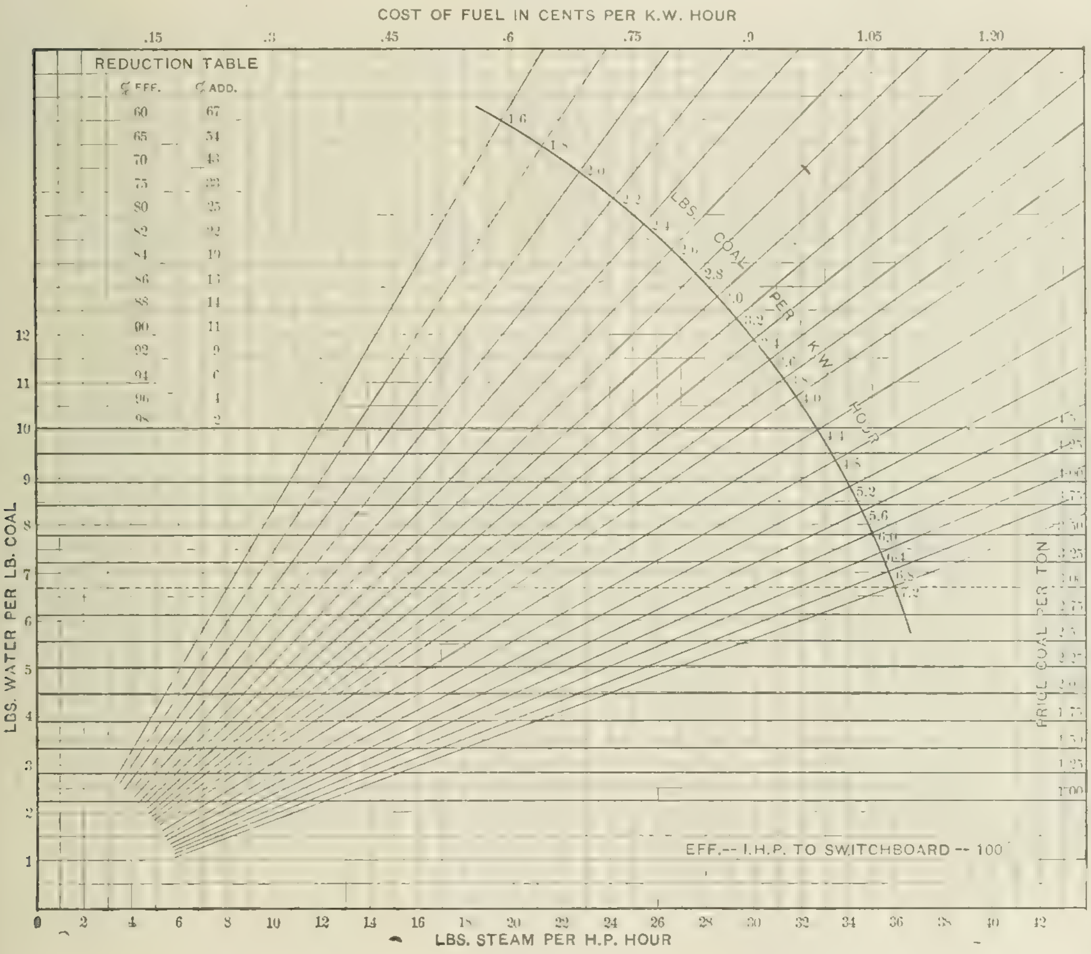


FIG. 2.

The cost to produce power from water is often compared with the cost to produce from coal on the basis of continuous operation for twenty-four hours a day. For street-railway service this method gives a false impression, since it implies that the machinery is working at its full capacity for 8760 hours per annum, or 100 per cent. load factor; as a matter of fact for street-railroad service a load factor of 33 per cent. is high.

To look at this from another point of view; the demand for power for street railways cannot be increased at will as it may be in a manufacturing concern. In the latter if it is found advisable to run night and day at full capacity, instead of ten hours, there is produced a correspondingly greater amount of the product, be it flour, steel rails or carbide of calcium, and this output is produced at a correspondingly decreased cost per unit.

For street-railway service on the other hand there has to be installed sufficient generating machinery to take the peak of the load. This is usually three times the average and is only of a few hours' duration each day. If it were necessary or profitable to use this full capacity continuously for other industries, it would be possible to do this with very little increase of labor, no increase of fixed charges and the additional expense of producing the greater output would be merely the coal and a slight increase of supplies and repairs. This combination is the feature of the Niagara work.

When the expense of transmission shall have been decreased by the successful employment of higher voltage, it will then become a problem as to whether it will not be profitable to produce power from a steam plant located at a coal mine, coal costing in this case but 80 cents a ton. This would bring the cost of fuel to 0.12 cent per kw hour as against 0.3 cent for standard plant. Further, this expense would only continue for the comparatively small number of hours that the plant would have to be operated for street-railway service. This might be better economy than to pay the fixed charges that would accrue from the expensive development of water powers at possibly much greater distances.

It is to be noticed in this connection that the cost of installing the steam station would be considerably less when located at the coal mine, since it would then be unnecessary to equip with the most economical and expensive machines.

Water power produced in various parts of the country varies greatly in its cost. It is reported that the electrical energy so produced costs from $14 to $32 per annum per kilowatt continuous output. This expense is largely made up of fixed charges, which increase rapidly as the expense of making the necessary improvements is greater. The standard steam plant produces power with $3 coal for $29, and with 80-cent coal for $22 per kilowatt per annum, which compare very favorably with the above for water power.

A disadvantage occurring in the use of water power is that in some cases, on account of certain periods of low water, an auxiliary steam plant has to be kept in reserve, which is, of course, an additional expense.

There can be no general rule given that will determine whether it is more advantageous to use water or steam power. Each case must be figured by a competent engineer, and decided on its merits.

The great majority of street railways being operated by steam, I shall not dwell longer on water power, as there is still considerable ground to be covered in the consideration of the steam stations.

I have compiled and classified the data on representative ones throughout the country—tables Nos. 1 and 2 give the results.

The general arrangement of the tables is as follows: Each vertical column contains the data for a different station during a stated period. Each station is represented by a number which appears at the head of the column. Only a portion of the table is exhibited to you on the large diagram, for obvious reasons, but I will describe the different items as they appear in the completed table. The first column is headed S. for standard station; following down the column first comes the capacity expressed in multiples of 1000 kilowatts, 3.6 meaning 3600 kilowatts.

The number of units of engines is 3, ditto for generators, 3; number of engine units per 1000-kw capacity is 0.83, obtained by dividing 3 by 3.6, ditto for generators, 0.83. The next line under Type is a description as to whether the engines are belted or direct connected to the generators—B. for the former and D. C. for the latter. The two lines marked S. C. T. and N. or C. refer to engines simple, compound or triple, non-condensing or condensing, as in standard C is compound condensing.

The period during which the averages are taken is given in days. Load factor is in per cent. Inserted in the proper place under costs are the per cent. S. and per cent. total, which figures represent the per cents. the items bear to the corresponding ones for standard, and to the total operating expense respectively.

The number of shifts, duration in hours and shift hours, together with the rate of pay of men in cents per hour, and number of men per shift per 1000-kw capacity, complete the data necessary for the analysis of the cost of labor. Costs are all expressed in cents per kw hour. Opposite Fuel, pounds of coal per kw hour and price, which is in dollars per short ton, give the necessary figures to analyze the cost of fuel per kw hour. Kind A. or B. refers to anthracite or bituminous.

Repairs, supplies other than coal—that is, water, oil, waste, lamps and miscellaneous, as well as superintendence and general expenses—are treated as one item hereafter called general expense.

As a supplement to the tables, in order to more clearly illustrate the relation of the costs, I have constructed diagrams, in which these are represented by different styles of lines, Figs. 3 and 4.

It will be noticed that these lines are of various heights, their [illegible] to the cost of the power in cents per kw hour. Four styles are used, that with horizontal shading showing the cost of coal, with vertical shading, cost of labor, and diagonal shading, general expense. These, which are operating expenses, are laid out above the line, and the solid black line showing fixed charges is plotted below the line. The distance from the base line up to 1 represents 1 cent and the magnitude of each item is denoted by the length of its line. The diagram for table No. 1 is laid [illegible] for each station. The first or left-hand column in each group represents the costs for the standard station. You will notice that its total length, including the solid black, is about equal to the distance between 0 and 1, so that including fixed charges the cost of power per kw hour [illegible] for the standard station amounts to about 1 cent. It also appears that the fixed charges are approximately equal to the coal. Labor is roughly about half the coal, and general expense about half the labor. These proportions are simple and easily remembered, and we might expect them to hold approximately for stations under similar governing conditions.

I shall next call to your attention station No. 3, whose equipment differs from the standard as follows: It has two units instead of three. Each generator is 800 kilowatts, making a capacity of about half that of the standard. The generators and engines are direct connected, the latter being compound condensing, smaller, of course, than the standard, but in other respects similar. Three 500-hp water-tube boilers, economizers and heaters complete the important part of its equipment.

Group No. 3 indicates the cost of power for this station. At the extreme left is standard, the next column showing costs per kw hour averaged for one year. At the extreme right of the group is the average for a light month and at the left of this is the month of high output. It is to be noticed that the total cost of operation for the year is somewhat greater than standard. Coal expense practically the same. Labor and general expense somewhat higher. Coal expense being the same does not in this instance indicate that the economy of the station is as good, as, by referring to the table, it will be seen that the pounds of coal per kw hour are 2.61 as against 2.2 for standard. This increase is, however, nearly balanced by the reduction in the price per ton, which was $2.60 as against $3 for standard. It might be expected that on account of the diminished size of the station the labor expense would be larger, on account of requiring more men per 1000 kilowatts. An examination of the table shows that the number of men per 1000 kilowatts is nearly double what is required for standard. This would double the labor expense, providing the rate of pay and load factor remained the same, but by a coincidence the rate of pay is lower and the load factor enough higher to bring the labor expense down to nearly standard figures.

To illustrate the effect of a high-load factor in reducing the cost of labor per kw hour, it will be interesting to look at the next column for this station, which represents the cost during January. In this month the load factor was 50 as against 46 for the year, and it will be noticed that the labor is reduced to less than the standard. The reduction in the total cost for this month, as against the yearly, is also apparent, and this is due principally to the reduction in labor.

TABLE No. 1.—SHOWING COST OF OPERATION OF POWER STATIONS.

	No. of Station.	S.	1	2	3	4	5	6	S.	1	2	3	4	5	6	S.	1	2	3	4	5	6
Cap. in 1,000 k w		3.6	.6	2	1.6	12.68	2.38	.744	3.6	.6	2	1.6	12.68	2.38	.744	3.6	.6	2	1 6	12.68	2.38	.744
Type.	Units E	3	3	2	2	8	2	4	3	3	2	2	8	2	4	3	3	2	2	8	2	4
	Units G	3	3	2	2	8	7	12	3	3	2	2	8	7	12	3	3	2	2	8	7	12
	Units E per 1000 k w	.83	5	1	1.25	.63	.84	5.4	.83	5	1	1.25	.63	.84	5.4	.83	5	1	1 25	.63	.84	5 4
	Units G per 1000 k w	.83	5	1	1.25	.63	2.94	16.2	.83	5	1	1.25	.63	2.94	16 2	.83	5	1	1.25	.63	2.94	16.2
	B. D. C.	D C.	D C.	D.C.	D.C.	D.C.	B.	B.	D.C.	D.C.	D.C.	D C.	D.C	B.	B.	D.C.	D.C.	D C.	D.C.	D.C.	B.	B.
	S. C. T.	C.	C.	C.	C.	C.T.	T.	S.	C.	C.	C.	C.	C.T.	T.	S.	C.	C.	C.	C.	C.T.	T.	S.
	N. or C.	C.	C.	C.	C.	C.C.	C.	N.	C.	C.	C.	C.	C.C.	C.	N.	C.	C.	C.	C.	C.C.	C.	N.
Period.	Days	365	365	343	365	365	365	365	31	31	31	31	31	31	31	30	30	30	30	30	30	30
					-1897-						-Janu	ary.	1897-					Septe	mber,	1897-		
Load Factor.	Per Cent.	33⅓	22.3	33 6	46.4	34.8	52.2	47	33⅓	30	50.6	58.6	46 4	64	48.4	33⅓	17.7	28	43.2	27 6	42.6	43
	Per Cent. of S	----	67	101	139.5	104	157	141	----	90	152	176	140	192	145.5	----	53 2	84	130	83	128	129
Labor	Shifts	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	Duration	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
	Shift-hours	8,760	8,760	8,232	8,760	8,760	8,760	8,760	744	744	744	744	744	744	744	720	720	720	720	720	720	720
	Men per 1000 k w	1.94	4.67	2.91	3 36	1.9	4 79	5.95	1 94	4.66	2.95	3.24	1.93	4.93	6.36	1.94	4.96	3	3 8	1.77	4.5	6
Cost in Cts	Rate pay	27	26 8	25.7	25 8	28 6	26.6	25.3	27.	26.5	26.2	25.	29.	25 8	25 6	27.	25.	25.6	24.4	28.4	27.6	24.2
	Per k w hour	.157	.56	.223	.187	.156	.243	.321	.157	.41	.153	.138	.121	.198	.336	157	.705	.273	.215	.182	.292	.338
	Per Cent. total op	27	46.7	32.5	20 4	22 6	28 7	29.1	27.	47.	27.2	23.	18.3	26.8	27.7	27.	51.4	40 6	32 5	25 9	31.8	31.7
	Per Cent. S	----	356	142	119	99.1	154	204	----	261	97.4	88	77	127	214	----	448	174	137	116	186	215
Fuel	Lbs per k w hour	2.2	3.18	2.48	2.61	2 86	3.24	4.13	2.2	3.07	2.36	2.65	2 74	3.19	4.74	2.2	3.3	2.34	2.48	2 84	3.3	4.05
	Price per short ton $	3	2 6	2 62	2 6	2.72	2.6	2.9	3	2.75	2.65	2.54	2.88	2.71	3.08	3	2 48	2 56	2 53	2.43	2.56	2 44
	Kind, A or B	B.	.3 A. .7 B.	.25 A. .75 B.	.3 A. .7 B.	B.	.2 A. .8 B.	B.	B.	.3 A. .7 B.	.25 A. .75 B.	.3 A. .7 B.	B.	.2 A. .8 B.	B.	B.	.3 A. .7 B.	.25 A .75 B	.3 A. .7 B.	B.	.2 A. .8 B.	B.
Cost in Cts	Per k w hour	.33	.414	.325	.340	.389	.42	.599	.33	.421	.313	337	395	.430	.729	.33	4.09	.299	.314	.345	.423	.494
	Per Cent. total op	57.	34.5	47.4	51.6	55.2	49 7	54.3	57.	42.	55 6	56 4	59 9	58.4	60.1	57.	29.8	44.3	47.5	48 8	46.1	46 4
	Per Cent. S	..	125.5	98.5	103	117.5	127	182	----	127.5	94 5	102	120	130	220	...	124	91	95	104	128	140.5
[illegible]	Per k w hour	.093	.225	.138	.132	.159	.182	.182	.093	.172	.0975	.123	.144	.109	.147	.093	.258	.102	.133	.176	.203	.233
	Per Cent. total op	16.	[illegible]	20 1	20.	[illegible]	21.6	16.5	16.	17.	17.2	20.6	21 81	14.8	12 2	16.	18 8	15.1	20.	25.1	22.1	21 9
	Per Cent. S	..	242	148	142	171	196	196	----	185	105	132	155	117	158	----	278	110	143	189	218	250
Total Operating Costs.	Per k w hour	.58	[illegible]	.686	[illegible]	.704	.845	1 102	.58	1.003	.563	.598	.66	.737	1.212	.58	1.372	.674	.662	.703	.918	1.065
	Per Cent. S		[illegible]	118	114	122	146	190	----	172 5	97.	103	114	127	208	----	236	116	114.5	121	157	184
[illegible]	[illegible]	[illegible]	..			----		----	.405	----	---	----	---	---	----	.405	...	.		----	----	----
	[illegible]	[illegible]							70				----			70	...	---	----	----	----	----
	[illegible]																			----	----	----
[illegible]		[illegible]				----		----	----	----	----	----	----	----			----	----	----	----	----	----

TABLE No. 2.—DATA ON "OPERATION OF POWER STATIONS."

	No. of Station.	8	10	11	12	13	14	15	16	17	18	19	23	25	26	28	29	30	31	32	33	34	35	37	40	42	43	44	45	47	48	50
	Cap. in 1,000 k. w.	3.6	.4	1.4	1.0	2.6	1.6	1.6	1.6	.8	.4	3.0	.6	4.0	.8	1.4	1.9	1.7	.9	5.3	1.5	2.0	1.2	1.5	9.2	1.8	3.3	6.0	1.0	.75	6	..
Type.	Units E	3	2	5	3	4	4	10	8	2	2	6	3	10	7	4	5	5	3	5	4	4	1	3	6	3	5	6	4	4	2	----
	Units G	3	2	8	7	4	4	16	8	4	3	6	3	19	12	8	5	5	3	30	12	4	1	11	6	6	10	12	7	4	2	----
	B. or D. C.	D.C.	D.C.	B.	B.	D.C.	B. D.C.	B.	B.	B.	B.	D.C.	B.	B.	B.	B.	B.	B.	B.	B.	B. D.C.	D.C.	D.C.	B.	D.C.	B.	B. D.C.	B.	B. D.C.	D.C.	D.C.	----
	S. C. T.	C.	S.	S.	C.	S.	S.C.	S. C,	C.	C.	S.	----	C.	S.	S.	S.	C.	C.	C.	C.	C.	C.	C.	C.S	C.	C.	C.	C.	C.	C.	C.	---
	N. or C.	C.	N.	N.	C.	N.	N.C.	N.C.	C.	C.	N.	----	C.	N.	N.	C.	C.	C.	C.	C.	C.	C.	C.	C.N.	C.	N.	C.	C.	C.	C.	C.	---
	Period Days	365	1	365	365	365	365	183	365	365	365	31	183	365	365	31	365	365	365	365	365	183	365	151	365	365	365	365	30	183	365	...
	Load Factor Per Cent	33⅓	24	23	23	42	19	41	33	24	----	----	16	33	19	23	27	23	32	31	16	57	37	11	36	45	15	30	28	20	35	----
	Taken from Car-miles	----	----	×	----	----	----	----	----	×	----	----	×	----	----	----	----	---	----	----	----	----	----	----	----	----	---		×	×	----	---
Labor.	Shifts	3	----	2	2	2	2	2	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	2	3	2	2	2	----
	Duration	8	----	12	12	12	12	12	8	12	12	12	12	12	12	12	10	10	10	12	12	12	12	12	8	8	12	8	10	12	10	----
	Shift-hours	8,760	----	8,760	8,760	8,760	8,760	4,380	8,760	8,760	8,760	744	4,380	8,760	8,760	744	7,300	7,300	7,300	8,760	8,760	4,392	8,760	3,624	8,760	8,760	8,760	8,760	600	4,380	7,300	----
	Men per 1,000 k. w.	1.94	7.5	3.7	3.7	3.0	1.87	6.3	3.7	3.7	3.7	3.0	3.3	----	----	5.0	3.2	3.0	4.5	3.5	5.0	5.0	2.1	8.0	2.7	5.0	3.7	3.3	3.0	8.0	6.7	----
	Rate of Pay	27	18	20	20	22	15	16	20	18	12	17	25	----	----	17	21	21	21	20	20	20	26	16	23	26	16	24	15	12	15	----
	Cts. per k w Hr.	.157	----	.32	.31	.16	----	.25	.23	.28	----	----	.51	----	----	.37	.25	.27	.29	.23	.62	.18	.15	1.1	.17	.29	.59	.26	.16	.41	.29	----
Fuel	Lbs. per k w Hr.	2.2	----	6.7	4.3	6.5	----	6.5	5	5	----	----	6	5.6	6.8	7	3.9	3.3	4.4	3.5	4.3	5.3	4.7	7.3	3	5.7	3.7	3.5	4.7	5.1	3.3	..
	Price ($) per Ton	3	2	2.24	2.93	1.44	----	2.10	3.30	1.43	.75	.60	3.41	1.05	1.15	1.63	2.80	3	2.84	3	3.08	1.0	1.24	1.75	1.60	1.60	2.70	1.60	1.90	2.12	2.75	----
	Kind—A. or B.	B.	.5 A. .5 B.	A.	B.	B.	----	B.	B.	B.	B.	----	B.	----	----	----	----	B.	B.	B	B.	B.	B.	.5 A .5 B	A.	A.	.6 B. .4 A.	A	B.	.5 A .5 B.	B	----
	Cts. per k w Hr.	.33	----	.75	.63	.47	----	.68	.83	.36	----	----	1.03	.29	.39	.57	.55	.49	.62	.52	.66	.27	.29	.63	.24	.45	.50	.28	.45	.54	.45	----
	Gen. Ex.—Per k w Hr.	.093	----	.33	.11	.09	----	.14	.09	.06	----	----	.16	----	----	.08	.23	.15	.19	.09	.22	.12	.04	.12	.11	.18	.11	.15	.05	.21	.28	..
	Total Op.—Per k w Hr.	.58	1.5	1.4	1.05	.72	----	1.07	1.15	.70	----	.68	1.7	.56	1.2	1.02	1.03	.91	1.1	.84	1.5	.57	.48	1.85	.52	.92	1.03	.69	.66	1.16	1.02	----
	Fixed Charges	.405	----	----	.44	.24	----	.24	----	----	----	----	1.	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----

It will be seen that the coal expense is but slightly less and seems not to be reduced by the increased load factor. The explanation of this lies in the fact that the station is tied in with others, which keeps its load from fluctuating even on the low load factor. This will be still further exemplified by referring to a light month; the column at the right of the group gives the costs for September, during which the load factor was 43 as against 59 for January. The coal expense is still further diminished, and by reference to the table will be found to be due to an increase in the efficiency of the station. This might be found to be on account of not having to force the boilers. The increase of labor due to the low load factor is to be noticed.

I wish to say at this point that it is impossible for me in the limited time to give you more than a general idea of the large number of interesting facts which may be obtained by careful study of the tables.

Plant No. 2 is somewhat larger than the last and is equipped with two 1000-kw generators direct connected to compound condensing engines. It has also economizers and heaters. Its costs are in column No. 2. In looking at the yearly average it will be noticed that the total costs rise above the standard, which is due to an increase in labor and general expense. Coal as before is the same, the decreased efficiency being balanced by the lower price per ton. Examining the table with a view to accounting for the increase of labor we find the load factor approximately the same as standard, but an increase in the number of men per 1000 kilowatts. This is accounted for by the smaller size of the station. General expense is greater as would be expected. A glance at the diagram representing the heavy month for this station gives a nice illustration of the effect of the high load factor, which is 51 as against 33 for the year. It is to be noticed that the coal is practically the same, the reduction coming in the other two items.

This brings the total cost for the month below standard. In the light month with a low load factor of 28 per cent. the labor increase is very apparent.

I shall now present the costs of operation of a large station. Its equipment consists of six 1200-kw generators direct connected to triple condensing engines, two 1500-kw generators direct connected to compound condensing engines, and an auxiliary plant of forty 62-kw generators belted to compound non-condensing engines and used only in case of emergency. Economizers, heaters and electric feed pumps complete the important part of the equipment.

Group No. 4 indicates the costs for this station. The yearly average shows that we are approaching standard figures in labor. This item is not much less, as the units are only slightly greater capacity. Load factor, rate of pay and men per 1000 kilowatts correspond very closely with standard. The general expense and coal bring the total somewhat higher. General expense is high on account of the heavy repair account. The station is about eight years old and repairs are heavy, due to replacing of worn-out parts. The decrease in efficiency, as shown by pounds of coal per kw hour, might be shown by a test to be due to old boilers.

The plants just considered have all been direct connected. Station No. 5 is a belted plant, a little more than one-half the capacity of the standard, equipped with seven 340-kw generators belted to a countershaft, to which are belted three triple condensing engines, the auxiliary apparatus, affecting the economy of the station, being economizers and feed-water heaters. Diagram No. 5 represents the costs of a year, and also for the heavy and light months. During the three periods the coal expense remains about the same, but there is considerable variation in the other items, due principally to the change of load factor.

Notwithstanding the high load factor, 52 per cent., the labor for the year is still above standard. This would be expected from the multiplicity of parts to look after in a belted countershaft station. The reduction of general expense and labor in the heavy month is due to the load factor of 64 per cent.

Diagram No. 6 represents the costs for a belted plant of about one-fifth the capacity of standard. Its equipment is twelve generators belted to four simple high-speed non-condensing engines. There are feed-water heaters, but no economizer. High coal consumption is the feature of this diagram, the cost of fuel alone for the year being equal to the total operating expenses for standard. Labor is also high, and the total cost of power per kw hour is nearly double the operating expense of standard. This station furnishes a good illustration of the effect on the cost of power of a simple non-condensing belted equipment. It is to be remarked also that this plant has the benefit of a high load factor.

It will now be interesting to turn our attention to a small direct-connected station, which is numbered 1. This operates about thirty cars. It is equipped with three 200-kw generators and has compound condensing engines, heaters, but no economizers. It does not feed in with other stations, as do those which have been previously mentioned, and has a very fluctuating load, as may be imagined in the operation of so small a number of cars. This station is just one-sixth the size of the standard, and it will be noticed that the column representing its operating expenses is about twice as high. The great increase is in the labor, although the station is operated by a corporation which has had a vast amount of experience in railroad work. Can we account for this increase in labor? By referring to the table we find the rate of pay of men is practically the same as standard; the load factor is low, 22 per cent., as against 33.

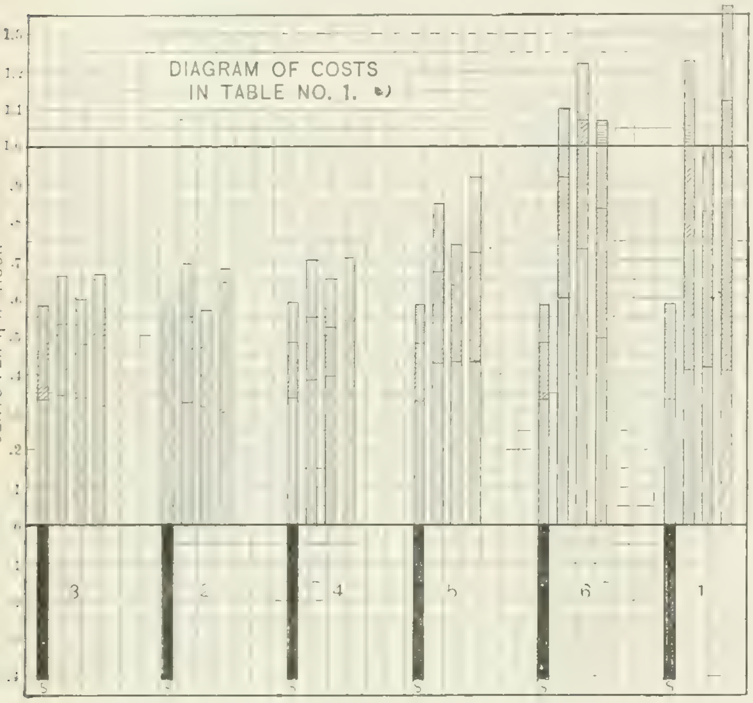


Fig. 3.

Referring to the heavy month for this station, which has the benefit of a 30-per cent. load factor, we find that the labor is reduced, but it is still a long way from bed-rock figures. The examination of the table discloses the fact that the increase comes in the men per 1000 kilowatts, being about 2.5 times the standard figure. The station records show the following men operating: On the first shift two engineers and one fireman, second shift one engineer, one oiler and one fireman, third shift one engineer and one fireman. Can this number of men be reduced? In a station whose equipment requires that the boilers be hand fired it is, to say the least, difficult to imagine that the boilers could be operated with less than one fireman per shift. The secret then for the large number of men per 1000 kilowatts lies in the small number of kw capacity. These same men could look after a station of greater capacity.

I shall next give the costs on plant No. 12, the figures of which are presented in table No. 2. This plant is about one-third the size of standard. It does not feed in with other stations. Its generators are belted to three tandem compound condensing engines [illegible] steam pressure of [illegible] pounds. It has water tube boilers averaging four years of service, heaters, but no economizers. [illegible] By reference to the table it will be seen that the station produced power to the extent of [illegible] per cent. of its capacity during the past year at [illegible] cents per kw hour, including fixed charges, the operating expenses alone amounting to a little over one cent. The total cost of operation for the year was [illegible], of which [illegible] was for fuel. Water costs this station nothing and the labor was about one-half the coal bill. By referring to the diagram No. 12, Fig. 4, it will be seen that the coal and labor are both much higher than standard, and if standard performance had been reached a saving of [illegible] would have been made in the operating expenses for the year. An analysis of the items is given in column No. 12 of the table, and by comparing with standard the differences may be readily seen. I do not wish to be understood in making these comparisons that it would necessarily pay to make the changes required to effect this saving, my present idea being to bring clearly before you the differences.

Station No. 13 is an interesting combination of cheap coal, simple non-condensing engines direct connected to the generators, together with a high load factor. Its capacity is 70 per cent. of the standard, major part being three 800-kw generators; the smaller unit is 200 kilowatts. It produced power to the extent of 42 per cent. of its capacity at 0.96 cent per kw hour, inclusive of depreciation and fixed charges. The depreciation is charged in at 5 per cent. on a capital expenditure of about $60 per kilowatt. The total expense for the year was $92,617.28, which is made up of

Labor	$15,453.25
Repairs and renewal of steam plant	1,839.69
" " " " electrical plant.	56.71
Fuel	44,780.94
Water	4,405.40
Oil, waste and lubricants	1,881.53
Tools, appliances and supplies	634.23
Taxes	1,945.65
Insurance	2,146.94
Interest	11,472.94
Depreciation 5 per cent. on $160,000	8,000.00
	$92,617.28

The analysis of these items is given for comparison with standard in column No. 13 of table No. 2. The diagram shows labor for this station to be equal to standard, principally on account of high load factor; the other differences are also apparent. It is interesting to note that the road operated by this power station used on an average of about 1.3 kw hours per car-mile. Total car-miles for the year was 7,207,308, about 10 per cent. of this mileage being trail cars. There are other interesting data about this road which time will not permit me to review.

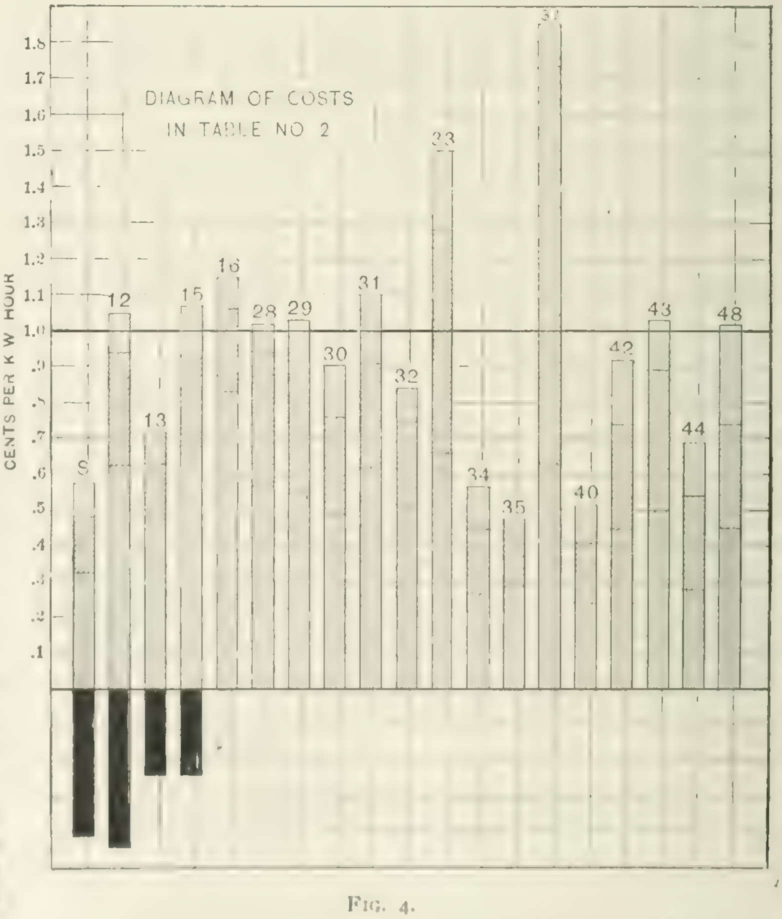


Fig. 4.

Plant No. 15 is an interesting example of what a multiplicity of units will do for labor, the figure being 6.3 men per 1000 kilowatts.

The effect of this would be much more apparent on the diagram, were it not for the high load factor and low rate of pay.

Plant No. 16 is of 1000 kw capacity. The cost for power for past year was $53,000. Load factor is the same as standard. Standard operates to produce about double the output for the same figure.

Station No. 28 is 1400 kw capacity, has slow-speed condensing engines, heaters and economizers. The feed water leaves economizer at the high temperature of 258°. The engines are simple belted to the generators and coal costs but $1.63 per ton.

Plant No. 29 is a compound condensing slow-speed belted station of 1900-kw capacity and feeds in with another station. The coal costs $3.86. Plants Nos. 30 and 31 are operated by the same corporation as No. 29.

No. 32 is a combination of two power houses feeding into the same system. These stations are interesting, because these costs are for the past year, and since then these two stations, as well as smaller ones operated by the same company, have been consolidated into a large water-power plant, from which power is transmitted at 13,000 volts. The two steam stations shown in column 32 have five triple-expansion condensing engines. This road operated on about 1.4 kw hours per car-mile. The coal costs $3 per ton. The water-power plant which replaced the steam has not been in operation long enough to enable its costs to be given.

Station No. 33 has rather a tall column, due principally to its low load factor of 16 per cent.

Station No. 34 operated at a lower cost than standard, on account of the high load factor 57 per cent., reducing the cost of labor and low price of coal $1 per ton.

No. 35 is a plant of 1200-kw capacity, interesting on account of the fact that it has but one unit. It operates with 2.1 men per 1000 kilowatts a load factor of 57 per cent., coal costing $1.24 per ton. Its costs are quite a little lower than standard.

No. 37 is a record breaker in the opposite sense. It is of slightly greater capacity than No. 35, but has three engines and eleven generators, which require eight men per 1000-kw capacity. It has a load factor of but 11 per cent. during 151 days from January 1 to May 31, 1898. The effect of this on the cost of labor is very apparent.

No. 40 has a capacity of 9200 kilowatts. It is direct connected, has economizers and compound condensing engines. Anthracite coal is burned, costing $1.60 per ton. This plant operates at less than standard figures.

No. 42 is a belted plant, compound non-condensing engines, heaters, but no economizers. It has a good load factor, but the effect of the belted and small units shows in all three items.

No. 43 is a combination of alternating and direct-current apparatus. It has a low load factor of 15 per cent., the effect of which is noticed on the labor.

No. 44 is a 6000-kw station, and, although belted, has large compound condensing engines and economizers, which, with coal at $1.60, brings the cost of fuel below standard figures.

It will now be instructive to take a general survey of the diagrams for all stations in table No. 2. No. 37 towers above all the rest. Standard is at the extreme left. Coal in No. 37 is greater than the total operating expense for standard. This station pays but $1.75 per ton, but it uses 7.3 pounds per kw hour. Compare this with No. 35, about the same size plant, paying $1.24 for coal and using but 4.7 pounds per kw hour.

I can hardly ask you to compare the labor, but it is easily seven times as large in No. 37 as in No. 35. The load factor of 11 per cent. as against 37 per cent. would make this item three times as great and men per 1000-kilowatt. Eight as against 2.1 would again increase the cost of labor three times. The higher rate of pay in plant No. 35 prevents the discrepancy being greater.

Let us look along the line for high coal cost. No. 16 seems to bear off the palm in this respect; $3.30 per ton and 5 pounds per kw hour accounts for this. For strikingly low costs we have Nos. 34, 35 and 40.

Electrical Concessions in New United States Territory.

Franchises for electric lighting and traction enterprises in Cuba and Porto Rico have been requested of the Government, but the War Department refuses as yet to grant them, on the ground that it is too early to complete industrial arrangements until the governmental affairs of the islands are more settled

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The Electrical Fixation of Nitrogen.*

BY SIR WILLIAM CROOKES.

My chief subject is of interest to the whole world—to every race—to every human being. It is of urgent importance to-day, and it is a life and death question for generations to come. I mean the question of food supply. Many of my statements you may think are of the alarmist order; certainly they are depressing, but they are founded on stubborn facts. They show that England and all civilized nations stand in deadly peril of not having enough to eat. As mouths multiply food resources dwindle. Land is a limited quantity, and the land that will grow wheat is absolutely dependent on difficult and capricious natural phenomena.

It is now recognized that all crops require what is called a "dominant" manure. Some need nitrogen, some potash, others phosphates. Wheat pre-eminently demands nitrogen, fixed in the form of ammonia or nitric acid. All other necessary constituents exist in the soil; but nitrogen is mainly of atmospheric origin, and is rendered "fixed' by a slow and precarious process which requires a combination of rare meteorological and geographical conditions to enable it to advance at a sufficiently rapid rate to become of commercial importance. There are several sources of available nitrogen.

The only available compound containing sufficient fixed nitrogen to be used on a world-wide scale as a nitrogenous manure is nitrate of soda, or Chili saltpetre. This substance occurs native over a narrow band of the plain of Tamarugal, in the northern provinces of Chili, between the Andes and the coast hills. In this rainless district for countless ages the continuous fixation of atmospheric nitrogen by the soil, its conversion into nitrate by the slow transformation of billions of nitrifying organisms, its combination with soda, and the crystallization of the nitrate have been steadily proceeding, until the nitrate fields of Chili have become of vast commercial importance, and promise to be of inestimably greater value in the future. The growing exports of nitrate from Chili at present amount to about 1,200,000 tons.

I have passed in review all the wheat-growing countries of the world, with the exception of those whose united supplies are so small as to make little appreciable difference to the argument. The situation may be summed up briefly thus: The world's demand for wheat—the leading breadstuff—increases in a crescendo ratio year by year. Gradually all the wheat-bearing land on the globe is appropriated to wheat growing, until we are within measurable distance of using the last available acre. We must then rely on nitrogenous manures to increase the fertility of the land under wheat, so as to raise the yield from the world's low average—12.7 bushels per acre—to a higher average. To do this efficiently and feed the bread-eaters for a few years will exhaust all the available store of nitrate of soda. For years past we have been spending fixed nitrogen at a culpably extravagant rate, heedless of the fact that it is fixed with extreme slowness and difficulty, while its liberation in the free state takes place always with rapidity and sometimes with explosive violence.

There is a gleam of light amid this darkness of despondency. In its free state nitrogen is one of the most abundant and pervading bodies on the face of the earth. Every square yard of the earth's surface has nitrogen gas pressing down on it to the extent of about 7 tons—but this is in the free state, and wheat demands it fixed. For years past attempts have been made to effect the fixation of atmospheric nitrogen, and some of the processes have met with sufficient partial success to warrant experimentalists in pushing their trials still further; but I think I am right in saying that no process has yet been brought to the notice of scientific or commercial men which can be considered successful either as regards cost or yield of product. The fixation of atmospheric nitrogen, therefore, is one of the great discoveries awaiting the ingenuity of chemists. It is certainly deeply important in its practical bearings on the future welfare and happiness of the civilized races of mankind. This unfulfilled problem, which so far has eluded the strenuous attempts of those who have tried to wrest the secret from nature, differs materially from other chemical discoveries which are in the air, so to speak, but are not yet matured. The fixation of nitrogen is vital to the progress of civilized humanity. Other discoveries minister to our increased intellectual comfort, luxury, or convenience; they serve to make life easier, to hasten the acquisition of wealth, or to save time, health or worry. The fixation of nitrogen is a question of the not far distant future. Unless we can class it among certainties to come the great Caucasian race will cease to be foremost in the world, and will be squeezed out of existence by races to whom wheaten bread is not the staff of life.

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*Extracts from the presidential address before the British Association for the Advancement of Science, Bristol, September, 1898.

Let me see if it is not possible even now to solve the momentous problem. As far back as 1892 I exhibited, at one of the soirées of the Royal Society, an experiment on "The Flame of Burning Nitrogen." I showed that nitrogen is a combustible gas, and the reason why when once ignited the flame does not spread through the atmosphere and deluge the world in a sea of nitric acid is that its igniting point is higher than the temperature of its flame—not, therefore, hot enough to set fire to the adjacent mixture. But by passing a strong induction current between terminals the air takes fire and continues to burn with a powerful flame, producing nitrous and nitric acids. This inconsiderable experiment may not unlikely lead to the development of a mighty industry destined to solve the great food problem. With the object of burning out nitrogen from air, so as to leave argon behind, Lord Rayleigh fitted up apparatus for performing the operation on a larger scale, and succeeded in effecting the union of 29.4 grammes of mixed nitrogen and oxygen at an expenditure of 1 horse-power. Following these figures, it would require one Board of Trade unit (kilowatt hour) to form 74 grammes of nitrate of soda, and, therefore, 14,000 units to form 1 ton. To generate electricity in the ordinary way, with steam engines and dynamos, it is now possible, with a steady load night and day and engines working at maximum efficiency, to produce current at a cost of one-third of a penny per Board of Trade unit. At this rate 1 ton of nitrate of soda would cost £26. But electricity from coal and steam engines is too costly for large industrial purposes; at Niagara, where water power is used, electricity can be sold at a profit for one-seventeenth of a penny per Board of Trade unit. At this rate nitrate of soda would cost not more than £5 per ton. But the limit of cost is not yet reached, and it must be remembered that the initial data are derived from small scale experiments, in which the object was not economy, but rather to demonstrate the practicability of the combustion method, and to utilize it for isolating argon. Even now electric nitrate at £5 a ton compares favorably with Chili nitrate at £7 10s. a ton; and all experience shows that when the road has been pointed out by a small laboratory experiment, the industrial operations that may follow are always conducted at a cost considerably lower than could be anticipated from the laboratory figures.

Before we decide that electric nitrate is a commercial possibility, a final question must be mooted. We are dealing with wholesale figures, and must take care that we are not simply shifting difficulties a little further back without really diminishing them. We start with a shortage of wheat, and the natural remedy is to put more land under cultivation. As the land cannot be stretched, and there is so much of it and no more, the object is to render the available area more productive by a dressing with nitrate of soda. But nitrate of soda is limited in quantity, and will soon be exhausted. Human ingenuity can contend even with these apparently hopeless difficulties. Nitrate can be produced artificially by the combustion of the atmosphere. Here we come to finality in one direction; our stores are inexhaustible. But how about electricity? Can we generate enough energy to produce 12,000,000 tons of nitrate of soda annually? A preliminary calculation shows that there need be no fear on that score; Niagara alone is capable of supplying the required electric energy without much lessening its mighty flow.

Acetylene and Calcium Carbide in France.

The consular report on this subject states that there are ten fac- [illegible]

The Development of Wireless Telegraphy.*

BY SIR WILLIAM CROOKES.

The fundamental discovery by Hertz, of the electromagnetic waves predicted more than thirty years ago by Clerk Maxwell, seems likely to develop in the direction of a practical application which excites keen interest—I mean the application to electric signaling across moderate distances without connecting wires. The feasibility of this method of signaling has been demonstrated by several experimenters at more than one meeting of the British Association, though most elaborately and with many optical refinements by Oliver Lodge, at the Oxford meeting in 1894. But not until Signor Marconi induced the British Post Office and foreign governments to try large scale experiments did wireless signaling become generally and popularly known or practically developed as a special kind of telegraphy. Its feasibility depends on the discovery of a singularly sensitive detector for Hertz waves—a detector whose sensitiveness in some cases seems almost to compare with that of the eye itself. The fact noticed by Oliver Lodge in 1889, that an infinitesimal metallic gap subjected to an electric jerk became conducting, so as to complete an electric circuit, was rediscovered soon afterward in a more tangible and definite form and applied to the detection of Hertz waves by M. E. Branly. Oliver Lodge then continued the work, and produced the vacuum filing-tube coherers with automatic tapper-back, which are of acknowledged practical service. It is this varying continuity of contact under the influence of extremely feeble electric stimulus alternating with mechanical tremor, which, in combination with the mode of producing the waves revealed by Hertz, constitutes the essential and fundamental feature of "wireless telegraphy." There is a curious and widely spread misapprehension about coherers, to the effect that to make a coherer work the wave must fall upon it. Oliver Lodge has disproved this fallacy. Let the wave fall on a suitable receiver, such as a metallic wire or, better still, on an arrangement of metal wings resembling a Hertz sender, and the waves set up oscillating currents which may be led by wires (inclosed in metal pipes) to the coherer. The coherer acts apparently by a species of end-impact of the oscillatory current, and does not need to be attacked in the flank by the waves themselves. This interesting method of signaling—already developing in Marconi's hands into a successful practical system which inevitably will be largely used in lighthouse and marine work—presents more analogy to optical signals by flash-light than to what is usually understood as electric telegraphy; notwithstanding the fact that an ordinary Morse instrument at one end responds to the movements of a key at the other, or, as arranged by Alexander Muirhead, a siphon recorder responds to an automatic transmitter at about the rate of slow cable telegraphy. But, although no apparent optical apparatus is employed, it remains true that the impulse travels from sender to receiver by essentially the same process as that which enables a flash of magnesium powder to excite a distant eye.

The Resistance of the Human Body.

Experiments to determine the resistance of the body to the passage of electric currents are described in a communication from Mr. James E. Boyd, of the Ohio State University, to the "Physical Review," August, 1898. The experiments were made with both direct and alternating currents, the circuit being from hand to hand, contact being made by immersing the four fingers of each hand in salammoniac solution. With alternating currents the resistance was obtained by measuring with a dynamometer the current flowing through a given resistance and with the same voltage that flowing through the body. With e. m. fs. varying from 4 to 6.8 volts, the resistance was found to be practically independent of the current flowing, averaging 1550 ohms, the current varying from 2.6 to 4.4 milamperes. With direct currents the resistance of the contacts was eliminated by using the fall of potential method, the measured currents being passed through the body and fall of potential between wrist and wrist, or any parts desired being measured by means of a condenser and galvanometer, the fall of potential without current being subtracted from that with current to eliminate any electrolytic effect. With about [illegible] volts and 0.8 of a milampere the resistance from wrist to wrist was found to be about 625 ohms. From the liquid in the jar to the adjacent wrist a value of 350 ohms was found, giving a total resistance from jar to jar of about 1325 ohms. Other resistances found were those from wrist to elbow, [illegible] ohms, from wrist to end of shoulder blade, [illegible], and from shoulder to instep, [illegible]

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*Excerpts from the presidential address before the British Association for the Advancement of Science, Bristol, September, 1898.

The Annual Meeting of the Association of Edison Illuminating Companies.

The nineteenth convention of the association of Edison Illuminating Companies was held at the Hotel Iroquois, Sault Ste. Marie, Mich., September 12 and 13. There was a large attendance and the convention was a success, both in respect of work done and in its social features.

The first meeting was opened promptly at 9 A. M. Monday, September 12, by President Samuel Insull. There was no formal presidential address. After roll call the representatives of the Edison companies of Detroit, Chicago, Brooklyn, New York and Boston stated their experiences during the past year and their present practice in the making of rates for supply, especially the low rates for long-hour use, particular reference being made to the Wright and the two-rate methods of charging. The statements showed great diversity in methods, but good results invariably follow readjustment in favor of long-hour consumers. The discussion was general and was by consent reopened the next day. At Monday evening's session Mr. W. S. Barstow described the Brooklyn multiphase system in detail. He was followed by Mr. J. W. Lieb, Jr., who reported what the engineering commission recently sent to Europe by the Edison Electric Illuminating Company of New York, consisting of Mr. Lieb, Mr. John Van Vleck, and Mr. Arthur Williams, saw there of electrical and mechanical interest. The discussion was opened by Mr. Herbert A. Wagner, of St. Louis, and had reference largely to alternating current practice.

On Tuesday morning Mr. Arthur Williams spoke of European practice in meters and charging systems, lamps, fixtures and details, as observed by the New York Company's commission. His talk was followed by three papers on meters and metering, by Mr. E. A. Leslie and Mr. Charles S. Shepard, of New York, and Mr. Oliver J. Bushnell, of Chicago. These were replied to by Mr. Caryl D. Haskins, of the General Electric Company, and discussed very fully by Messrs. Scovil (Cleveland), Huntington (Spokane), Chandler (Sault Ste. Marie), Barstow (Brooklyn), and Ferguson (Chicago). A special afternoon session was found necessary, at which the discussion of meters and metering was continued; two papers were read by Mr. C. C. Perry, of Indianapolis, and Mr. W. F. Kingan, of Sault Ste. Marie, on the problems of smaller stations; and a very full report was presented by Mr. Chandler from the association's committee on Welsbach burners and acetylene gas (Messrs. Stetson, Chandler and Leslie).

The last session, held Tuesday evening, received and considered the reports of the Executive Committee, the Committee on Incandescent Lamps, and the Lamp Testing Bureau. The final business was the election of officers for the ensuing year, who are as follows:

President, R. R. Bowker, New York; vice-president, G. R. Stetson, New Bedford, Mass.; treasurer, W. S. Barstow, Brooklyn; secretary, Wilson S. Howell, Newark, N. J. (Post Office Box 114).

Executive Committee—Samuel Insull, Chicago; Charles L. Edgar, Boston, Mass.; J. W. Lieb, Jr., New York; Alex. Dow, Detroit; J. H. Vail, Philadelphia.

The greater part of the attendants at the convention arrived at Sault Ste. Marie by the steamer Northwest Sunday evening and returned by the same steamer, leaving Wednesday afternoon. The lake trip was highly enjoyed and was one of the most pleasant features of the convention of 1898, especially as it afforded opportunity for a good deal of interchange of opinions and experiences. At Mackinac Island, on the upward trip, the delegates and the ladies of the party were entertained by a carriage ride to points of interest, the invitation being tendered by the General Electric Company. At the "Soo" the Edison-Sault Company arranged carriage and steamboat excursions and also provided canoes and Indian guides to carry the more venturesome members of the party through the rapids of the St. Mary's River. The thanks of the ladies and of the association were tendered to the Sault Company and to the General Electric Company for these courtesies.

They Might Carry the Lines Also.

In Berlin, Germany, a new system of fire-department communication has been established with alarm boxes, into which telephone instruments can be plugged. It seems that each fire captain carries a small (?) leather box containing a telephone receiver, a microphone and induction coil, with automatic switch, and a condenser and battery. Just why the captains are required to carry these on their persons does not appear.

Convention of the New York State Street Railway Association.

The sixteenth annual meeting of the Street Railway Association of the State of New York was held at the Manhattan Beach Hotel, Manhattan Beach, New York city, on Tuesday and Wednesday, September 13 and 14, 1898.

The meeting was a remarkably pleasant one, the location being a recreation resort admirably suited for the accommodation of a convention and, owing to the lateness of the season, not crowded with other guests. The weather was fair and cool, the papers and the discussions were on subjects of vital interest and full of valuable suggestions to their hearers, and the entertainments were exceptionally attractive and interesting.

TUESDAY, SEPTEMBER 13.

The meeting was called to order by the president, Mr. G. T. Rogers, of Binghamton, at 11:15 A. M., about thirty members being present, besides several invited guests, among them the railroad commissioners of the State of New York and the usual following of supply men, representatives of the press, etc.

After the transaction of routine business President Rogers read his annual address, which may be briefly abstracted as follows:

THE ADDRESS OF THE PRESIDENT.

"I wish at the outset to mention a calamity which has recently overtaken us. Since our last annual meeting an Almighty Power has seen fit to call to his long rest our beloved and respected attorney, the Hon. Edmund O'Connor, in the death of whom the people of this State, as well as our association, have suffered an irreparable loss. The Street Railway Association of the State of New York is stronger, larger and more representative than ever before. Each year our conventions are more largely attended, and more interest is shown in the work. The affairs of the association at Albany have been conducted during the past year by the executive committee in a most conservative, dignified and frank manner.

"Rapid transit in large cities has exerted a marked influence for the health, comfort and welfare of the resident poor and working classes, and has resulted in an equalization of real estate values, thereby avoiding a congestion of the population that has existed in the past, and creating better living conditions for all. It has opened up large areas of valuable properties hitherto inaccessible, but now within time distance of important and objective points.

"The local transportation companies are fairly entitled to the public aid and encouragement, which has in many instances been grudgingly given, as numerous difficulties have demonstrated.

"The return upon the capital invested in street railway enterprises is generally overestimated by the public; many lines are constructed or extended and operated at an actual loss for years, but I believe that the public begins to see and appreciate the great advantage on its side, and that a more liberal policy will prevail.

"In relation to rapid transit and its development in Brooklyn, I might mention that the operation of through cars from the remotest districts of Brooklyn direct to City Hall, Manhattan, is now an accomplished fact. Nothing was more needful for the convenience of the residents of Brooklyn and the building up of its outlying territory than a quick and convenient mode of transportation to New York. That it has filled a long-felt want is evidenced by the tremendous popularity it has attained. The number of people carried back and forth seems to be limited only by the number of cars which can be operated with celerity and safety.

"In my address of 1896 I stated that the great city of New York was far behind all other cities of the State in modern transportation facilities. It was my pleasure at the last convention to call your attention to the progress made in the installation of improved motive powers in the old city of New York. It then appeared that the State Board of Railroad Commissioners had authorized the use of electricity upon railroads covering 110 miles of track. Since that time the railroads have put in operation over 86 miles of trackage, of which 54 miles have been constructed and completed during the present year.

"The rapid track construction in the city of New York, involving as it does the reconstruction of sewers, changing and laying gas and water pipes, has been one of the noticeable features in railroad history, and deserving of great commendation, which has been bestowed by the New York press. The reconstruction of the Sixth and Eighth Avenue lines in twenty-five days after the ground was broken on July 20, so as to permit of the temporary operation of horse cars to the shopping centres for the convenience of the public, is a record unparalleled in city railroad construction. With a power house costing $3,000,000, New York city will be furnished with a system of transportation that may well be envied by all roads of the country.

"At the present moment the Metropolitan Street Railway Company is engaged in reconstructing 22 additional miles of trackage for operation by electricity, leaving a balance of 120 miles of the Metropolitan system and 114 miles of the Third Avenue system yet to be transformed.

"The interest in the cable system is now purely historical. It has served its purpose and served it well, but its day is done. From the railway standpoint there is nothing to be hoped from it, but we all look back on it with gratitude, as it was first instrumental in displacing the horse.

"Its availability for overcoming heavy grades cheaply remains unimpaired, but its merit for average transportation has been excelled by electric system."

Following the president's address the treasurer submitted a report showing the gross receipts for the past year to be $6,205, the balance on hand from the year before being $1,359.71. The disbursements during the past year were $6,400.26, leaving a balance on hand of $1,164.45. The report of the executive committee was also presented.

The first paper read was one by Mr. H. M. Kennedy, entitled

METHODS OF DEVELOPING NEW TRAFFIC ON STREET RAILWAYS.

The writer pointed out the increase of business obtainable by proper methods of advertising and encouraging street railway riding. He advised the establishment of a suitable "special traffic" or "general passenger" department to undertake this work. He pointed out the duties of this department in obtaining favorable press notices, establishing special trolley party traffic in parlor, buffet and specially illuminated cars, and went into the subject of pleasure resorts. In this connection he described particularly the resorts reached by the Brooklyn companies, notably Bergen Beach, North Beach, etc., which are not managed directly by the companies, but which are encouraged in advertising and other ways by co-operation and division of the expense, special advertising on the cars, etc. The paper closed as follows: "But special cars, pleasure resorts, advertising and co-operation are not the only methods for developing new traffic. Clean, ample cars, through lines and generally efficient service are requisites to satisfy those who are induced to patronize the road and hold those who are already patrons, making it such a pleasure to travel that they would rather be on the road than at home."

In the discussion of this paper Mr. T. L. Johnson, president of the Nassau road in Brooklyn, stated that some three years ago his road introduced a uniform 5-cent fare, and that last year it had practically a monopoly of the business to Coney Island. This season the other system in Brooklyn, representing 75 per cent. of the carrying capacity of Brooklyn lines, have gone into Coney Island, Bergen Beach and other resorts; but notwithstanding this the Nassau business has increased steadily, which shows that the traffic will grow as inducements are offered. The Sunday business has been only limited by the capacity of the lines. Mr. Johnson also described a rather unusual car in use on his road, consisting of a single-truck car body 31 feet in length, with ten benches arranged vis-a-vis, and with six exits, two at the platforms and four side doors, and one side solid with glass. By letting down the end windows the car can be made as cool as an open car in summer, and rendered more weatherproof than a closed car in winter. The [illegible] side is intended to be replaced during the hot months by one long curtain to be controlled by the motorman or conductor. About 250 of these cars will be on the road by the 1st of October.

President H. H. Vreeland, of the Metropolitan Street Railway Company, of New York city, said that that company did not have to stimulate travel, but found it difficult to accommodate that which naturally came to it. Speaking of other lines with which he was connected, he described the Atlantic Coast line and its successful [illegible] resort at Pleasure Bay, near Long Branch, but stated that, as a rule, he believed in the old saw "Shoemakers, stick to your last."

Mr. J. P. E. Clark described the work of the Binghamton Company with two parks which, he said, increased the average monthly receipts of the road [illegible] One of these is a park [illegible] by the city, the [illegible] being provided by the company; the other is owned and operated entirely by the company, and is [illegible] from the [illegible] fare being 5 cents

Delegates of the New York State Street Railway Association at Manhattan Beach.

Following the discussion a paper was read by Mr. H. S. Cooper on

A SIGNAL SYSTEM FOR SINGLE TRACK ROADS.

Where an electric road is similar in conditions to steam roads, and where its traffic will warrant the outlay, steam road signal and safety systems may, of course, be adopted; but most electric roads are not conditioned in this way and other systems must be used. Certain requirements are essential to success, as follows: 1. Reasonable cost of installation and maintenance; 2, simplicity in construction and operation; 3, proof against frost, sand, dust, mud, sleet, sun, snow, water, oil and ordinary tampering; 4, reliability and inability to give safety signals when out of order; 5, capability of being used as a signal between two points at the same time. The uses of such a system would naturally be mainly to prevent collisions, as a dispatching system and as a means of communication. In connection with the first use collisions are not likely to occur at terminals and switches, but mainly at the intermediate runs. The only system which has yet appeared to be satisfactory to the writer is a simple telephonic dispatch system.

In the discussion of this paper Mr. James A. Powers described the difficulties found in his experience with single-track roads requiring that motormen should be absolutely forbidden to run by switches under any circumstances. If the telephone line breaks down the cars wait until they get orders in some other way. This blocks traffic and limits the schedule capacity of the road and necessitates a system of double heading the cars, or large cars. The Stillwater and Mechanicville line is using 15-bench open cars, seating ninety passengers and carrying fully 130 to 150 passengers per car. Great need is felt for a system by which it would be impossible for a car to enter upon a block already occupied without becoming derailed, but there has been no satisfactory apparatus offered as yet.

Further discussion brought out the general opinion that the best means of solving the signal system problem on single-track roads is to double track them.

The next paper read was one by Dr. M. M. Fenner, entitled

BY-PRODUCTS OF THE POWER HOUSE.

The one by-product discussed in this paper was exhaust steam, the efforts to make use of which by the Dunkirk & Fredonia Railroad were described in detail. In the winter season of 1893-4 the road sold its exhaust steam for the purpose of heating a hotel immediately across the street from the company's power house. The system used was found to be a flat failure, and the company was compelled to heat the building with live steam injected into the exhaust with sufficient pressure to compel the circulation. During the summer of 1894 the railway company made an investigation and requested the experience of several others, notably that of the Buffalo Electric Lighting Company, some reports being absolutely discouraging, but others, notably those from the users of one system, were more hopeful. The company went ahead and put in this system and also added an electric light and power plant. The capital of the company had increased from $57,000, when it was operating a horse railroad, to $116,200, and it had acquired a bonded 5 per cent. debt of $61,000, but 6 per cent. was paid on the increased capital. Of this 3 per cent. came from the railroad returns and 3 per cent. from the sale of exhaust steam. It was sold by meter at a rate based upon $4.17 per ton for a high-grade anthracite coal, and at this rate users preferred it to their own heating plants. The back pressure is about four to six pounds, thus giving ample circulation at considerable distances, with the aid of the partial vacuo caused by condensation, the condensed water being trapped to the sewer. The back pressure makes no noticeable difference in the coal consumption. The system has been found profitable and satisfactory in every way. The underground steam distribution is effected by the Holly system as installed by the American District Steam Company, of Lockport, N. Y., wherein the steam pipe is placed on rests 1 inch high, within bored logs, the bore being 2 inches greater than the external diameter of the pipe, so as to give 1 inch of dead air, the pipe itself being wrapped with asbestos. The log has a shell 4 inches thick soaked with preserving materials and lined with tin, which is covered with three-ply tar roofing felt, the whole being laid on a board at the bottom of a trench 5 feet deep. Expansion joints are inserted at proper intervals with brickwork above them, proper tile drainage being placed beneath the structure to carry off the water. A rough rule for the amount of heating which a power plant may do with its exhaust steam is to figure on 10,000 cubic feet of space in average buildings per horse-power. At the rate of $13 per thousand cubic feet this would give $30 per horse-power year. The system is adaptable to all sorts of consumers, and during the hours when the steam consumption of the engines is small it may be supplemented by live steam at small cost, owing to the fact that the load on the boiler equipment is thereby rendered much more uniform.

The meeting then adjourned until afternoon.

AFTERNOON SESSION.

In the discussion of Mr. Fenner's paper Mr. W. J. Clark spoke of the combined working of the railway and lighting business, stating that in New England the electric lighting concerns have been very careful to see that electric railways did not get the right to encroach upon their business. In the West, however, a great many systems are worked together, and wherever it has been tried in smaller places the combination, as a rule, has been found advantageous, producing economies which would be impossible in running two small systems independently.

Prof. R. C. Carpenter stated that the profit from exhaust steam would depend largely on the nature of the engine. With an economical compound condensing engine from which a hp hour can be obtained from 2 to 4 pounds of coal, it would, as a rule, not pay to attempt to use the exhaust steam for heating purposes. He also cited Ithaca and Cortland, N. Y., as instances where the power stations for the lighting and railway service have been combined with great advantages. In each case the two systems are run by two companies, having, however, common stockholders and common officers. He cited tests made at Cornell University of heat insulation, showing that the best results practically attainable reduced the condensation to about one-fifth of that in pipes exposed to the open air. In open air exposure about one-third of a pound of steam is condensed for each square foot of surface.

In answer to a question as to the distance to which steam can be economically carried, Mr. Fenner stated that at Cedar Rapids, Ia., the exhaust is carried over a mile to the centre of distribution and used satisfactorily.

Following the discussion, Mr. G. E. Chapin read a paper on "Track Bonding," prepared by Mr. R. P. Brown and himself, a reprint of which will be found in another column.

After a brief discussion Mr. W. J. Clark read a paper on "Electric Railways as Auxiliary to Coast Defenses," an abstract of which will be published later in these columns. Papers were also presented on "Rails; Their Construction from a Scientific Standpoint," by Mr. Moxham, and on "Track Construction," by Mr. G. F. Carver. Abstracts of these papers will also appear later.

In the discussion of the latter paper, Mr. H. H. Littell, of Buffalo, spoke of 5 miles of track which the Buffalo Railway Company had installed in 1897 without any ties. A trench was dug 20 inches wide and 17 inches deep, and the 60-pound rails, with staggered joints, suspended above it, and adjusted to line and gauge by a clamping appliance. Concrete made up of Portland cement and fine broken stone was then tamped under the rail and filled to a level just above that of the base of the rail. After twenty-four hours the clamping appliances were removed. The track has proved perfectly solid, there being not the slightest sign of movement, and it is difficult to find a joint. Seventeen miles of road had been laid in Buffalo with the concrete base laid first and the rail placed on top of it, and filled with Portland cement mortar. This is not as satisfactory. Concrete foundation is, however, difficult to install where the track must be hurriedly used. In some track lately relaid a tie was put in every 10 feet to preserve alignment, the concrete being tamped under the ties as well as under the whole rail. Such track can be used five or six days after being laid, and in the Buffalo piece it is very difficult to find the joints. They were laid as tight as they could be.

THE DISCUSSION OF STORAGE BATTERIES.

The question of storage batteries coming up, Mr. Littell spoke of the big Buffalo installation, which has been in use about nine months. The battery installation is rated at 1200 hp hours, the steam plant having a nominal output of 7000 horse-power and 2000-hp supply coming in from Niagara. The battery trays are sufficiently large for an increase of 67 per cent., and this increase will probably soon be made. The company is very much pleased with the operation. It has the same effect as a safety valve on the steam boiler or a standpipe on a water works; it takes the sudden impulses. There have been instances where with but one 1200-hp engine running and 2000 horse-power coming in from the Falls, the latter has been unexpectedly shut down, but the cars went on and the people did not know it. The battery held the load for fifteen or twenty minutes until more engines could be put in. The battery has carried the night load for three or four hours alone.

Mr. H. H. Vreeland stated that as a result of considerable experience with batteries in Philadelphia and Pittsburg the Metropolitan Street Railway Company of New York city has just contracted for one of the largest plants that has ever been erected for a street railway company. The situation of this company is peculiar. It is building a power house of 70,000 horse-power, which will not be ready until next spring. The temporary generators now in use or under erection will not carry the load through the winter, and a storage battery auxiliary is to be put in to be worked permanently with the large plant when that is in service. The experience of plants throughout the country with storage batteries has shown that they are economical auxiliaries wherever the power capacity is reached in the heavy hours.

In answer to a question, Mr. Littell expressed the opinion that any small road running from thirty to fifty cars would be justified in putting in a storage battery.

At the conclusion of this discussion, Mr. T. J. Little, of New York, read a paper on "The Relation Between the People and the Street Railways," after which a nominating committee was appointed, consisting of Mr. H. H. Littell, of Buffalo; Mr. Ira A. McCormack, of Brooklyn, and Mr. F. D. Rounds, of New York. The convention then adjourned for the day.

WEDNESDAY, SEPTEMBER 14.

The meeting was called to order at 10:15 A. M., the first business being the report of the nominating committee, the nominations of which were as follows: President, G. Tracy Rogers, Binghamton, N. Y.; first vice-president, W. Caryl Ely, Niagara Falls, N. Y.; second vice-president, Albert L. Johnson, Brooklyn; secretary and treasurer, Henry A. Robinson, New York. Executive committee: Herbert H. Vreeland, New York; John W. McNamara, Albany; Henry M. Watson, Buffalo; Clinton L. Rossiter, Brooklyn. A unanimous ballot was cast for the officers nominated.

Ithaca was chosen as the next place of meeting of the association, the meeting to be on Tuesday and Wednesday, September 12 and 13, 1899, according to the by-laws.

On the request for a few remarks, Mr. K. Sugahara, chief engineer of several street railroads soon to be built in Japan, spoke on somewhat the same lines as his address before the American Street Railway Association.*

After thanking the Brooklyn companies for their courtesies, the convention adjourned.

THE BANQUET.

On Tuesday evening, after the display of Pain's fireworks, the delegates sat down to a banquet at the Manhattan Beach Hotel. The Hon. T. L. Johnson was toastmaster. President Vreeland responded to the toast "Transportation in Greater New York," saying that the street railways in Greater New York collect 600,000,000 5-cent fares per year, of which three-fourths are taken in on Manhattan Island. Other toasts were proposed and responded to as follows: "Our Best Patrons, the Ladies," by A. B. Colvin; "The Busy Boys, Our Legislators," by State Senator J. A. Cantor; "Our Host," by J. H. Stedman; "A Necessary Evil, the Lawyers," by J. Aspinall; "Our Association," by W. Caryl Ely.

WEDNESDAY'S ENTERTAINMENT.

At 11 o'clock, after the adjournment of Wednesday morning's session, the delegates boarded electric cars and were carried over various interesting lines through Brooklyn to the Brooklyn Navy Yard. Here they saw several of Uncle Sam's warships lately returned from active service, but were disappointed in not being permitted to board them. From here the party was taken to the bridge dock, where it embarked for a trip around Manhattan Island. The trip was greatly enjoyed, and those locally acquainted were kept busy pointing out the objects of electrical, and particularly of electric railway, interest on the route. Among these were the mammoth Eastern District power house of the Brooklyn Rapid Transit Company, the new generating plant of the Kings County Electric Light & Power Company, the partially constructed 70,000 hp power house of the Metropolitan Street Railway Company, the [illegible] railway and lighting [illegible] of the New York & Queens County Company, the terminal car storage structure and temporary electric and compressed air power house of the Metropolitan Street Railway Company at One Hundred and Forty-[illegible] Street, and the [illegible] car house and power plant built for the [illegible] of the Third Avenue Railroad Company, but [illegible] in franchise litigation. The shores of New York Harbor are rapidly becoming studded with large plants for the generation of electricity, and had the convention gone down the bay instead of up the river it would have passed the power house of the Nassau Railroad, the southern station of the Brooklyn Rapid Transit Company, the new high-tension multiphase central generating station built by the Brooklyn Edison Company and the combined railway and lighting station of the New York & Staten Island Electric Company.

Exhibits and Notes.

MR. C. W. OLDS represented the American Blower Company, 141 Broadway, New York.

MESSRS. J. E. WALLACE and J. L. Lawton represented the Smith-Wallace Supply Company, Boston.

MR. KORAN SUGAHARA, an electrical engineer of Japan, was an interested attendant at the convention.

THE COLUMBIA MACHINE WORKS, Brooklyn, N. Y., were ably represented by Mr. W. R. Kerschner.

MR. J. S. BRADLEY looked after the interests of the New Haven Car Register Company, New Haven, Conn.

PROF. R. C. CARPENTER, of Sibley College, Cornell University, was a visitor at the meetings of the Street Railway Association.

MR. W. J. CLARK, of the General Electric Company, was in attendance at the convention, and participated in the discussion of the papers presented.

MESSRS. THOMAS H. BIBBER and Herbert W. Smith were present in behalf of the Bibber-White Company, Boston, and made an exhibit of a general line of electric railway supplies.

THE KEYSTONE ELECTRICAL INSTRUMENT COMPANY, Philadelphia, was represented by Mr. J. F. Stevens. Many good things come from the Quaker City, among them being Keystone instruments.

THE ECONOMIES obtainable through the use of storage batteries in railway work were brought to the attention of the delegates by Mr. Charles Blizzard, who represented the Electric Storage Battery Company.

MESSRS. WENDELL & MacDUFFIE, New York, sent Mr. J. H. Wright down to Manhattan Beach to represent them. Both Messrs. Wendell and MacDuffie accompanied the party on the boat ride around the harbor.

THE CONSOLIDATED CAR HEATING COMPANY, Albany, N. Y., was present in the person of Mr. H. N. Ransom, who reminded the street railway men that cold weather was approaching and that they would need some heating apparatus for their cars.

MR. H. B. CUTTER, president of the Cutter Electrical & Manufacturing Company, Philadelphia, Pa., was an attendant at the convention. He visited the Brooklyn Navy Yard with the party on Wednesday, but was unable to take the sail around the harbor.

THE SAFETY THIRD RAIL ELECTRIC COMPANY, New York, was represented by Capt. J. McLeod Murphy and Messrs. William Duvoe, John Cokeley, Frank Murphy and E. V. Baillard. An operative model of the system was shown, and it excited much interest among the delegates.

MESSRS. GEORGE A. PARMENTER & CO., of Cambridgeport, Mass., were represented by Mr. Parmenter, who had an exhibit of a Parmenter fender and wheel guard. Over 2000 of this firm's fenders and wheel guards are in practical operation on electric railways throughout the United States.

MR. J. EMORY MEEK looked after the interests of the H. W. Johns Manufacturing Company at the convention. He did some effective work among the street railway men present. Mr. A. Hall Berry, manager of the electrical department of the same company, dropped in on the convention and met the delegates.

THE FALK MANUFACTURING COMPANY, Milwaukee, Wis., represented by Mr. J. Z. George, showed an auto-motoneer, which device is designed to avoid the needless waste of current in starting cars. The apparatus was briefly described in the last issue of THE ELECTRICAL WORLD in connection with the Falk Company's exhibit at the Boston convention.

MR. W. I. THOMSON, of the firm of Wilson, Thomson & Co., 313-315 Fulton Street, Brooklyn, N. Y., showed the Wilson patent trolley pole catcher and reel, manufactured by the firm above named. The object of this device is to catch and hold the trolley pole whenever the trolley wheel jumps the wire. It, therefore, prevents damage to overhead wires, etc. The clock spring inside of the case keeps the rope taut at all times. This device was described and illustrated in THE ELECTRICAL WORLD of February 19, 1898.

MR. GEORGE L. CAMPBELL, manager of the Campbell Electric Traction Company, [illegible], Pa., had intended to show a model of the Campbell system of electric traction, but unfortunately the model was damaged in transit. He, however, explained the system to the delegates. The conduit of this system is a continuous body (air and water tight), about 6x9 inches in cross section, and rests upon the top of the ties. A continuous electrical conductor lies on the bottom of the conduit, inside. The top of the conduit, which is composed of sections of metal 8 feet long, but insulated from the rest of the structure, is brought into electrical contact with the conductor by means of a [illegible] designed tower, or traveler, which runs in the conduit, the movement of the tower being controlled by a pair of strong electromagnets in the car. [illegible] on the top of the conduit and [illegible] the current to the motor. It is evident, therefore, that no part of the conduit surface is alive except the 8-foot length immediately under the car. The advantages claimed for the Campbell system are (1) no excavation is needed to install the conduit, (2) cheapness of installation, and (3) simplicity of construction. From these three principal advantages many other obvious ones follow. The system is in fact a surface contact inclosed conduit system, and as there is no slot or other opening the conduit cannot become filled with water or dirt.

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*See THE ELECTRICAL WORLD [illegible]

DIGEST OF CURRENT ELECTRICAL LITERATURE
AMERICAN AND FOREIGN
By Carl Hering.

Dynamos, Motors and Transformers.

POLYPHASE NON-SYNCHRONOUS MOTORS. Rhodes. Lond. "Elec. Rev.," Sept. 2.—Although polyphase induction motors are self-starting, they are not all equally good in this respect, and many difficulties are to be overcome in their design. In a short theoretical deduction he shows what the starting resistance should be, but to use this requires sliding contacts. He then considers the attempt of Boucherot to attain this end without the use of a variable resistance. (Several references to descriptions of this motor have already been given in the "Digest.") Briefly described, this motor has two distinct stator windings on a common framework; one is fixed and the other is capable of being moved through a certain angle by means of a lever; there are also two motors of the squirrel cage type mounted on the same shaft. At the start the two stator windings are placed at angular distances from each other, corresponding to half a period of the current, and after the start this angle is gradually diminished until it becomes zero, at which the motor runs normally. Thus the start is effected by varying the difference of phase between two systems of polyphase circuits placed in parallel, and a high starting torque is obtained without the use of rubbing contacts. He gives the results of tests of the efficiency and power factor, both of which are high, namely about 86 per cent.; the starting torque was three times as great as the normal torque at full load, and the starting current about three times the normal current. The curves, giving the speed, efficiency and power factor, are reproduced.

SAYERS DYNAMO.—Lond. "Elec.," Sept. 2.—A brief, illustrated description of a Swedish type of this dynamo. The illustrations are for an eight-pole machine yielding 1700 amperes at 100 volts at 235 revolutions. Some years ago the improvement was made to increase the air gap toward the trailing pole-tips, so as to obtain a nearly uniform distribution of the field at full load; this also had the effect of making the reversing field more nearly proportional to the load, thus securing a nearly constant position for the brushes; the result of the experiment was most successful, and the machine ran without sparking from full down to one-tenth load.

ALTERNATORS IN PARALLEL.—Lond. "Elec. Eng.," Sept. 2.—Several answers to a question whether it is advisable to run two alternators of different design in parallel; also to the question what the smooth running of alternators in parallel chiefly depends upon. Although alternators of different design are frequently run in parallel, the practice is not to be recommended.

ROTARY CONVERTERS. De Marchena. "L'Ind. Elec.," August 25.—The continuation of his mathematical discussion (see "Digest" Sept. 3); no general conclusions appear to be drawn.

STRAIGHT VS. T TEETH.—"Amer. Elec.," Sept.—An editorial comparing the relative advantages and disadvantages and concluding that it is probable that the straight teeth will become the preferred American practice, although a method for securing the coils which is better than band wires is still desired.

ARMATURE WINDINGS. Rice. "Amer. Elec.," Sept.—In this continuation of his serial he describes the Wenstroem windings.

INDUCTION MOTOR. Wiener. "Amer. Elec.," Sept.—In this continuation of his serial he describes the armature windings of induction motors.

STEAM ALTERNATOR.—"Amer. Elec.," Sept.—An illustrated description, including a double-page plate of some large steam alternators of 2500 horse-power made in this country for a station in England.

Lights and Lighting.

ENERGY IN THE VACUUM TUBE LIGHT. Ebert. "Wied. Ann.," No. 8; abstracted in the Lond. "Elec.," Sept. 2.—In an article on alternating current discharge tubes, he gives the results of measurements of the energy consumed in the "lamp of the future." He used high-frequency currents obtained by direct transformation, and not by means of condensers; the generator was really a transformer, transforming from direct to alternating current; the alternating current was transformed to 1000 or 2000 volts by the transformer, and the current was measured by a hot wire ammeter; the voltage was measured by a Bjerknes voltmeter, consisting of an aluminum leaf hanging between two plates and at 45° with them; the alternations were 1000 per second. For a long discharge tube the following figures were obtained: 64 volts, 1.81 amperes, 116 watts for the continuous current; 33 volts, 1.05 amperes and 27 watts for the low-pressure alternating current, the phase difference being 50.5°; 2200 volts, 0.01 ampere and 20.6 watts for the high-pressure alternating current, the latter figure being the consumption in the tube at a time when it gave a perfectly steady light of about 16 candle power. The actual watts consumed compare favorably with the incandescent lamp, but not the watts consumed in the original circuit.

ECKMUEHL LIGHTHOUSE. Dary. "L'Elec.," Aug. 20.—An article giving an illustrated description of this new, large lighthouse in France; other descriptions have already been noticed.

TESTING ARC LIGHT CIRCUITS. Markland. "Elec. Eng.," Sept. 8.—The first installment of an article. He claims that the question of testing circuits while the current is on has not received the attention which it deserves, as about nine-tenths of the arc light stations rely wholly on the magneto-bell for testing. He seems to favor the use of the voltmeter instead, and in the present portion he mentions some uses to which the voltmeter may be put.

Power.

CLEES-YVERDON TRANSMISSION AND DISTRIBUTION PLANT. Laffargue. "L'Ind. Elec.," Aug. 25.—A long, illustrated description of this plant, which is said to be one of the largest and most important of those recently constructed; it has been in regular operation since December, 1896, and provides about twenty villages with light and power. A three-phase current at 5000 volts and a frequency of 50 is used; the available power is 1800 horse-power at the turbines; a waterfall of the Orbe is used; the total length of the primary circuit is 50 km; there are thirty sub-stations with a total of 1000 kw; the distribution net-work has 120 volts for the incandescent lamps or for three arc lamps in circuit; for small installations only two wires are used; the differences in the loads on the different phases do not cause any trouble in the steadiness of the lights. The number of incandescent lights is about 6500, and there are about 50 arc lamps; the chief application of the current is for motive power, as there are at present eighty motors from 0.1 to 120 horse-power of a total of 750 horse-power. The small motors are connected to the lighting circuit, while several have special transformers; there is only one motor of 45 horse-power, which is connected directly to the 5000-volt circuit. The motors all are without brushes—that is, have short-circuited armatures. Above 2 horse-power starting resistances are used, in order not to affect the lights; an illustration of one of the motors is given. The charges for current are also given, and are quite low; for a 1-hp motor the charges are $48 per year, and for a 10-hp motor at the rate of $38 per hp-year; special reduced terms are made for motors which are used only during daylight hours; in such cases there is an hour meter in series with the circuit.

POWER FOR MACHINE-TOOLS AND SHAFTING. Langdon. Lond. "Elec. Rev.," Sept. 2.—A brief abstract of his recent paper before the Institute of Mech. Eng., on the electric machinery of the Midland railway. The following figures are given in the abstract. There is a shaft 98 ft. long, 2 in. in diameter, with 12 bearings, 4⅜ in. long, which drives 15 tools; ordinarily it drives 19 belts; the main shaft, without any belting, absorbed 272 watts; with the 19 belts resting on it (probably meaning running idle) the power absorbed was 518 watts, and with the countershafts added (how many is not stated in the abstract), 794 watts. To drive a 9.5-in. screw cutting lathe alone absorbed 381 watts; when cutting a gun metal bar at 1.1 oz. per minute 545 watts were used; the work done only used 164 watts, or at the rate of nearly 500 watts per oz. of metal per minute. A low-efficiency motor geared directly to the lathe used only 214 watts per oz. of metal cut per minute, showing the advantages in favor of direct gearing. A comparison is made of the power absorbed in removing metal from a lathe driven from a shaft and from a small motor; according as the metal was being removed at 1, 2 or 3 cuts, the power absorbed per oz. per minute was, with belt driving, 591, 389 and 275 watts, and with motor driving 206, 191 and 143, for exactly the same conditions as to speed and time. Thus a motor driving direct absorbed very much less power than a motor with shafting and belts, barely a fourth when the lathe was running light; this shows the economy possible with electrical driving; the difference is even greater, owing to the intermittent nature of the work, as the continuous dead load of the shafting bears a higher ratio to the live or working load than nominally appears.

TRANSMISSION SYSTEM.—Lond. "Elec. Rev.," Sept. 2.—A short article ridiculing the suggestion of Asher noticed in the "Digest" Aug. 27.

COMPRESSED AIR AND ELECTRICITY.—"Eng. News," Sept. 8.—A brief description of an interesting change which is being made in the plant of the Lassig Bridge and Iron Works, of Chicago, in which the use of line shafting will be dispensed with and all the tools will be operated by compressed air or electricity, according to which power is the best adapted for each particular purpose; the electric plant is referred to only very briefly.

CRIPPLE CREEK.—"Elec. Eng.," Sept. 8.—A brief description of the plant which has just been started and in which power is transmitted from Canon City to the Cripple Creek gold mines. (See also "Digest" Sept. 10.)

Traction.

ELECTRIC TRACTION ON STEAM ROADS IN PARIS.—"L'Ind. Elec.," Aug. 25.—A short editorial on the extension of the Orleans Railroad into the heart of Paris, on which extension electric traction is to be used, as much of the line is underground. The work on this extension is being pushed rapidly with the hope of completing it in time for the exposition of 1900. The locomotives will weigh 45 tons and have 7000 horse-power; current will be taken from the third rail; the locomotives will have four axles, each provided with a motor of 125 kilowatts; they will be able to draw normally a train of 250 tons at a speed of 50 kilometers per hour, and under certain circumstances a train of 300 tons; with this load they can start a train on a grade of 11 in a thousand. The central station will have two units of 1000 kilowatts each, and will generate three-phase currents at 5500 volts; there will be two transformer stations, in which this will be transformed into a continuous current of 550 for traction and 450 for lighting. The locomotives will be attached at the Austerlitz station, and the change will require but two minutes.

COMBINED ACCUMULATOR AND TROLLEY TRACTION. Scott. Lond. "Elec. Rev.," Sept. 2.—The beginning of an article which is intended to show that a good working compromise is possible in large cities when the accumulator and the overhead trolley systems are combined. This mixed system was first used in Hanover and Dresden; in the former the extra cost of the combined system, compared with the trolley system alone, does not exceed 0.4 cents per mile (probably car mile); the running expenses, including the driver, amounted to 4.44 cents per car mile; these figures are based on the official report of 1896; there is sufficient evidence that the system has been found very remunerative in Hanover, and can be honestly pronounced to be a success. In none of the continental systems are the batteries moved about the way they are in Birmingham; in Berlin this system, as also the combined trolley and conduit system, is used, and the authorities appear to prefer the former, as the streets are not disturbed and the trouble with the drainage of the conduits is eliminated. He then gives a description of the latest of these plants in Paris.

HOLMENKOLLEN MOUNTAIN RAILWAY. Hoffmann. "Elek. Zeit.," Sept. 1.—A long, illustrated description of this line, running out from Christiania, Norway; it passes through a very hilly region, and is largely a tourists' line. The difficulties involved in curves and grades were quite great, 40 per cent. of the line being straight and 60 per cent. on curves; the maximum grade is 1 in 25 and the mean 1 in 27, the total rise being 192 metres and the total length 6.59 km. The current is obtained from the power house of another line, the voltage being 530; parallel to the dynamo is a battery of accumulators located 3.5 km from the power house; it contains 250 cells, and can be discharged in from one to three hours; ordinarily it is simply connected in parallel, but for complete charging it is divided into three groups, each two of which are charged in series; there are two meters in circuit, each running in only one direction, so that the charging and discharging currents are both measured; the proportions are such that the state of charge at the beginning and end of a day's operation is the same; the difference in the voltage of a battery at charging and discharging is 30 to 40 volts. Each car has two motors of 25 horse-power each; the controller diagrams are reproduced.

STATIONARY ACCUMULATORS IN POWER HOUSES. De Waal. "L'Elec.," Aug. 27.—An abstract in French of the paper by Schroeder, which was noticed in the "Digest" last year.

MEASURING THE POWER FOR PROPELLING SHIPS.—[illegible] Sept. [illegible]—A short editorial on the experimental tank which is being built by the Navy Department in Washington, the object of which is to [illegible] the speed of ships with the aid of models. It is expected that the tank will be completed by October; [illegible] the tank is [illegible] long and [illegible] wide; the model ships will be drawn by means of [illegible] carriage driven electrically at speeds from [illegible] per minute; the weight of this carriage will be [illegible] pounds, and it will have four motors to be operated at [illegible] volts; the controller will give [illegible] different speeds.

CONTROLLER CONNECTIONS.—"Amer. Elec.," Sept.—Four diagrams, showing the connections in the controllers of the General Electric, the Westinghouse, the Walker and the Johnson companies.

CAR WIRING. [illegible] "Amer. Elec.," Sept.—A short article, giving practical hints concerning the details in car wiring.

CRIPPLE CREEK. [illegible] "[illegible]," Sept. 8.—A long illustrated description of this electric railway, which is said to be the highest in the world, connecting Cripple Creek and Victor [illegible].

CLEVELAND. Fairchild. "Elec. Eng.," Sept. 8.—The first part of an article in which he gives illustrated descriptions of the [illegible] railways from Cleveland [illegible].

BOSTON. Waller. "Elec. Eng.," Sept. [illegible]—An illustrated description of the [illegible] power station of the Boston Elevated Railway Company.

Installations, Systems and Appliances.

ACCESSORIES FOR 250-VOLT INSTALLATIONS. Passavant. "Elek. Zeit.," Sept. 1.—A reprint of his paper read before the annual meeting of the Union of German Electricians. It is a mere summary, as it is practically the same as the paper which was noticed in the "Digest" July 30.

WATER POWER INSTALLATIONS IN THE FRENCH ALPS.—"Elek Zeit.," Sept. 1.—An abstract of a short article noticed in the "Digest" Aug. 27.

ELECTRICITY IN SPAIN.—"L'Elec.," Aug. 20.—An abstract in French of the German article noticed in the "Digest" May 28.

DETROIT.—"Eng. News," Sept. 8.—A long analysis of the third annual report for this municipal plant, this city having made the largest venture in a municipal electric lighting system of any city in the United States. A table is given showing the average cost of the arc street lighting in each State and in each of the principal cities in the United States; comparing the Detroit figures with the average for 1045 plants included in the first table, it is shown that in Detroit the hours per lamp were greater, the cost for coal less, the cost per lamp per year less, and the cost per lamp per hour considerably less than the average of all the stations reporting. An extract of the original report was published in The Electrical World Aug. 13.

Wires, Wiring and Conduits.

COST OF COPPER, ALUMINUM AND IRON CONDUCTORS. Kershaw. Lond. "Elec. Rev.," Sept. 2.—A short article in which he calculates the relative costs of copper, aluminum and iron when used as electrical conductors; first, on the basis of the data in Hunt's recent (American) paper and then based on prices taken from current price lists. He obtains a simple algebraic expression in which he substitutes the values used by Hunt and obtains 101 to 100 as the relative cost of copper and aluminum wire of equal lengths and equal electrical resistance; this agrees closely with Hunt's figures. Substituting the figures taken from current price lists, in which the price of copper is taken as nearly 12 cents per pound instead of 14, as assumed by Hunt, and that of aluminum as nearly 32 cents, instead of 29, and for its conductivity 59, instead of 63, he obtains the ratio 100 to 135; he assumes 99 per cent. aluminum; thus aluminum is 1⅓ times as costly as copper. The cost of converting the ingot metal into wire will probably be about the same in the two cases. He doubts whether any company will ever be able to produce 100 per cent. aluminum in wire at 29 cents per pound. He then makes a similar comparison between iron and copper, obtaining the ratio 278 to 100, assuming a conductivity for iron of 16.4 Matthiessen standard at a price of about $18 per ton; it is therefore by far the cheapest metal for electrical transmission, and although its weight, compared with copper and aluminum, prevents its being used for overhead lines, there seems to be no reason why it should not be used for underground conductors or in factories where the lightness of the conductor is of secondary importance, and where the current is a low potential one; for high potentials the difficulties of insulation make the iron more costly. In conclusion he gives a summary of these figures, showing the relative cost of conductors of equal length and equal electrical resistance; they are as follows: Aluminum, 99 per cent., at present market prices, 375; copper, electrolytic, at present market prices, 278; aluminum, 100 per cent., at A. E. Hunt's value, 275; iron, at present market prices, plus 28 per cent. for rolling, 100.

CALCULATING THE WIRE FOR THREE-PHASE CIRCUITS.—"Amer. Elec.," Sept.—A note giving a convenient rule for calculating the proper size of wire for a three-phase power transmission. The ratio of the amounts of copper used for equal power and voltage is 100 for the single-phase and 75 for the three-phase system; for the single-phase system the calculation is the same as for the direct current with two wires; if the proper size of wire is calculated for direct currents and the required millage divided by two, it will give the proper size of wire for the three-phase circuit, because 75 per cent. of the volume of two wires of a given size is equal to the volume of three wires of half that size, the lengths being equal.

Electro-Physics and Magnetism.

VOLTAGE CURVES IN DISCONNECTING INDUCTIVE RESISTANCES. Natalis. "Elek. Zeit.," Sept. 1.—In disconnecting an inductive resistance the lines of force which have been linked with the windings will pass out, thus producing an e. m. f., and the voltage arising at the ends of the coil is of opposite sign; the amount of this voltage is equal to the product of the number of windings, and the speed with which the lines of force move; there are several things which oppose this change—the Foucault currents in the iron, the hysteresis and the sparking or arcing current; as the calculation of this voltage is, therefore, not practicable, he made experiments to determine it, and in the present paper he describes the methods and the results. He used the well known [illegible] Joubert disc and determined the voltage curves for a coil with many windings, and then for one with few windings, in each case with or without a solid iron core or a bundle of wires, and finally for the field circuit of a small dynamo. The curves show the [illegible] voltage as a function of the time. The tests cease just where they begin to be of practical interest to the constructor, but they include some interesting results. The speed of revolution of the disc and the nature of the contact surfaces have a very great effect on the voltage curve; the more rapid and perfect the interruption, the higher the voltage. Contrary to expectations, very little difference was found when the solid iron core was used in place of one made of a bundle of wires. All the curves have a similar form; at the moment of the opening of the circuit the voltage changes its sign; it drops from the original positive value to a negative maximum, which is generally considerably greater than the original positive value; at this maximum negative value the curves show a characteristic sharp point; it is this negative maximum which is of special interest, as it is the one to which the insulation of coils is subjected. The values so determined required some correction, as the galvanometer gives only the mean value; he shows how the maximum may be calculated. Measurements were also made when the break was shunted with a non-inductive resistance. In one of the cases in which iron was used the voltage increased 7.8-fold, while in another it was 3.5-fold, the difference being due to the difference in contact at the break, which was more rapid in the first case; without an iron core the increase was 5.13-fold, a result which is surprising because the energy stored in the iron was about 18.6 times as great, and it shows the lines of force in the coil without iron pass out about 18.6 times as rapidly. In another set of coils a very low voltage—1.23—was used, the speed of interruption of which was much greater, as the sparking current did not continue so long; the induced voltage at breaking was, therefore, relatively much higher, it being 15.9-fold in one case, 37.3 in another, and in still another, when the coil had no iron core, it was as high as 73.3-fold; special attention is called to the great increase in voltage when there is no iron in the coils. Another curve shows the effect of an inductionless shunt to the break. Still another shows the voltage curve when the coil is switched into circuit; the voltage rises, owing to self-induction, a little above the steady voltage, after which it falls down to that value. The voltages may be even still higher than those which he obtained, as he found that he could in certain cases draw sparks from the circuits to the ground. The results of his experiments show that very high voltages may be obtained in breaking such circuits, and they may easily reach ten times the original voltage; the breaking spark forms a natural protection, and takes care of part of the energy set free; other artificial means are the use of carbon contacts, which prolong the duration of the spark, or shunts, which should be as free from induction as possible, like carbon or liquid resistances. Suddenly opening the circuit of a machine with the aid of an apparatus for blowing out the spark can become very dangerous when that is the only circuit connected to the dynamo.

EXTRA CURRENT AT BREAKING. Arons. "Wied. Ann.," 63, p. 177; abstracted in "Elek. Zeit., Sept. 1.—An abstract of the article noticed in the "Digest" Aug. 27.

CURRENT RUSHES IN TRANSFORMERS. Hay. Lond. "Elec. Rev.," Sept. 2.—The conclusion of his article (see "Digest last week). In the present portion he gives the results of his experimental investigations, which fully confirm the theoretical deductions to which he arrived. The curves are reproduced, and show the gradual subsidence of the abnormal waves as well as the inequality of successive half waves of counter e. m. f.; he also shows the enormous importance of the initial magnetic induction in determining the current rush. He concludes that the generally accepted notions regarding the phenomenon of initial current rushes appear to be of the vaguest and most unsatisfactory kind; it is repeatedly stated that transformers are liable to break down at the instant of connecting, owing to the current rush, the argument advanced being about as follows: Assuming that the current rush takes place, the magnetic induction will, during the initial quarter wave of current, be carried far above its normal maximum value; during the next half wave the abnormal induction is removed and a reversal to the normal maximum takes place, thus developing an abnormally high e. m. f., which breaks down the insulation. His experimental results show how utterly fallacious this reasoning is; they show that it requires a large number of waves to wipe out the abnormally high magnetic flux, the core settling down gradually into its normal cycle of magnetization; hence even when the current rush is exceptionally large there is no corresponding rise of voltage. There is another consideration, which seems to have been overlooked by others—namely, that if there is a high voltage produced, how is it that only the transformer producing it suffers, as the disturbance should spread through the entire network? Where breakdowns have occurred it is either due to a defect in the insulation or, as suggested by Swinburne, by the high induced voltage at the instant of switching off instead of on; the fault so developed would remain unnoticed until the next time of switching on. His deductions show that the phenomenon of current rushes is capable of being explained in a simple and straightforward manner; also that the alleged breaking down of transformers at the instant of connection is a scientific myth for which there is neither theoretical nor experimental foundation.

PARALLEL AND SERIES CONNECTION OF CURRENTS OF DIFFERENT WAVE FORMS. Roesseler. "Elek. Zeit.," Sept. 1.—When there are several alternating currents in parallel the effective value of the combined current and its phase are readily determined graphically by means of the well-known diagram, when the curves of the currents are sinusoidal; this may also be done when the currents are connected in series. In the present article he endeavored to find whether this method is also correct when the curves are not sinusoidal; the question is of importance, as in the usual parallel connections the current curves often differ greatly from the sine form. The conception of a phase shifting ceases when the various curves differ from each other; in such cases another conception of the phase angle can be used; the angle, in such cases, may be assumed to be that whose cosine, multiplied by the current, gives the effective value of the latter—that is, the "watt component," while the original current, multiplied by the sine of that angle, gives the wattless component. Instead of the usual graphical diagram for sinusoidal currents, the total current might also be found by separating each of the currents into its watt component and its wattless component, adding each separately, the two resulting sums being then the two components of the corresponding total current; in this way there is no need of the conception of a phase shifting; with his method of combining them it can then be shown whether the method can be used for curves of any form. On these lines he finds that the watt or energy component of the combined current is equal to the sum of those of the single currents; but this is not true in general for the wattless components. The same conclusions apply to the series connection of separate currents. He shows further that the magnetizing component of the total current in the parallel connection of alternating apparatus is not in general equal to the sum of the magnetizing components of the separate currents. In an appendix he gives a general proof of the statement that for all voltage and current curves the mean value of the energy is less than, or equal to, the product of the effective values of the voltage and the current.

EFFECT OF FORM OF ALTERNATING-CURRENT CURVE. Webber. "Wied. Ann.," 63, page 366; abstracted in "L'Eclairage Elec.," August 13.—It is generally supposed in the methods of measuring the capacity and coefficients of induction by alternating currents that the wave form is strictly sinusoidal, but this condition is rarely satisfied. In the present article he shows how the formulas should be modified accordingly.

LAW OF INDUCTION. Feldmann. "Elek. Zeit.," Sept. 1.—A communication in which he cites some cases to which the new law suggested by Breslauer (see "Digest," Aug. 20) does not apply, and it is, therefore, not satisfactory. He concludes that the conception of e. m. f. by the cutting of lines of force is the simplest one and is applicable to all possible cases; it may, therefore, be considered as the fundamental form of the law; the conception, based on the increase or diminution of the lines of force inclosed by a circuit, is a special case of this fundamental law.

CONSERVATION OF ENERGY. Tauleigne. "Cosmos," June 18.—The first part of an article on the principle of the conservation of energy as applied to electrical phenomena.

POTENTIAL MATTER. Schuster. Lond. "Elec.," Aug. 26; reprinted from "Nature."—A short article called "A Holiday Dream," which is of a speculative nature, discussing the subject of matter and anti-matter; it is general in character and has no special reference to electricity.

VAPORIZATION OF THIN WIRES. Toepler. "Wied. Ann.," No. 8; noticed briefly in the Lond. "Elec.," Sept. 2.—Descriptions of experiments made with his 60-plate influence machine, showing the stratification of the vapor of a thin wire when it was disintegrated by a strong discharge; when the vapor is caught on a glass plate held near the wire the deposit is beautifully stratified.

CONTACT RESISTANCE. Branly. "L'Elec.," Aug. 27.—A reprint of his Academy paper on the resistance of contact of discs of the same metal, which was noticed in the "Digest" Aug. 27.

ELECTRIC WAVES. Bose. Lond. "Elec.," Sept. 2.—A reprint of a Royal Society paper on the rotation of the plane of polarization of electric waves by a twisted structure.

HERTZIAN OSCILLATIONS. Ekstroem. "Wied. Ann.," 64, page 315; abstracted in "L'Eclairage Elec.," August 6.—He studied Hertzian oscillations by the stationary waves in wires.

HERTZIAN WAVES. Waitz. "Wied. Ann.," 63, page 234; abstracted in "L'Eclairage Elec.," August 6.—He measured the unequal absorption of the electric and the magnetic vibrations of Hertzian waves.

ELECTRIC OSCILLATIONS. Motte. "Wied. Ann.," April; noticed in "L'Eclairage Elec.," August 13.—An article on the higher order of electric oscillations.

DIMINUTION OF RESISTANCE BY OSCILLATIONS. Auerbach. "Wied. Ann.," March; abstracted briefly in "L'Eclairage Elec.," August 13.—He investigated the diminution of the resistance produced by electric and acoustic oscillations.

DAMPING OF ELECTRIC WAVES. Planck. "Wied. Ann.," 63, page 419; abstracted in "L'Eclairage Elec.," August 6.—He discusses the damping of the radiation of energy in the space surrounding an oscillator.

DAMPING OF RESONATORS. Lagergren. "Wied. Ann.," 64, page 290; abstracted in "L'Eclairage Elec.," August 6.

DIELECTRIC PROPERTIES OF ICE. Abegg. "Wied. Ann.," 65, page 229; abstracted in "L'Eclairage Elec.," August 6.

RESEARCHES WITH NICKEL AND ITS ALLOYS. Guillaume. "L'Eclairage Elec.," August 13.—A long abstract of a pamphlet recently published containing the results of his very elaborate researches with the properties of nickel and its alloys; the abstract is quite long, and is followed by an abstract of a paper by Dumont on researches made with the magnetic properties of nickel steels, under the direction of Guillaume. Portions of the descriptions of Guillaume's researches have already been referred to in that journal, and were duly noticed in the "Digest." The electric and magnetic properties form only a portion of the properties investigated. Among other things he found that alloys containing from 0 to 25 per cent. of nickel are irreversible—that is, at the same temperature they can exist in two essentially different states, according to the cycle of the previous temperatures; above about 25 per cent. the alloys are reversible. He gives a formula for the temperature at which the magnetism is lost, as a function of the percentage of nickel in the alloy. The effect of an addition of chromium to the non-reversible alloys is to considerably lower the temperature of transformation. The specific electric resistance of nickel steels is high, and it differs little in the various alloys; for those investigated it was between 80 and 90 microhm centimetres; he determined the resistance for a large number of temperatures between 20° and 250°, and many different alloys; it was not possible to find a relation between the variations of the resistance and the other phenomena observed for these alloys. He discusses the subject theoretically and suggests some applications of the properties of these alloys. In the paper by Dumont the method of measurement is described with the aid of a diagram of the connections, and the results are given in curves. For the reversible alloys at different temperatures he found the following law: "At equal distances from the point of magnetic transformation all the reversible alloys have the same permeability." Also "the magnetic permeability increases with the percentage of nickel." The results obtained with the irreversible alloys and with the addition of chromium are also briefly referred to in the abstract. He also determined the hysteresis curves, and found that for annealed alloys they approach closely to the cycles for soft iron.

THERMOMAGNETIC PROPERTIES OF BISMUTH. Everdingen. "Proc. Akad. Amsterdam," August 9; abstracted in Lond. "Elec.," August 26.—Riecke concluded from experiments that the thermomagnetic differences of temperature is zero in bismuth; the present author subjects this conclusion to a detailed criticism. The two surfaces of a plate of bismuth were kept at different temperatures and connected through a galvanometer, while the magnetic field to which the plate was exposed was reversed; a considerable difference was observed in pure bismuth. There is an undoubted difference of conductivity produced in bismuth by exposure to a magnetic field, but the difference in electrical conductivity is larger than in the thermo-conductivity; Riecke's theory wrongly ascribes the whole conduction of heat to the charged particles.

THERMO-MAGNETIC PROPERTIES OF BISMUTH. Defregger. "Wied. Ann.," No. 63, page 97; abstracted in "L'Eclairage Elec.," August 6.—He investigated this property in the longitudinal direction, subjecting the plate of bismuth to a magnetic field. He showed that the action of the magnetic field on the thermo-electric properties of bismuth varies with the direction of the field.

THEORY OF ZEEMAN EFFECT. Lorentz. "Proc. Akad. Amsterdam," August 9; abstracted briefly in Lond. "Elec.," August 26.—An expansion of his theory in order to explain some new phenomena of the multiplication of spectrum lines; he assumes that a molecule may have a number of arbitrarily distributed electrical charges.

ZEEMAN EFFECT. Zeeman. "Proc. Akad. Amsterdam," August 9; abstracted in Lond. "Elec.," August 26.—According to theory a certain symmetrical effect might be expected; experiments made by him to determine this, however, failed to show any such kind of symmetry.

EFFECT OF VIBRATIONS ON MAGNETISM. Fromme. "Wied. Ann.," 63, p. 314; abstracted in the "Elek. Zeit.," Sept. 1.—He determined whether electrical oscillations in the neighborhood of the iron changed the magnetic condition of it.

MAGNETIC CHARTS. Mathias. "Jour. de Physique," Aug.; abstracted briefly in Lond. "Elec.," Sept. 2.—He recommends a new kind of magnetic chart for France, on which are to be entered, not the magnetic elements for the time being, but the difference between the local elements and those of the central observatory; as a result the curves obtained will be practically stationary for a number of years.

Electro-Chemistry and Batteries.

ASSAYING GOLD. Bock. "Chemiker Zeit.," Vol. 22, p. 358; abstracted in Lond. "Elec. Rev.," Sept. 2.—A description of a semi-electrolytic process. He found that by using water as an electrolyte, only faintly acidified with nitric acid, the electrolyte does not become cloudy, as it does when strong nitric acid is used, [illegible] while the [illegible] are deposited [illegible] is based on the phenom- [illegible] an example [illegible] preparing [illegible]

ELECTROMETALLURGY. Moissan. "Zeit. fuer Elek.," August [illegible] Congress paper [illegible] the production of [illegible]

[illegible] "Zeit. fuer Elek.," August 14.—[illegible] Congress paper. [illegible] between the deposited metal and the mould, thus stripping one from the other; the advantage of the electrolytic method of making such cooking utensils is that the metal may be made any desired thickness at any desired places.

RAPID DEPOSITS.—"Zeit. fuer Elek.," August 14.—A note stating that according to an English patent to Swan the rapidity of the electrolytic deposition of copper may be greatly increased if the electrolyte is kept in continuous circulation. The current density was increased to 20 amperes per square decimetre, thus enabling an electrotype to be produced in one hour instead of six hours, as usual.

PASSIVE STATE OF IRON. Houllevigue. "Jour. de Physique," Aug.; abstracted briefly, with the curve, in Lond. "Elec.," Sept. 2.—When a bar of iron is rendered passive by concentrated acid and is plunged into nitric acid of a certain density there is a certain temperature which forms the transition point between the stable and the unstable condition; he determined the condition governing this stability for various samples of iron, densities and temperatures; the stable passive state has an upper and lower temperature limit.

SEPARATION OF CHROMIUM, BROMIUM AND IODINE. Specketer. Lond. "Elec. Rev.," Sept. 2.—A brief abstract of the article noticed in the "Digest" July 2.

ELECTROLYTIC THEORIES. Edser. "Elec. Eng.," Sept. 2.—In this continuation of his serial he discusses some forms of cells capable of producing current, but in which no chemical reactions take place. In one of these there are two electrodes of copper, one above the other, the lower being in a denser solution of copper sulphate; in another the two electrodes are zinc amalgam of different concentrations.

AMMONIUM CHLORIDE ACCUMULATOR. Stine. "Amer. Elec.," Sept.—A short article on this accumulator, made with carbon plates, with which he made experiments as early as 1891, thus anticipating the invention of the same battery by Sandaran. The plates were made of carbon dust saturated with a 20 per cent. solution of chloride of ammonia; the cell was capable of receiving a considerable charge without gasing; the voltage immediately after charging was 1.7, but always fell to less than 1 volt on standing twelve hours; the gas which is given off is extremely offensive; the ampere-hour capacity and the watt efficiency were low; the cells are inexpensive and can no doubt be made much lighter for a given capacity than lead storage batteries.

Units, Measurements and Instruments.

CAPILLARY ELECTROMETER. Burgess. Lond. "Elec. Rev.," Sept. 2.—A short communication in reply to a recent criticism in that journal. He points out the advantages which he found in using the electrometer for insulation measurements, claiming it to be superior to the galvanometer in several ways. The fact that the zero method is required is no disadvantage; the use of a high graphite resistance of about 1 megohm is entirely practical, as he found it very satisfactory in measuring values as high as 30,000 megohms; moreover, a dynamo current may be substituted for the testing battery, and this is better, as cables should be tested at a pressure at least as great as that with which they are intended to be used.

COMPOUND QUADRANT ELECTROMETER. Haga. "Proc. Akad. Amsterdam," August 9; abstracted briefly in Lond. "Elec.," August 26.—He devised a five-cell apparatus, in which a hollow copper cylinder is made to vibrate in a magnetic field as a damper. The sensitiveness is very great, but depends largely on the suspension fibre; with a certain quartz fibre 17 cm long a single Clark cell gave a displacement of 12 m (presumably mm) at a distance of 2 m, the needles being charged to 180 volts.

NEW FORM OF CAPILLARY ELECTROMETER. Vanni. "Nuovo Cimento," June; abstracted briefly, with the illustration, in the Lond. "Elec.," August 26.—He designed a form of instrument adapted for school use. It consists of a tank containing mercury and sulphuric acid, into which dips a vertical capillary tube, which does not touch the mercury; this is made one pole, while the mercury at the bottom of the tank is the other; the capillary tube is filled with mercury. A few ten-thousandths of a volt can be readily seen when this is projected on a screen.

ELECTROMETER FOR OSCILLATIONS. Toepler. "L'Eclairage Elec.," August 6; abstracted, with the illustration, from the "Wied. Ann.," December.—A description of a modified electrometer for studying electrical oscillations.

SHUNTED ELECTRO-DYNAMOMETER. Wien. "Wied. Ann.," 63, p. 390; abstracted in the "Elek. Zeit.," Sept. 1.—In order to use the same instrument for currents of greatly different capacity, it is desirable to shunt an electro-dynamometer, as is done with a galvanometer. In the present article he shows how this can be done. The self-inductions of the electro-dynamometer and the shunt should be in the same proportion as their resistances, this proportion is determined by inserting them in the branches of a Wheatstone bridge. There should be no iron, steel or large masses of metal in or near the movable coil.

CONDENSERS FOR LARGE CURRENTS. Boucherot. "Elek. Zeit.," Sept. 1.—A long abstract of the article noticed in the "Digest" March 12 and April 16.

LEYDEN JAR OF VARIABLE CAPACITY. Leduc. "L'Eclairage Elec.," Aug. 20.—An abstract of a French A. A. S. paper. He described a Leyden jar, the capacity of which is varied by altering the distances between the coatings. In using influence machines for the production of X-rays the Leyden jars used are generally of too great a capacity; for these purposes the present adjustable jar is especially adapted. A machine with two plates of 55 to 60 cm diameter will easily give the same result as a coil giving a 15 to 20 cm spark, and has the great advantage that the tubes are more easily handled.

INDUCTION STANDARD. Froehlich. "Wied. Ann.," 63, p. 142; abstracted in the "Elek. Zeit.," Sept. 1.—A description of a standard self-induction coil, the value of which could be calculated from the geometric proportions. It was wound on a core of marble, and there was only a single layer of very thin wire. The comparisons with other coils showed a very good agreement between the calculated and the observed values, the largest difference being less than 0.2 per cent.

WIMSHURST MACHINE. Leduc. "L'Eclairage Elec.," Aug. 20.—An abstract of a paper read before the French A. A. S. The theories of this machine, which credit the combs with the function of starting the machine, are incorrect, as they do not agree with facts; these collectors have nothing to do with the starting, their only function being to gather up the charges produced. He studied the action of such a machine in the dark, and from these observations he shows how the machine may be considered to operate. From this he found that the output can be increased, as also to a slight degree the voltage, by replacing the combs of the collectors with brushes sliding on the sectors, which are then much more completely discharged.

MEASURING THE EFFICIENCY OF A DYNAMO. Taeuber. "Elek. Zeit.," Sept. 1.—A description of a test made to determine the electrical losses in a 220-kw three-phase generator with a vertical axis, coupled with a turbine; the object of determining the losses was to find the efficiency. Under the circumstances the dynamo could not be uncoupled from the turbine, and, moreover, the design was such that the water pressure in the turbine relieved the pressure on the bearings; the generator could not, therefore, be run without also running the turbine. A motor whose efficiency was known or determined was belted to the dynamo shaft, and the current required for this motor was measured; a diagram of the connections is given. The turbine was first brought to normal speed by means of water power, after which the water supply was kept quite constant and the turbine, therefore, generated the power to turn itself, the dynamo and all the friction and air losses in the dynamo and the small motor; the field was then excited, which reduced the speed; current was then supplied to the motor to bring the speed back to the normal and the electrical energy was measured; the results are given in curves, which give one of the factors in determining the efficiency. Similar tests were then made to determine the copper losses, and the Foucault currents caused by the armature current, the three-phase generator being short-circuited through three amperemeters; this gives the other factor for calculating the efficiency. The motor was then uncoupled, and the energy measured to bring it up to the same speed as it had in the tests. Although a change of speed could not be observed for a less difference of energy than 1000 watts the results are not as inaccurate as it might at first appear; the losses of about 5 per cent. were determined with an accuracy of about 8 per cent., so that the efficiency of the generator was determined to within less than half of one per cent.

USE OF QUANTITY METERS. Hospitalier. "L'Ind. Elec.," Aug. 25.—A short article in which he calls attention to the advantages of quantity meters instead of the usual energy meters, under certain circumstances. In installations where the voltage is practically constant the advantage is in favor of the quantity meter, as it does not involve the loss of the shunt current, which at 5 watts during 8760 hours in the year represents 44 kw-hours of energy; this is doubled in 220-volt installations. For small powers or small consumers it is, therefore, much better to use the quantity meter. These he then divided into electrochemical and mechanical; the former have been gradually abandoned and have the disadvantages that they absorb from two to three volts for a current of 5 amperes; he does not think they will ever be very satisfactory. Among the mechanical meters he believes that the motor meters are incomparably superior to those involving clockwork. In the class of motor meters two important inventions have recently been made, one a meter by Blondlot, described recently before the French Academy (see "Digest" Aug. 6 and 20), and another by O'Keenan; descriptions of both of these are promised in that journal.

COMPARISON OF LOW RESISTANCES. Callendar. Lond. "Elec.," Sept. 2.—A reply to the recent communication of Fisher (see "Digest" last week). He points out the importance of taking due precautions to avoid or eliminate thermo-electric effects in comparing low resistances; if such a thermo-electric voltage exists the error will be the same, whether the measurement is made by a potentiometer or the bridge method; their effects may be of less importance in current measurement with the ordinary potentiometer than they are in the comparison of very low resistances by any of the methods under discussion; he illustrates this with numerical examples. It is in the testing of ammeter shunts, such as are used on switchboards, that errors due to thermal effects begin to be of great importance.

MEASURING THE LENGTH OF THE ARC.—Lond. "Elec. Eng.," Sept. 2.—Two brief descriptions of how the distances between the carbons of an ordinary arc and of the inclosed arc are measured; in both the usual lens and screen method is used.

LOW TEMPERATURE SCALES. Dickson. Lond. "Elec.," Sept. 2.—A reprint of an article from the "Phil. Mag.," noticed in the "Digest" July 2.

APPARATUS FOR ILLUSTRATING CHANGE OF PHASE. Moreland. "Elec. Eng.," Sept. 8.—An abstract of his A. A. A. S. paper. He describes an apparatus, which consists of a divided circuit, each branch of which is a conductor stretched between the poles of an electro-magnet with means for adjusting its tension so that it may be made to vibrate in accordance with the period of the alternating current. A small mirror is attached to one end of each of the conductors, and they are placed at right angles to each other, so that a beam of light is reflected successively from the two mirrors, one conductor being horizontal and the other vertical. If only one vibrates a horizontal or vertical beam of light will be seen; if both vibrate in phase, there will be an inclined band formed; if an iron core is introduced into one branch of the circuit the phase will lag, and the resulting figure produced will be an ellipse; a similar result will be obtained with a condenser in one of the circuits, but the movement of the spot of light will be in the opposite direction. In order to show the direction of motion the beam of light is passed through a small hole and then through a slit attached to a tuning fork, so that the light can pass on the mirrors only in the middle position of the tuning fork; the time of vibration of the tuning fork is adjusted so that it makes one vibration, while the conductors make two, so that instead of a complete ellipse one sees only a stationary arc; if the time of the vibration of the fork is then slightly increased the arc will move around slowly in the direction in which the spot actually travels.

STANDARDS. Carhart. "West Elec.," Sept. 10, and "Science," Sept. 9.—A reprint of the report on standards of measurements by a committee appointed by the A. A. A. S. The determination of the mechanical equivalent of heat by the electrical method gives larger values than Rowland's result, and it thus created a demand for the redetermination of the ampere in terms of the electrochemical equivalent of silver; this redetermination was made for the committee and is described in a paper to that association by Guthe; the determination was made with a specially constructed electro-dynamometer of large dimensions, and the value found was 0.0011192 gram per ampere per second in a used solution of neutral silver nitrate made of 15 parts by weight of the silver salt to 85 parts of distilled water; this exceeds Lord Rayleigh's value by about one-ninth of 1 per cent., and would cause the discrepancy in the mechanical equivalent of heat to disappear. The corresponding change in the e. m. f. of the Clark cell will be from 1.4342 to 1.4327 at 15° C. Kahle obtained the value 0.0011182 by using a fresh solution, while Pellat and Potier obtained the same value as Guthe.

SHUNTS FOR INSTRUMENTS.—"Amer. Elec.," Sept.—An illustrated description of a simple, convenient and accurate method of making low resistance shunts of a certain ratio to that of the indicating instrument. A fine wire is wound with the desired number of windings over a plate of mica, the edges of which are then clamped between suitable terminals, the wires being then in multiple arc.

Telegraphy, Telephony and Signals.

ACCUMULATOR INSTALLATION FOR TELEGRAPHY. Tribelhorn. "Elek. Zeit.," August 25.—A brief, illustrated description of the plant at the main telegraph station at Buenos Ayres. The plant is for seventy lines and twenty local circuits. A diagram shows the complete connections; there are two batteries made up of groups, of 50 volts each; for the lower voltages there are two sets of batteries in multiple; the charging takes place while they are in action, the dynamo being driven by a gas engine. For the local circuit there is a separate set of batteries in two groups of 25 volts each.

TELEPHONE SYSTEM. Montillot. "L'Elec.," Aug. 20 and 27.—An illustrated description of the system used by the Omnibus Company in Paris; a self-adjusting pendulum call is used, and is described with the aid of a good illustration.

AUTOMATIC TELEPHONE EXCHANGE.—Lond. "Elec. Rev.," Sept. 2.—A brief, illustrated description of the Direct Telephone Exchange Syndicate's system, which has already been referred to in the "Digest."

LUMINOUS SIGNAL SWITCHBOARD. Miller. "Amer. Elec.," Sept.—In this continuation of his serial he gives an illustrated description of such switchboards, which have now come into general use in American telephone installations.

SIGNALING IN THE GERMAN NAVY. Pontifex. "Elec. Rev.," Sept. 14.—A reprint of the article noticed in the "Digest" last week.

LODGE'S SYSTEM OF WIRELESS TELEGRAPHY.—"Elec. Rev." and "El'ty," Sept. 7.—A reprint of the article abstracted in the "Digest" Sept. 3.

Miscellaneous.

ELECTRIC DEVICE FOR ENABLING THE BLIND TO READ. Turine. "L'Eclairage Elec.," August 6.—A short article suggesting an apparatus by means of which the blind could be enabled to read printed or written characters. Five small points like the teeth of a comb are to be moved along the line at a uniform velocity, the space included between the two outside, corresponding to the height of the letters; suppose that each time one of these teeth passes from white to black—that is, cuts the line forming a letter—a momentary sound is produced, the pitch of which is different for each of the teeth; the succession of these acoustic signals would then be characteristic of the letter over which the teeth have moved. The duration of each signal is an indication of the time during which the point passes over the line and the height of the note corresponds to the distance of that point from the base line. He suggests making these points of selenium, which will cause the current to be varied as the intensity of the light falling on it varies; different devices could be used for transforming these variations into acoustic signals, one form of which he describes. This system has the advantage over the phonograph, in that the reproduction of the phonograph cylinders is an expensive and slow process, and it would require many cylinders to include the matter in a book.

ELECTRICAL INDUSTRIES IN BERLIN.—"Elek. Zeit.," August 25.—Reports from the largest electrical manufacturers in Berlin concerning the present development of the industry.

BIOGRAPHICAL.—The English journals, Sept. 2, contain biographical notices of the late Dr. John Hopkinson. The Lond. "Elec. Rev." contains a good full-page portrait; also a tribute to him from one of his associates. The Lond. "Elec. Eng." contains the best account of the sad accident.

MAGNETIC SURVEYING FOR IRON ORES. Nordenstroem. Lond. "Elec. Eng.," Sept. 2.—A reprint of an illustrated paper read before the Iron and Steel Institute in Stockholm. In Sweden magnetic instruments have long been employed on a large scale for discovering iron ores, and the instruments have reached great perfection.

CONSTRUCTION WORKS.—Lond. "Elec.," Sept. 2.—A brief, illustrated description of the works of the Davy Company.

FRENCH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. Blondin. "L'Eclairage Elec.," Aug. 20.—Abstracts of the electrical papers read at the recent congress at Nantes, Aug. 4 to 11; these papers are noticed in the "Digest" under their respective headings. Next year the meeting will be at Boulogne and in 1900 it will be in Paris.

Motor-Generator for Electroplating.

The machine shown in the accompanying illustration is a motor-generator designed by the Jantz & Leist Electric Company, 222 East Ninth Street, Cincinnati, Ohio, for electrotypers. It is of the multipolar type, with spherical cast yoke, into which are set laminated soft wrought-iron pole pieces. The field coils, which are form-wound, are interchangeable.

The armature is of the iron-clad type, notched to receive the windings. On the motor end these are form-wound and insulated before being placed in the notches; on the generator end the coils consist of a bare copper-wire cable with a carrying capacity of 1200 amperes without heating more than 30 degrees C. [illegible] carbon brushes, set in radial holders, the tension being adjusted automatically. [illegible]

[illegible] means of a rheostat in the shunt circuit connected across the main line termi[illegible]

Electroplating Motor-Generator.

A New Rubber Wire Factory.

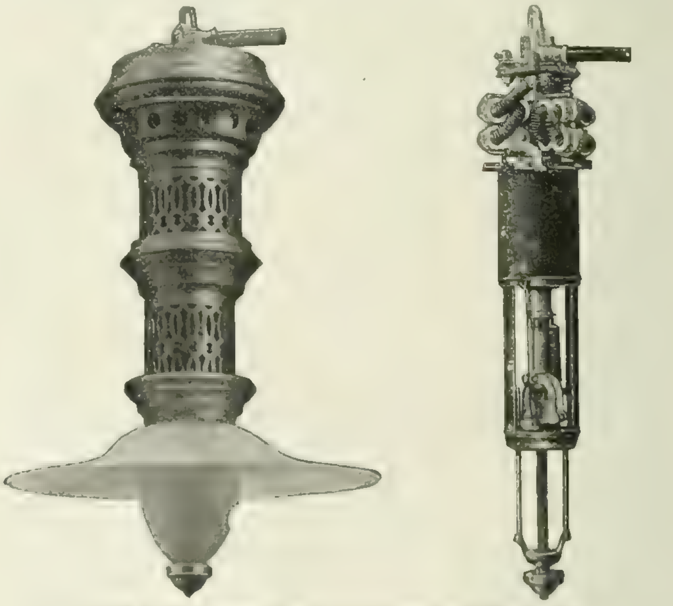
The John A. Roebling's Sons Company is now manufacturing rubber insulated wires at its new factory recently completed in Trenton, N. J. The very best and latest machinery has been installed for preparing the rubber for insulating all sizes and kinds of electrical conductors from wires for houses and cars, etc., up to the heavy lead incased cables for power and light plants, working under high-tension currents. While hitherto supplying rubber insulated wires in large quantities to the trade, there has been some disadvantage in not actually turning out the product entirely from the raw material at the company's own works. With every appliance in the way of rolling mills, wire mills and other machinery it became imperative for the company to supply its own "Roebling" rubber wire to its customers, taking advantage of the reputation of the products of its mills. The new factory is located conveniently near the other parts of the electrical wire department, and has ample shipping facilities both by rail and water. The heavy machinery is installed on the ground floor of a large three-story brick building about 60 feet by 160 feet. The other floors are utilized for lighter machinery, drying rooms, etc.

The field for rubber insulation is a large one, and many varieties of conductors are manufactured,, and the Roebling Company is now equipped for handling everything of the kind that is made.

Miniature Enclosed Arc Lamp.

The miniature enclosed arc lamp of the General Electric Company promises another advance in providing for the use of arc light in smaller units so that it may compete with oil, gas and incandescent lamps in illuminating halls, offices, display windows and rooms of limited area. The illuminating power and the current are much less than those of the large lamps, so that several lamps are not more expensive to operate than one large one, while by dividing the total amount of light required the general illumination is greatly improved. The miniature arc lamp is also suitable for other places where a large arc lamp would supply more light than necessary. It is of the single globe and reflector type, the light of the arc being thrown down from the polished under surface of the reflector.

This miniature arc lamp, designed for 110-volt direct current circuits, is frequently required to operate at slightly higher or lower voltages. An adjustable resistance has, therefore, been provided in the top of the casing, which adapts the lamp to any line voltage from 100 to 120. The lamp takes, ordinarily, 2½ amperes, but a loop in the magnet coil permits an adjustment for 3 amperes. Seventy-three to 75 volts are required at the arc, and when adjusted for 2½ amperes, with a line voltage of 110, the energy at the terminals is 275 watts. Adjusted for 3 amperes the energy is 330 watts. The life is from 40 to 45 hours with standard current, and from 35 to 40 hours with 3 amperes.



Miniature Enclosed Arc Lamp and Its Mechanism.

The mechanism of the miniature arc lamp operates on the General Electric carbon-feed principle. The carbon is fed through a brass tube extending through the centre of the magnet coil. The double-cam clutch, which operates directly upon the carbon, is simple in its action and has few parts. Special attention has been given to the design of the carbon holders and the general arrangement of the frame to facilitate rapid trimming.

The principal dimensions of the lamp are:

Length over all	18½	inches.
Weight	9½	pounds.
Upper carbon	8½x½	inches.
Lower carbon	3½x½	inches.
Inclosing globe, top diameter	2	inches.
Maximum, top diameter	3	inches.
Bottom, top diameter	13/16	inches.
Height	4	inches.
Porcelain shade	11x[illegible]	inches.

The outer globe is [illegible]. Each lamp is arranged with a switch, so that it can [illegible] thrown in or out of circuit.

Several hundred of these lamps have been introduced among central stations [illegible] the past [illegible] days, and there seems to be an increasing demand for arc lamps of small and attractive design.

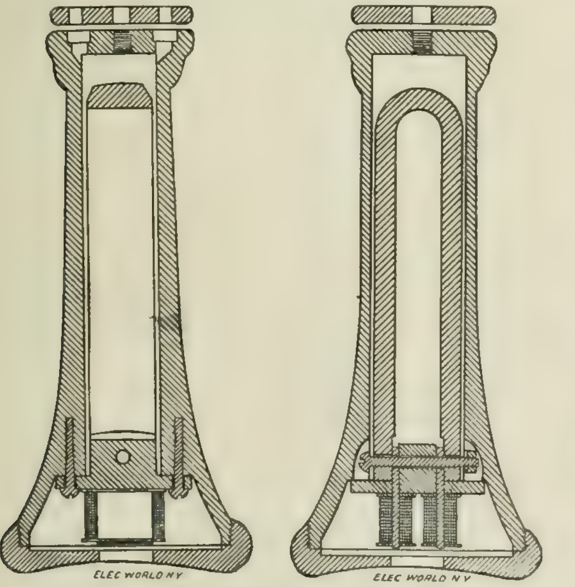
How to Install Lightning Arresters.

Mr. W. R. Garton, president of the W. R. Garton Company of Chicago, has been making some very careful experiments on various electric railways throughout the country in the matter of lightning arrester installations. As a result of this work and his observations he suggests that some information as to the proper method of installing lightning arresters would not be amiss, and at the same time calls attention to some of the improper methods practiced. "Electric railway and electric light companies," he states, "have in their employ men, classed as linemen or electricians, who are intrusted with the installation of various instruments or devices which are purchased for their plants. It is often the case that these men trust to their own judgment rather than to the judgment of the manufacturer, and install the apparatus in accordance with their own ideas. It is not to be said that these men are not oftentimes well versed and in possession of valuable information gleaned from their own practical experience, but it is always better to carry out the instructions of the manufacturer and allow him (the manufacturer) to shoulder the blame if the operation of machines or instruments is not satisfactory. The writer has found many such cases, which explain the reason for failure of lightning arresters to protect plants, transformers, etc. Lightning arrester lead wires should never be curled or twisted around span wires or tied into knots to take up the slack. If the wire is too long it should be cut to the proper length and made as straight as possible. To test lightning arrester grounds, especially on railway circuits, a bank of five lamps should be carried, and if, when the terminals of the lamp circuit are connected with the line and ground terminals of the lightning arrester, the lamps come to candle power, the ground can be considered as satisfactory. Otherwise it should be improved. As a matter of mechanical protection gas pipe has been used to cover the ground wire, and in hundreds of instances has rendered the lightning arrester useless, as the iron pipe around the wire acts as a choke to the discharge. Wherever ground wires are run to the ground through pipes they should be connected to the pipe through which they run. This applies to any wire in a lightning arrester circuit. Where installations have been made in this way I have often advised removing the insulation from the wire at the top of the pipe and driving a wooden wedge into the pipe to force the wire against the pipe, to keep it in that position. The ground wire should never be alive; therefore there is no danger from having the wire connected with the pipe. Lightning arresters which were unsatisfactory with the wire run through the pipe have proven very satisfactory after having made the changes above spoken of."

W. & C. Bipolar Telephone Receiver.

The W. & C. bipolar receiver, illustrated herewith, has just been placed upon the market by Messrs. Whitman & Couch, Boston, Mass. It is said to have been pronounced by experts as perfect as any receiver ever produced. It will enable many exchanges to improve their service and reduce expenses.

The firm claims that this instrument is in permanent adjustment and is unequalled in points of construction and efficiency. In its construction the magnets are made very heavy, with brass spools. They are secured to the pole pieces by a bolt, which binds the two parts together upon the brass bed plate. They are then fastened to the shell by two machine screws at a point so near the diaphragm that the shell may contract or expand without changing the adjustment of the instrument. The shell is made of the best rubber. Its interior form gives it great strength and at the same time affords a close jacket for the magnet. The pole pieces are of nickel-plated brass, and the soft-iron cores are milled off even and parallel.



Sections at Right Angles to Each Other.

Water Motor for Driving Small Dynamos, Etc.

For small powers, such as are needed for the driving of small dynamos and other light power machinery, water motors may be used with advantage and satisfaction, and the demand for an efficient motor of this class has led manufacturers to give special attention to improvement in construction. The water motors made by the A. Rosenberg Company, 629 North Carey Street, Baltimore, Md., are claimed to be the best and most efficient machines of this kind that have ever been put upon the market. The motor has the additional peculiar advantage of being adjustable or tiltable in any direction while running.

The body and stand being of iron and finished in black, and the ball-and socket joint being polished brass, the motor has a very neat and attractive appearance. Leather packing rings are inserted between the socket and the clamp ring, insuring a water-tight joint.

These motors can be set up anywhere upon the special bracket provided, and since the ball-and-socket joint admits of universal adjustment the pulley can be lined up with a dynamo, lathe, fan, sewing machine and other like machinery, and the belt tightened while the motor is in operation. It is never necessary, therefore, to cut or shorten the belt to take up slack, the latter being taken up by the adjustment of the body of the motor.

These motors are said to operate satisfactorily by the ordinary house water supply by attachment to any faucet where there is a pressure of 25 or 30 pounds or more. The 7-inch motor, which stands 15 inches high, runs at over 2000 r. p. m., with 50 to 60 pounds pressure. It is stated that these machines will last for years without perceptible wear. They are noiseless in operation, and require practically no attention save that necessary to oil the machine once a day.

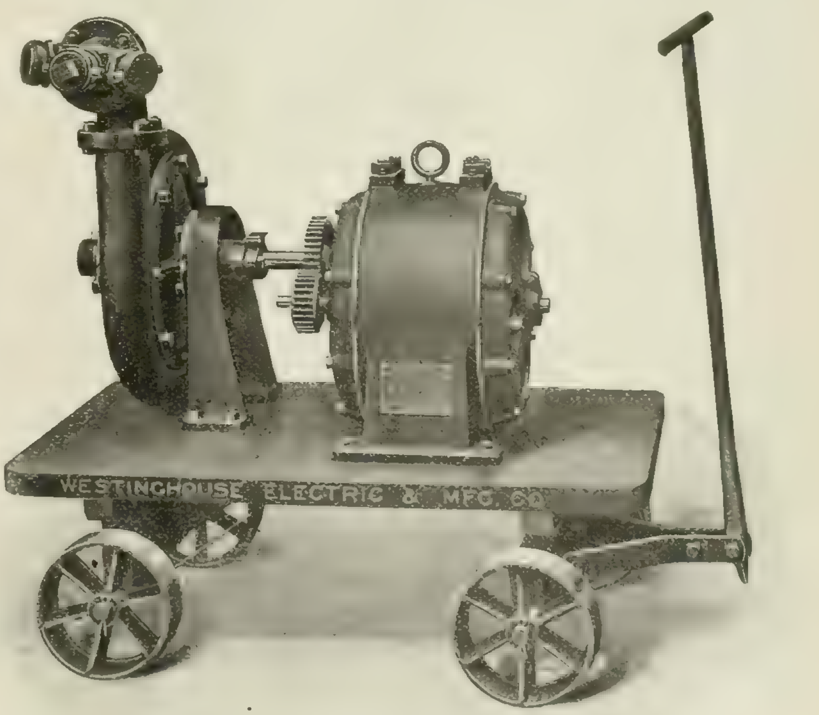
Motors are made 7 and 9 inches in diameter. It is stated that these machines do not leak at the bearings, no matter how far they are tilted or how much the bearings are worn.

Portable Electric Pumps.

The varied applications of electric power are no more strikingly illustrated than in the subject of this article. While the combination has been especially designed to be used in the California Winery, of Sacramento, Cal., it is one that may be applied to various other purposes.

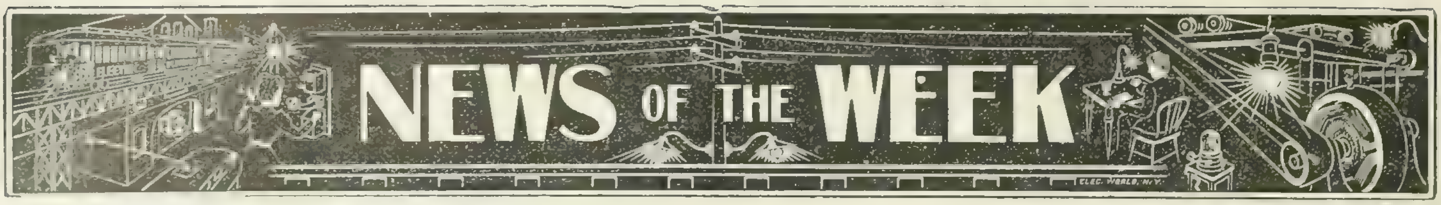
The outfit consists of a Westinghouse Electric & Manufacturing Company's type "G" alternating-current induction motor of 2-hp capacity direct-connected to a centrifugal pump. The machines are mounted upon a suitable truck, by which they are transferred from place to place in the operation of pumping wine from one vat to another. Receptacles for electrical connection are provided at convenient points throughout the winery, and the motor is connected by means of flexible cable to the circuit of the Central California Electric Company, whose power is generated at Newcastle, 30 miles distant from Sacramento.

The simplicity of both pump and motor renders them ideal in construction. The motor has neither commutator nor brushes, and there is no connection between the revolving part and the electric circuit. Beyond the occasional oiling of the bearings, no further attention is required over long periods of operation, and it may be handled by the most inexperienced persons with perfect safety.



Portable Electric Pump.

The centrifugal pump is peculiarly adapted to' handle liquids of whatever nature. It is capable of pumping under the most difficult conditions, and will handle hot or cold liquids successfully, even though they contain from 30 to 40 per cent. of solids. Thus it will be seen that the applicability of the device extends beyond the luxuries of life, as in the pumping of wine, beer or other spirits, to the more arduous duty of pumping the dirty and muddy accumulations in electric subway manholes, tannery, liquids, dyes, bleaching solutions, vinegar and brine liquids used in pickling, and, in fact, is applicable to a multitude of services in the arts and manufactures in which it is destined to be a permanent economic feature.



NEWS OF THE WEEK

ELEC. WORLD, N.Y.

Financial Intelligence.

THE AMERICAN ELECTRIC TELEPHONE COMPANY, Chicago, certified to an increase of capital stock from $100,000 to $130.000.

THE WEST END STREET RAILWAY COMPANY has declared a semi-annual dividend of 3½ per cent., payaole September 17.

THE EDISON ELECTRIC ILLUMINATING COMPANY, of Brooklyn, has declared a quarterly dividend of 1½ per cent., payable October 1.

THE STOCKHOLDERS of the American Telephone & Telegraph Company at a special meeting on September 8 voted to increase the company's capital stock from $20,000,000 to $25,000,000.

GENERAL ELECTRIC'S NEW STOCK.—Dealings were made on the New York Stock Exchange on September 15, for the first time, in the reduced capital stock of the General Electric Company. The new stock sold at 78@78½, and the old at 46½.

THE WESTERN UNION TELEGRAPH COMPANY has declared a quarterly dividend of 1¼ per cent., payable October 15. The company's report for the quarter ending September 30 shows the following results: Revenues (estimated) $1,550,000, a decrease of $153,851 as compared with the actual revenues last year; interest $224,500, increase $82; balance $1,325,500, decrease $153,933. Dividends $1,216,990, increase $18. Surplus $108,510, decrease $153,951. Previous surplus $7,963,235, increase $315,694. Total surplus $8,071,745, increase $161,743.

THE GENERAL ELECTRIC'S CAPITAL REDUCTION.—A Boston dispatch to the "Wall Street Journal" on Friday last conveyed the information that the differences between the directors of the General Electric Company and the committee of the preferred stockholders opposing the capital reduction plan have been adjusted. The 10,000 shares of preferred stock deposited with the American Loan & Trust Company, under agreement with the preferred stockholders' committee, have been sold, subject to depositors' approval, to a syndicate of gentlemen who are interested in seeing the reorganization plan of the company carried through without delay.

THE REPORT OF THE METROPOLITAN STREET RAILWAY COMPANY, of New York, for the year ended June 30 shows the following results: Gross earnings $9,938,050, an increase of $1,049,701, as compared with the gross earnings in 1897; operating expenses $5,300,436, an increase of $490,201; net earnings $4,638,069, increase $559,500; other income $647,297, an increase of $99,768; total $5,285,366, increase $659,268; fixed charges $3,439,796, increase $252,821; balance $1,845,570, increase $406,447. Dividends $1,500,000, increase $300,000, leaving a surplus of $345,570, an increase of $106,447. Cash on hand $2,399 000, increase $2,103,987. Profit and loss, surplus $1,638,267, increase $305,779. Better-[illegible]

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
[illegible] st., NEW YORK, September 19, 1898.

THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS [illegible] obtained temporary notoriety through the finding of one of its old-style pins [illegible] Wednesday in the wood near Stapleton, Staten Island. The woman, who is supposed to have committed suicide, had nothing about her person that would lead to her identification, and it was thought that the discovery of the A. I. E. E. pin would [illegible]

[illegible] action against the United States Electrical Supply Company of this city to re-[illegible]

[illegible]

penalty for a violation of the law is a fine of not less than $300 nor more than $1000. It was decided that the District-Attorney should bring the matter to the railroad companies' attention, as it was possible that they had misunderstood the statute. There seemed to be a disposition on the part of the men to bring about an amicable settlement of their grievances.

THE NASSAU AND BROOKLYN RAPID TRANSIT COMPANY MAY CONSOLIDATE.—It is stated that negotiations are in progress in Brooklyn looking to either a consolidation of the Nassau Electric Railroad Company and the Brooklyn Rapid Transit Company, or a long lease of the former by the latter. It was reported that the Rapid Transit Company on Saturday last purchased more than half of the stock of the Nassau Company. This, however, does not include the holdings of Albert and Tom L. Johnson and P. H. Flynn. The attitude of these three interests toward the consolidation plan seems to be uncertain. It is stated that the Johnsons will not sell unless their holdings are purchased in their entirety; another report is that they will sell at their price. On the other hand Mr. Flynn, it is stated, is unalterably opposed to allowing the Rapid Transit Company to get a lease of the Nassau lines or to consolidation under any circumstances. The Rapid Transit people believe that if they can obtain control of two-thirds of the stock they could secure the desired lease or consolidation, but how they are to get the necessary additional number of shares to accomplish this result is yet, according to reports, a question for the future to determine. The plan to combine the Brooklyn railway interests has been talked of for a long time. Ex.-Gov. Roswell P. Flower and his associates, who control the Rapid Transit Company, have been in favor of the combination, and believe that it will not only result in increased earnings, but in better transportation facilities for the general public. It is said that the Brooklyn companies were all sounded some time ago and that negotiations for the absorption of the Coney Island and Brooklyn road are now under way. It has been said that the Rapid Transit folks have even the absorption of the elevated railroads in mind. Negotiations were started some time ago, but abruptly broken off. However, they are reported to be in such condition that they can be taken up again at any time. It has been estimated that the combination of all of the transportation facilities in Brooklyn would result in a great saving of expenses. Where the lines compete a greatly decreased number of cars might do the business, and the jam on the bridge could be lessened without seriously affecting the convenience of the public. It is said that the saving in power would alone amount to half a million or more dollars a year if the Nassau road could be absorbed.

PHILADELPHIA NOTE.

Branch Office of THE ELECTRICAL WORLD,
929 Chestnut Street.
PHILADELPHIA, Pa., September 17, 1898.

PAPERS ON RAIL BONDING AND THE STORAGE BATTERY.—A meeting of the electrical section of the Franklin Institute will be held at 8 o'clock on the evening of September 27. Two interesting papers will be presented, one by Mr. W. E. Harrington on the subject, "Rail Bonding, with Special Reference to Cast-Weld Joints," and the other entitled "The Present Status of the Storage Battery," by Mr. Herbert Lloyd.

BUFFALO AND NIAGARA FALLS NOTES.

BUFFALO, N. Y., September 17, 1898.

THE CATARACT POWER & CONDUIT COMPANY, which delivers all power from the Niagara tunnel to outlying towns, is now assured of the needed franchises in both Tonawandas. These towns always insis[illegible] an agreement to make rates lower than those for towns on longer lines.

LOCKPORT is to have a power line direct from the Niagara tunnel. The changing of the line of the Erie Railroad from Tonawanda to that city into an electric line makes it easy to carry the cables to Lockport, and this will be done soon. The stepping down of the 11,000-volt current will be effected in the transformer station at North Tonawanda, now building. The consumers of current generated in Lockport are eager for the cheaper current.

IT WAS ANNOUNCED some days ago that the Buffalo North Main Street & [illegible] had been abandoned and would be taken up at once. [illegible] part of a land scheme, but when the boom went to pieces the road fell into the hand of the General Electric Com-[illegible]

CHICAGO NOTE.

Branch Office of THE ELECTRICAL WORLD,
936 Monadnock Building,
CHICAGO, Ill., September 16, 1898.

[illegible] president and general [illegible] of the Williams Electric [illegible] the present week.

ST. LOUIS NOTES.

St. Louis, Mo., September 15. 1898.

THE CITIZENS' ELECTRIC LIGHT & POWER COMPANY will finish the work of laying its conduits next Saturday night, and will then be ready to erect a power house.

ON SUNDAY last the Kinloch Telephone Company erected some poles in an aristocratic portion of the city, over which work the residents threaten to go to law. Being Sunday the residents could not get an injunction.

THE CITIZENS' ELECTRIC COMPANY will not be under the necessity of erecting poles over the city, as it has leased cross-arm privileges from the Kinloch Telephone Company. The Kinloch Company has some 9500 poles.

THE STRIKING LINEMEN and men who are still at work for the electric companies came into conflict with one another several times last week. On two or three occasions the fights were so serious that the police were called out.

THE MISSOURI-EDISON ELECTRIC LIGHT & POWER COMPANY put eighteen men to work this week in different parts of the city. These men were brought from Kansas City to take the place of the striking linemen. There are more on the way here from Kansas City and Toledo.

THE NEW TELEPHONE SERVICE.—The Kinloch Telephone Company's service will open October 1. Four-fifths of the number of connections on the switchboard have been tested, and the rest will be tested within the coming week, leaving nothing to be done except to break in the "hello" girls, which is to be done gradually.

RECEIVER F. B. BROWNELL, of the People's Railway Company, has filed a report for the month of August, showing that the road has been operated at a profit during the month. The cash on hand August 31 was $10,491.57. The bill due amounted to $679.65, and the wages amounted to $3532.15, leaving cash resources of $6279.77

PACIFIC COAST NOTES.

San Francisco, Cal., September 11, 1898

MR. DANIEL MASON, construction engineer for the Sprague Electric Company, who has spent the greater part of the past two years on this coast in connection with elevator work, recently left for Chicago and the East.

THE LATEST FAD of wealthy residents along the shores of Lake Merritt in Oakland, Cal., is to erect searchlight towers, from which they produce spectacular effects by sweeping the lake and the neighboring country side with powerful rays of white light.

THE SHEEP RANCH MINE COMPANY, of California, is said to have closed a contract with the Westinghouse Electric & Manufacturing Company for the installation of a two-phase electric transmission plant, having a capacity of 5000 horse power. Water power will be utilized.

THE UNITED STATES SIGNAL SERVICE is constructing a telephone system up Mount Tamalpais, 13 miles from San Francisco. A station was established a short time ago at the summit, and the observer will soon be able to announce by telephone sudden changes of weather, etc.

OWING TO the delay in approval of the franchise for the Hawaiian cable line, it is said the Pacific Cable Company has been considering a plan to lay a cable from Alaska and not touch the Hawaiian territory. It is estimated that a cable could be laid to reach Australia and the Philippines and terminate in China for $5,000,000, while an additional expense of $7,000,000 would be incurred if the cable should touch at Honolulu.

THE FORTY-FIVE CONSOLIDATED MINING COMPANY recently let contracts for the erection of a concentrator, having a daily capacity of 75 tons of ore, in the Sultan mining district, Washington. An electric transmission system will be installed, crossing the Williamson Creek Valley. A Tuthill water wheel will be installed to drive the generator, at Copper Lake Falls. Ore is now being taken out in small quantities.

MR. CHARLES F. SCOTT, chief electrician of the Westinghouse Company, recently made a tour of the Pacific Coast, during which he inspected the headworks at Snoqualmie Falls, Wash., where his company will install four 1500-kw generators for the Snoqualmie Falls Power Company. The generators will be placed at the bottom of the shaft, 300 feet below the surface of the ground. The water will be piped to the direct-connected wheels.

CANADIAN NOTES.

Ottawa, Ont., September 16, 1898.

MR. J. W. POUPORE, M. P. for Pontiac, is negotiating with an American syndicate, capitalized at $5,000,000, to erect smelters at Ottawa and on the Georgian Bay in connection with the Ottawa ship canal. In relation to this, a gentleman is in this city to patent an electrical smelter.

THE BIG FAIR at Toronto, Ont., proved a bonanza to the electric street railway of the city. The total number of passengers carried during the fair was 1,879,298, exclusive of transfer passengers. The increased earnings exceeded those of last year, during the same period, by $15,167.

THE CITY COUNCIL of Toronto, Ont., has accepted the tender of the Sprague Electric Company of New York for the supply of three electric elevators, with the plant for five, for the new municipal buildings of Toronto. The architect states that the electric plant will operate 300 or 400 lights in addition to the power required for running the elevators.

A JUDGMENT has been delivered by Judge Loranger, at Montreal, which declares that the rolling stock of the Montreal Street Railway, its rails, wires and poles are subject to assessment for municipal purposes. Hitherto they have not been taxed. The recent decision of the Ontario courts, declaring the right of the city of Toronto to assess such rails, wires and poles, has had the effect of stirring up an agitation in Montreal, resulting in the judgment referred to.

THE ROYAL ELECTRIC COMPANY, of Montreal, will hold a special meeting on October 18 next for the purpose of authorizing an issue of preferred stock and the acquisition of shares in the Chambly Manufacturing Company for an additional amount of $100,000. The Royal Company has heretofore been paying 4½ per cent. on its mortgage bonds, and a higher rate of interest for its customers' paper. The company's credit being excellent, any money required can be obtained in England at a much lower rate of interest, and the board deems it in the interest of the shareholders to avail themselves of that credit, instead of issuing common stock at once for all the money needed, which stock would carry 8 per cent. dividend.

ENGLISH NOTES.

(From Our Special Correspondent.)

London, September 7, 1898.

MR. BRUSH'S NEW GAS.—Considerable scepticism is shown on this side of the Atlantic as to Mr. Brush's discovery of new gases. Had he contented himself with the discovery of a single new constituent of the atmosphere he would not have been so severely criticised. But serious doubts are entertained as to his "periodic group of new elements," which is announced by cable.

THE DEATH OF DR. JOHN HOPKINSON.—The news of the sad death of Dr. John Hopkinson will, of course, have reached New York by cable. His loss is very keenly felt in the whole electrical profession. He was not only a distinguished scientist, but was foremost in the ranks of dynamo designers and consulting engineers. He was loved and respected by all who came in contact with him, and deep sympathy is felt with his widow and children, as well as with his parents, who are still living, and his brothers. The funeral took place at Territet, Switzerland, on Friday last. It was first intended to have the funeral in Dr. Hopkinson's native town, and the Institution of Electrical Engineers proposed to send representatives. In the circumstances they had to be content with sending a wreath and passing a special resolution of sympathy.

OBITUARY.—News has just come to hand of the death of Col. Henry Lake Wells, C. I. E., R. E., director of the Persian section of the Government telegraphs, of enteric fever. He died at Karachi on August 21 last, after an illness of only six days. Colonel Wells' career was a most distinguished one. After efficient service in the Afghan campaign of 1878-79, he was appointed assistant director of the Persian section of the Government telegraphs, and in 1885 was promoted to the post of director. He was frequently mentioned and praised in Government dispatches, and was considered one of the best officers in the service. He showed admirable spirit and set a thorough good example during the cholera epidemic of 1893. Among other recognitions for his services in Persia he received the sword of honor from the late Shah and a valuable diamond ring from the present Shah. A paper on "Telegraphs and Trade Routes in Persia" was contributed by him to the Society of Arts in 1894. The deceased leaves a widow and five children.

THE 1898 MEETING OF THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.—The annual B. A. meeting opens to-day at Bristol with the presidential address by Sir William Crookes, F. R. S. A number of most interesting papers are down for reading in Section A (mathematical and physical science) and in Section G (mechanical science), these two sections being under the presidency of Professors W. E. Ayrton, F. R. S., and Sir John Wolfe-Barry, F. R. S., respectively. In the latter section I may mention the following papers: "Some of the Mechanical and Economic Features of the Coal Question," by T. Forster Brown; "Description of an Instrument for Measuring Small Torsional Strains," by E. G. Coker; "A New Instrument for Drawing Envelopes, and Its Application to the Teeth of Wheels and for Other Purposes," by H. S. Hele-Shaw; "Electric Power in Workshops," by A. Siemens; "The Application of the Electric Motor to Small Industrial Purposes and Its Effects on Trade and on the Community Generally," by A. H. Gibbings; "Electric Power and Its Application on the Three-Phase System to the Bristol Carriage and Wagon Works," by W. Geipel; "Notes on the Electric Lighting System at Bristol, with Special Reference to Auxiliary Plant," by H. Faraday Proctor; "Corrosion of Gas and Water Mains by Earth Currents from Electric Tram Lines," by Prof. J. A. Fleming; "Combined Electric Lighting and Power Plant for Docks and Harbors," by T. G. W. Aldridge, and "Electric Canal Haulage," by A. H. Allen. Among the papers down for Section A are two by Professor Ayrton's students. The one of these which will awaken most interest is by Messrs. Cahen and Donaldson, and contains a comparison of the two methods of charging secondary batteries, viz., at constant potential and constant current. The conclusions in this paper will no doubt be of considerable practical as well as theoretical importance, especially in the application of the secondary cell to traction work. Another paper is by Mr. Maurice Solomon on "A Determination of the Temperature Coefficients of Two 10-Ohm Standards." In connection with this section there is to be an international conference on "Terrestrial Magnetism and Atmospheric Electricity," under the presidency of Prof. A. W. Rucker, M. S., D. Sc., which I expect will bring forth some useful information on this subject. On Monday evening a discourse is to be delivered by Mr. Hugh Jackson on "Phosphorescence." A number of excursions to places of interest in the neighborhood of Bristol will be made on the afternoon of Saturday next and on Thursday, the 15th inst.

General News.

NEW INCORPORATIONS.

THE HOME TELEPHONE COMPANY, Woodruff, S. C., has been formed by E. F. Pearson, president; L. H. Irby, secretary; S. J. Workman, treasurer.

THE MISSOURI & ILLINOIS TELEPHONE COMPANY, Meyer, Ill., has been formed with a capital stock of $2500. The incorporators are O. C. Clay, W. B. Henton and H. C. Chinn.

THE LEWISTON & GREENE TELEPHONE COMPANY has been incorporated at Portland, Me., with a capital stock of $10,000. The officers are: President, William Williams, Monmouth; treasurer, Walter H. Bean, Lewiston.

THE MIDLAND TELEPHONE COMPANY, Kimbrae, Minn., has been incorporated with a capital stock of $50,000. Among those interested in the new company are C. J. Smallwood, Daniel Shell and H. N. Douglass, of Worthington; Charles Mylius, L. M. Kaplan and A. M. Becker, of Adrian.

THE AMERICAN INDIES COMPANY has filed articles of incorporation with the Secretary of State at Trenton, N. J., with a capital stock of $18,000,000. The purpose of the company is to build and operate electric plants, telegraph, telephone, steamship and railway lines, to conduct real estate and mining operations and to carry on business in a number of other branches in Cuba and Porto Rico. The incorporators are Thomas Dolan, P. A. B. Widener and W. L. Elkins, Philadelphia; Thomas F. Ryan, Frederick P. Olcott, A. N. Brady, R. A. C. Smith, Henry D. Macdona, N. Ceballos, Guillermo de Zaldo, H. P. Booth and H. G. Runkle.

THE TELEGRAPH AND TELEPHONE.

KANSAS CITY, MO.—The purchase of a fire and police alarm system in this city is contemplated.

PAOLA, KAN.—The franchise of the Osawatomie Telephone Company has been assigned to the Paola Telephone Company, and the exchanges of the two cities are now under one management.

SAN DIEGO, CAL.—The Sunset Telephone Company is preparing to put up a fine system of poles and wires at Coronado. A submarine cable has also been purchased to be laid under the bay.

RENOVO, PA.—The Central Pennsylvania Telephone & Supply Company has begun the work of constructing a telephone line between Lock Haven and Renovo. It is expected to have the line completed in from six to eight weeks.

GREELEY, IA.—The Bishop Telephone Company, of Central City, Ia., has completed its line to Greeley. This will give the public direct connection with 650 'phones in Cedar Rapids, 500 in Waterloo, 150 in Manchester and 150 in Laport City.

CANISTEO, N. Y.—The Jasper & Canisteo Telephone Company has been organized, with the following officers: President, Chauncey E. Brown; vice-president, John H. Strait; secretary, Willis A. Schenck; treasurer, Leslie D. Whiting. Poles are being set and the line will be opened about October 1.

HOUSTON, TEX.—The Southwestern Telephone & Telegraph Company has received a carload of material at this place for the construction of another territorial line between Temple and Belton. There are now two lines between the two places, but the great amount of business between them requires another which will be erected.

PORTAGE, WIS.—The Central Wisconsin Long Distance Telephone Company has been organized in this city. It will build a line to Westfield, Oxford, Montello, Packwaukee and Endeavor, and will extend it to points in Adams County. The officers are: C. A. Colonius, president; J. H. Bryan, secretary and treasurer; F. E. Bell, general manager.

BOSTON, MASS.—The statement of the output of instruments by the American Bell Telephone Company for the month ended August 20 shows: Gross output 24,863, increase 9,096; returned 12,022, increase 1,868; net output 12,841, increase 7,228. From December 21 to August 20: Gross output 212,747, increase 69,202; returned 95,328, increase 33,327; net output 117,419, increase 35,875. Total output August 20 [illegible], increase [illegible]

ELECTRIC LIGHT AND POWER.

[illegible]—The citizens of this place have voted to issue [illegible] for the establishment of an electric light plant.

[illegible], OHIO.—A special election is called for October 3 to vote on the question of issuing $25,000 in bonds for the purpose of building a municipal lighting plant.

[illegible]—The City Council is contemplating the erection of an electric plant for the purpose of lighting the streets of the city, and [illegible]

[illegible]—The Commissioners of Public Works met and decided [illegible] light [illegible] to purchase [illegible] candle-power each. The work of overhauling and extending the present system will begin [illegible]

ERIE, PA.—An application will be made for a charter of incorporation for [illegible]

[illegible]

THE ELECTRIC RAILWAY.

[illegible]

[illegible]

[illegible]

Light & Power Company and the Sedalia & Brown Springs Electric Railway Company to Stewart & Co., of New York, the consideration being $400,000.

DOYLESTOWN, PA.—The Newtown Street Railway Company is extending its interests. It has just consummated an important deal by the purchase of the road and rolling stock of the Newtown, Langhorne & Bristol Trolley Company.

WATERVILLE, ME.—S. Furgeson & Son, of this city, have received contracts for constructing a two-mile electric railroad between the Kennebec River at Fairfield and Benton Falls on the Sebesticook. The rails will be laid so the Maine Central Railroad cars can run over the same, and the road will be used principally for transportation of freight.

WAUTOMA, WIS.—A scheme is now on foot for the building of an electric railroad from Berlin to this village, through the towns of Aurora, Pine River and Mount Morris. The road would be called upon to handle a large amount of freight, as this section has no railroad within a radius of 20 miles and is one of the best farming districts in Waushara County.

McKEESPORT, PA.—The new Homestead & Highland road to McKeesport is nearing completion. It runs along the south bank of the Monongahela to Duquesne, where it crosses the river and goes into McKeesport over a private right of way, bought at a cost of about $80,000. The company is now erecting a bridge over the Baltimore & Ohio and Pittsburg, McKeesport & Youghiogheny Railroad tracks at Riverton Street, to get into McKeesport without a grade crossing.

BUFFALO, N. Y.—A certificate of consolidation of the Buffalo, Tonawanda & Niagara Railroad and Tonawanda Electric Railroad has been filed. The consolidated road will be known as the Buffalo, Tonawanda & Niagara Falls Electric Railroad, with these directors: Henry B. Smith and H. M. Gillett, of Bay City, Mich.; T. E. Ellsworth, of Lockport; George Sandrock, James A. Roberts and C. M. Howard, of Buffalo; James Low, of Niagara Falls, and J. A. Read and B. S. Rand, of North Tonawanda.

ELIZABETH, N. J.—The Elizabeth Street Railroad Company, of which John Kean is president, has notified the Union County Board of Freeholders that it has filed its bond for $250,000, the price of the franchise agreed upon, to operate a trolley line between Elizabeth and Plainfield. The single fare will be 15 cents. The company also stated that it would at once change the motive power of the East Jersey Street line from horse to electricity from Staten Island ferry to the Central Railroad station on Broad Street. It is believed that the trolley line will be in operation by December 1.

NEW YORK, N. Y.—It is announced that the Union Railway Company has purchased the property of the Yonkers Electric Company, and now proposes to make important extensions to its lines from its present terminus at Hastings along the Albany Post road through Dobbs Ferry and Irvington to Tarrytown. The Pelham line, which is being extended to New Rochelle, will be continued to Larchmont and Mamaroneck, and there connect with the trolley road extending across country from the Sound, through White Plains to Tarrytown-on-the-Hudson, thereby connecting eleven towns by an electric railway loop more than 40 miles in circumference.

CHICAGO, ILL.—In addition to the work recently completed by the South Side Rapid Transit Company, whereby a change was made from steam to electric motive power, at a cost of $850,000, the company has now under way two electric storage plants at a cost of $125,000. One is located on Sixty-first Street, the other at Twelfth Street, each occupying a new building 50 by 130 feet in size. The plant is intended to store electrical power during hours when traffic is light, so that it can be utilized during the busy time. There are two batteries, each capable of receiving and delivering 700 horse-power an hour. The system was designed by Messrs. Sargent & Lundy, of Chicago, and is being put in by the Electric Storage Battery Company, of Philadelphia.

PETERSBURG, VA.—In the proceedings for foreclosure pending against the Petersburg Electric Railway Company in the Hustings Court, Commissioner Robert Gilliam has filed his report showing the indebtedness of the road, and a decree directing the sale of the road will be asked of the Hustings Court. Exclusive of the bonded debt, or mortgage, the indebtedness is small and the amount of debt unsecured is insignificant. The road has been in the hands of W. P. McRae as receiver since April last, and the report shows that it has during that time more than paid expenses of operation. The entire franchises and property of the road will, shortly after the decree which is expected, be sold at public auction by commissioners to be appointed by the court for that purpose.

[illegible], N. Y.—[illegible] that promoters are busy agitating the project of a trolley line to connect Syracuse and Corning, the plan involving the con[illegible] of [illegible] trolley companies, the Corning City line, the Penn Yan Suburban road, the Geneva, Waterloo, Seneca Falls & Cayuga Lake Traction [illegible] the Auburn City line and the lines in [illegible] In order to make [illegible] miles of road it will only [illegible] Corning and Penn Yan, Cayuga Lake [illegible] other lines [illegible] according to present plans. There are already [illegible] Corning, Penn Yan, Waterloo, Cayuga Lake Park, Moravia, [illegible] would be sufficient to supply power for the proposed line.

[illegible] residents of Bergen [illegible] trolley road from [illegible] to Hack[illegible] has been begun. The trolley people [illegible] to the county seat for the last [illegible] and it was not until a few months [illegible] the outskirts of the town of Hacken[illegible] made to the local authorities of [illegible] A few weeks ago the Erie Railroad [illegible] people and granted them a right of way [illegible] in Hackensack, thus enabling the [illegible] the heart of the town through private property. The road is [illegible] Bergen County Traction Company's line, which at present runs [illegible] Englewood. It will connect the Palisade region [illegible] with the interior of the county, which sections now are separated from one another. The trolley will open up a part of the county admirably adapted for homes, and consequently the value of real estate will be greatly enhanced. The road is less than 4 miles in length. It will cross the Hackensack meadows over a substantial steel trestle, while the Hackensack River will be crossed by an ornamental steel plate girder bridge of 125-foot span. The officers of the road are: Jacob E. Ridgway, president; W. N. Clark, vice-president; W. N. Barrows, secretary and treasurer; E. W. Lawson, manager. The engineer in charge of the work is Ralph Crump, of Boston.

EDUCATIONAL NOTES.

ELECTRICAL ENGINEERING AT THE DREXEL INSTITUTE.—The course of electrical engineering at this well-known Philadelphia institution offers unusual facilities for instruction, and is designed to make the instruction both scientific and practical. The laboratories have been equipped with the newest forms of apparatus and every appliance necessary for efficient training. Evening classes in applied electricity are held, using the same laboratory facilities, and the instruction is by the same teachers as in the day work. The evening classes run from October 1 to April 1. Prof. Arthur J. Rowland is in charge of the electrical engineering course. He and William B. Creagmile are the instructors of the evening classes in applied electricity.

THE ROCHESTER ATHENEUM AND MECHANICS' INSTITUTE, Rochester, N. Y., is entering upon its fourteenth year with an organization embracing various departments, including industrial and manual training, mechanical and fine art and domestic science. Each department is designed to give scientific instruction necessary for equipping students for some mechanical, artistic, scientific or domestic pursuit. There are day and evening classes in mechanical drawing, mathematics, electricity, telegraphy, etc. The institute has just issued a circular of information on the subject of its work, from which it appears to offer an excellent opportunity to young men and young women to improve their knowledge. Mr. William F. Peck is the corresponding secretary.

THE HENRY ELECTRICAL SOCIETY.—The announcement of this society for the season of 1898-99 sets forth the objects of the society and its methods of teaching. The society, which is the electrical section of the American Institute, holds meetings every Tuesday evening in Enginering Hall, Columbia College, for class instruction. The first year class will meet every Tuesday evening from 7:45 to 8:45 for the study of elementary algebra, and on alternate Tuesdays, from 8:45 to 9:45 for the study of electrical units, with a preparatory course in elementary mechanics. The second year class will meet on alternate Tuesday evenings from 8:45 to 9:45 for the study of the principles, calculations and construction of dynamo electric machinery. On each alternate Friday evening a lecture will be delivered on a subject to be announced prior to the meeting. Visits to central stations and electrical plants form an important feature of the work of instruction. The class year begins on the first Tuesday in October and ends on the last Tuesday in May. The headquarters of the society are at 111 to 115 West Thirty-eighth Street.

TEACHING BY CORRESPONDENCE.—The International Correspondence Schools, Scranton, Pa., after an experience of seven years in this method of imparting knowledge, enjoy a reputation that can only arise from intelligent and painstaking effort, and the resulting satisfaction to their students. Although this form of teaching is simple, it requires the experience of years before instruction can be prepared so that the mastery of a subject can be assured the student. Successful results depend largely upon the perfection of arrangement of the literature, since the student is encouraged in his work by a thorough understanding of the instruction without the aid of a teacher. Practical questions are arranged by the schools so that the application of theory to practice is fully and easily comprehended. In correcting the work of the students, which is submitted through the mails, it is stated that the schools employ a force of 500 professors, instructors, draftsmen, assistants, etc., who are housed in a building in Scranton recently constructed for the school work at a cost of $250,000. The schools have established a New York agency at 14 East Seventeenth Street, through which, it is stated, several thousand students have been enrolled since February of this year. Each student receives bound volumes of the course which he is studying. These are extremely valuable for reference.

PERSONAL NOTES.

MR. MORGAN BROOKS, of Minneapolis, Minn., has been called to the professorship of electrical engineering at the University of Nebraska, at Lincoln, which position was made vacant by the resignation of Prof. R. B. Owens. Mr. Brooks is a graduate of Brown University and Stevens Institute, and has delivered lectures upon electrical topics to the students at the University of Nebraska. He is president of the Electrical Engineering Company, of Minneapolis, and by reason of his technical and business ability he is well qualified to fill his new position. It is stated that his business interests in Minneapolis will remain unchanged.

MAJOR J. O. KERBEY, who is now at Wilmore, Pa., and who has given considerable study to and investigated the subject of rubber production, is of the opinion that rubber will grow in Cuba. If it can be grown there a great deal of time and money can be saved to the manufacturers. Major Kerbey will shortly leave for Peru to complete the negotiations for the rubber forests on the upper Amazon for an English syndicate. He will stop at Cuba and Porto Rico en route to study the conditions for rubber culture, and if they prove to be favorable he will endeavor to interest American capital in the enterprise. He will, while in Peru, collect seeds and plants of the genuine hevea or Para rubber, and bring them to Cuba for experimental cultivation. While in South America he will also give his further attention to the development of gutta-percha, which he found in the upper Amazon.

Trade and Industrial Notes.

THE RECENT fluctuations in the prices on sockets, receptacles, cut outs, insulators, etc., have made it somewhat difficult for the ordinary buyer to keep track of the market prices on these goods. The Electric Appliance Company, Chicago, Ill., has just issued a special price list of all of this material, giving trade prices that are up to date. It is in the form of a small circular, which should be of considerable value to the purchaser of staple electrical supplies.

ELECTRIC ROCK DRILLS.—The Marvin Electric Drill Company, Canastota, N. Y., has issued catalogue B, describing and illustrating its electric percussion drills. This system of drilling was fully described in THE ELECTRICAL WORLD of February 26, 1898.

SPEAKING TUBES are so closely related to electrical signaling devices, such as bells, annunciators, etc., that it may not be wholly irrelevant to refer to the special feature of the speaking tube manufactured by the Western Electric Company, Chicago. This company has for a number of years made its tubing with lap-weld seam, which is practically air tight, and is an added element of strength. The best grade of tinned sheet iron is used in their manufacture, and the tubes are uniform in material and shape.

THE LAKON COMPANY, manufacturer of the LaKon transformer, has issued a 32-page pamphlet devoted to explaining some of the peculiarities of alternating currents. A unique feature of the pamphlet is the entire absence of any algebraic formulæ. To avoid the use of mathematical expressions was difficult, but it has been successfully accomplished in this little work, and much valuable information is conveyed to the reader. A copy will be mailed to anyone interested in transformers by addressing the LaKon Company, Elkhart, Ind.

THE AMERICAN WHEELOCK ENGINE COMPANY'S EXHIBIT AT BOSTON.—In the description of the exhibits at the Boston convention of the American Street Railway Association, published in last week's issue of THE ELECTRICAL WORLD, it was stated that the exhibit of the American Wheelock Engine Company was in charge of Mr. J. L. Kimball, the company's New England agent. This was an error. The company has no New England agent; Mr. Charles C. Hardy, manager of the company's works at Worcester, was in charge of the exhibit.

THE DRAKE TELEPHONE COMPANY, McConnelsville, Ohio, has just issued a pamphlet describing the Drake selector system. This is said to be the latest, most improved and only form of selector device now in practical operation. It is combined with a regular telephone outfit, and dispenses with a switchboard and central office, day and night operators and numerous other employees usually found necessary to keep a telephone plant in operating condition. It requires but two line wires, and it is entirely under the control of each subscriber.

MESSRS. K. McLENNAN & CO., 100 Washington Street, Chicago, state that their commutator compound can be used on collector rings with as good results as on commutators. Wherever there is trouble from sparking of brushes Gale's commutator compound, it is stated, will entirely overcome the difficulty. The increased demand for the compound has necessitated an enlargement of the firm's laboratory, and it now has facilities to fill all orders without delay. It is claimed by the company that nearly every user of a generator or motor uses its compound. Those who have not tried it can obtain a sample free upon request.

THE WESTERN ELECTRIC COMPANY, Chicago, devotes its Bulletin "5 In." to Western Electric station instruments. These instruments include arc ammeters (made in one size), current direction indicators (one size), voltmeters, eight sizes), and ammeters (seventeen sizes, ranging from five amperes capacity to 2000 amperes). The arc ammeters, voltmeters and ammeters are practically dead beat, and do not contain springs nor permanent magnets in their construction, the voltmeter and arc ammeter being said to be accurate within 1 per cent. The current direction indicator is adapted for use upon arc circuits or both high and low tension systems of any manufacture, and gives a visible indication of the direction of the current flowing through the circuit.

THE ELECTRICAL TRADE will be interested to learn of the recent arrangement made by the Western Electric Company to exclusively represent the Stanley Electric Manufacturing Company in Michigan, Ohio, Kentucky, Tennessee, Alabama, Mississippi, Indiana, Illinois, Wisconsin, Minnesota, Iowa, Missouri, Arkansas, Louisiana, Texas, Indian Territory, Oklahoma, Kansas, Nebraska, South Dakota, North Dakota, Montana, Wyoming, Colorado and New Mexico. A complete stock of transformers and other appliances will be carried in Chicago to insure prompt shipment. Correspondence is solicited from intending purchasers of alternating apparatus for any purpose, single phase, polyphase, power transmission, transformers, switchboards, instruments, etc.

THE LEATHER PRESERVER MANUFACTURING CORPORATION, 27 West Monroe Street, Chicago, is doing a very satisfactory business in the renovation and repairing of belts. By its method the machine oil is extracted from oil-soaked belts, and the belts are otherwise put in first-class condition. The company also recements seams and laps, and lengthens and shortens belts when desired. It offers the most liberal terms to secure business, and this policy no doubt is a wise one, judging from the class of customers it has. It has recently cleaned three large belts for the Wells French Company, Chicago, and three large ones for the Joliet Penitentiary. It has also cleaned the main driving belt of the Consolidated Steel & Wire Company, at Joliet, Ill., replacing it on the pulleys, ready to run, in forty-eight hours.

A DIGEST OF TELEPHONES AND ACOUSTICS covering the United States patents in these lines from 1889 to 1898, inclusive, is being prepared by Mr. James T. Allen, examiner in the United States Patent Office, on authority of the Commissioner of Patents. The edition is to be limited to 200 copies, and should be of considerable value to those interested in the telephone patent field. It is carefully classified and indexed, and will be illustrated by reproductions of drawings of the important references. This digest is to be followed by others, embracing various classes of the electrical devices such as lighting, railways, generation, motive power, conductors, signaling and telegraphy and a monthly publication beginning with January, 1899, is to be issued, embracing patents in all these classes, the price of subscription to be $25 per annum.

GASKETS BLOW OUT.—Engineers complain that on account of the inferior quality of gaskets they are experiencing a great deal of trouble with leaking manholes and hand-hole plates. It is not an uncommon thing with engineers who use such gaskets to have them blow out entirely, which in most ease necessitates the shutting down of the plant and frequently results in personal injury to themselves. The Garlock cut gasket for manhole and handhole are guaranteed to give satisfaction. They are manufactured only by the Garlock Packing Company, Palmyra, N. Y. Prices and catalogues will be mailed on application to the main offices and factories, Palmyra, N. Y., or Rome, Ga., or from any of the company's salesrooms, New York, Boston, Philadephia, Pittsburg, Cleveland, St. Louis and Denver. The Garlock cut gasket is also sold by the leading dealers everywhere.

PAINTING ON METAL.—Messrs. Edward Smith & Co., 45 Broadway, New York, have just brought out a little work which will be appreciated by engineers. It is a scientific treatise on the subject of painting metal to prevent corrosion, together with two sets of specifications, one for best work and the other for ordinary work. In its preparation much of the subject matter was submitted in the manuscript to the criticism of numerous eminent engineers in all parts of the country. The increasing attention which this subject is attracting from engineers and its recognized importance renders this little volume of special value. Its contents represent the result of experience and careful study. Mr. A. H. Sabin is the author of the work, of which a small edition has been printed to be sent only to those who are interested in the subject.

ARC LAMPS AND ACCESSORIES.—The Western Electric Company's Bulletin No. 7002 is devoted to arc lamps and accessories. The bulletin contains full information regarding the different classes and types of arc lamps manufactured by this company, each style of lamp being illustrated. This line of manufacture includes open arc lamps, single carbon arc lamps, single carbon weatherproof lamps; single side-rod lamps; ornamental lamps; short, low ceiling lamps; focusing lamps for street lighting; open arc, constant potential lamps; lamps for stage lighting; inclosed arc lamps; chain-feed lamps; direct carbon feed lamps; switches, hangers, etc. Specifications of each style of lamp are given. On the first page is an illustration of an inclosed long-burning arc lamp of handsome design. It has an egg-shaped globe and reflector, the latter taking the place of the ordinary outer globe.

Directory of Scientific Societies, Associations, Etc., and Meetings of the Same.

HENRY ELECTRICAL SOCIETY meets every other Friday evening in the rooms of the American Institute, New York City, between October and May.

THE NEW YORK ELECTRICAL SOCIETY.—President, Gano S. Dunn; secretary, George H. Guy, 120 Liberty Street, New York.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.—F. W. Putnam, secretary, Salem, Mass.

ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA, Pittsburg, Pa.—Meetings, third Tuesday of each month.

CANADIAN ELECTRICAL ASSOCIATION.—President, William H. Browne, Montreal; secretary, C. H. Mortimer, Toronto, Ont.

CHICAGO ELECTRICAL ASSOCIATION.—Meetings, first and third Friday of each month, from October 1 to June 1; J. R. Cravath, secretary, Monadnock Block, Chicago, Ill.

NORTHWESTERN ELECTRICAL ASSOCIATION.—President, F. A. Copeland, La Crosse, Wis.; secretary, Thomas R. Mercein, Milwaukee, Wis.

MASSACHUSETTS CHARITABLE MECHANIC ASSOCIATION, Boston, Mass.—Exhibition of Motor Carriages, October 10 to December 3, 1898.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK.—President, G. Tracy Rogers, Binghamton, N. Y. Next meeting, Ithaca, N. Y., September 12 and 13, 1899.

NATIONAL ELECTRIC LIGHT ASSOCIATION.—President, A. M. Young, Waterbury, Conn.; secretary, George F. Porter, 203 Broadway, New York. Next meeting, New York, May or June, 1899.

AMERICAN STREET RAILWAY ASSOCIATION.—President, C. E. Sergeant, Boston, Mass.; secretary, T. C. Penington, 2020 State Street, Chicago, Ill. Next meeting, Chicago, 1899.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS.—President, W. W. Ryder, Chicago; secretary, P. W. Drew, Milwaukee, Wis. Next meeting, Wilmington, N. C., June 19, 1899.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, New York.—President, Dr. A. E. Kennelly; secretary, Ralph W. Pope, 26 Cortlandt Street, New York. Meeting, third Wednesday of each month, from September 1 to June 1.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES.—President, Samuel Insull, Chicago; secretary, Wilson S. Howell, Harrison, N. J. Last meeting, Sault Ste. Marie, Mich., September 12 and 13, 1898.

THE PACIFIC COAST ELECTRIC TRANSMISSION ASSOCIATION. President, W. F. Pierce; secretary, George P. Low, 427 Tenth Avenue, San Francisco, Cal.

THE OHIO ELECTRIC LIGHT ASSOCIATION.—President, Emil C. Schmidt, Sandusky; secretary and treasurer, Samuel Scovil, care of Cleveland Illuminating Company, Cleveland. Next meeting place, Cleveland, 1899.

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION.—Dr. C. R. Dickson, Toronto, Can., president; Dr. John Gerin, Auburn, N. Y., secretary. Last meeting, Buffalo, N. Y., September 13, 14 and 15, 1898.

PENNSYLVANIA STATE STREET RAILWAY ASSOCIATION.—President, Robert E. Wright, Allentown; secretary, S. P. Light, Lebanon. Last meeting, Scranton, Pa., September 7-8, 1898.

ASSOCIATION OF FIRE AND POLICE TELEGRAPH SUPERINTENDENTS AND MUNICIPAL ELECTRICIANS.—President, J. W. Aydon, Wilmington, Del.; secretary, H. T. Blackwell, Jr., New York. Next meeting, Wilmington, Del.

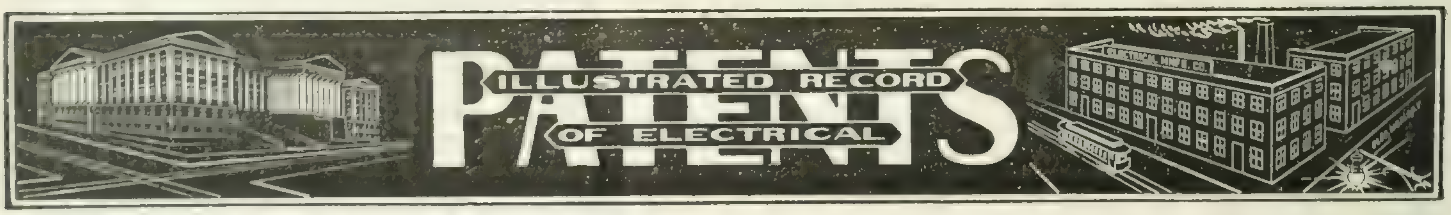
THE SOUTHWESTERN GAS, ELECTRIC AND STREET RAILWAY ASSOCIATION.—President, Carl F. Drake, Austin, Tex; secretary, E. L. Wells, Jr., Marshall, Tex. Next meeting, Austin, Tex., April 19, 1899.

INDEPENDENT TELEPHONE ASSOCIATION OF THE UNITED STATES.—President, Judge James M. Thomas, Chillicothe, Ohio; secretary, W. J. Vesey, Fort Wayne, Ind. Next meeting, June, 1899. Place to be named hereafter.

FRANKLIN INSTITUTE (Electrical Section), Philadelphia, Pa.—Secretary, William H. Wahl. Next meeting September 27. Papers to be read: "Rail Bonding, with Especial Reference to Cast Weld Joints," by W. E. Harrington; "The Present Status of the Storage Battery," by Herbert W. Lloyd.

Business Notice.

THE ILLUSTRATIONS in this issue were made by the Photo-Engraving Company, 9-15 Murray Street, New York City.



UNITED STATES PATENTS ISSUED SEPTEMBER 13, 1898.

[In Charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

610,539. ELECTRIC CLOCK; F. Hopes-Jones and G. B. Bowell, of London, England. App. filed Dec. 18, 1897. The combination of an electrically wound regulator, a secondary clock, the hands of which are moved through the agency of an electric current, means in the regulator for making the electric circuit which operates the secondary clock, and means in the secondary clock for opening said circuit.

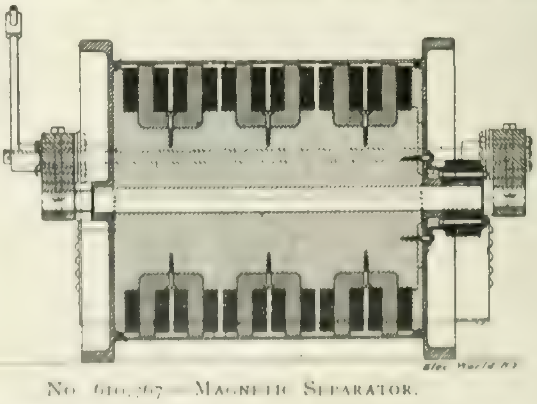
[illegible]. COMMUTATOR BRUSH HOLDER; W. K. Bamford, Jr., of Bound Brook, N. J. App. filed Feb. 1, 1898. The combination with a commutator of [illegible], a pusher for driving the block against the commutator, and [illegible] for retaining the block from the commutator against the action of the pusher.

[illegible]. CONDUCTOR OR CONDUCTING CABLES FOR ELECTRIC INSTALLATIONS OR OTHER PURPOSES; F. H. Hansen, of Copenhagen, Denmark. App. filed Feb. [illegible], 1898. A conductor consisting of cables, [illegible].

[illegible]. TELEPHONE SYSTEM; [illegible]. App. filed [illegible]. The combination with a telephone circuit of a switch for [illegible].

[illegible] FOR ELECTRICAL MACHINES; [illegible].

[illegible]. APPARATUS FOR STARTING AND CONTROLLING ELECTRIC MOTORS; [illegible] permanently in circuit with a main source of current supply, in combination with an independent source of current supply provided with means for connecting it in circuit with the armature of the motor and varying the current relations therethrough, in accordance with the load put upon it, the arrangement being such that the independent source of current supply is never electrically connected with the main source of current supply, substantially as described.



No. 610,767.—Magnetic Separator.

610,767. MAGNETIC SEPARATOR; A. Monell, of Munhall, Pa. App. filed Jan. 19, 1898. A wheeled truck or barrow having a receptacle, a drum arranged to be rotated by the wheels of the truck or barrow, and carrying electromagnets, and switches for said magnets arranged to be actuated by the rotation of the drum.

The Electrical World.

VOL. XXXII. NEW YORK, OCTOBER 1, 1898. No. 14.

PUBLISHED EVERY SATURDAY BY

THE W. J. JOHNSTON COMPANY,

9 Murray Street, New York.

Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York.

New England Office, 620 Atlantic Ave., Boston.
Western Office, 936 Monadnock Block, Chicago.
Philadelphia Office, 929 Chestnut Street.

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THE ELECTRICAL WORLD,

9 Murray Street, New York.

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SYNCHRONOUS VS. INDUCTION MOTORS.

The descriptions in these columns* of the two largest induction motors in the world have excited some interest in the reason why the induction type was used in these large machines. A brief comparison of the relative merits of the two types may be of interest.

The induction motor is undoubtedly a more difficult and expensive machine to build for satisfactory duty than is the synchronous motor with fields excited by direct current. The field of the induction machine is necessarily excited by wattless alternating currents lagging behind the impressed electromotive-force waves, and the reduction of these lagging currents to a minimum is essential to good voltage regulation. This requires that the self-induction of both the primary and secondary of the motor be kept as low as possible, and that the air gap be also reduced. The low self-induction means a multiplication of the slots, which must be more numerous and consequently narrower than is necessary in synchronous machines of the same size, speed and frequency. This makes induction motors more difficult to wind and to insulate and absolutely prohibits their connection direct to high-voltage circuits, since the insulation required for many thousand volts would leave in these narrow slots no room for copper. Induction motors, therefore, must be supplied from high-voltage transmission lines through step-down transformers. This requirement does not apply to synchronous motors which are constructed now even in moderate sizes to take 10,000 volts direct. Extreme reduction of the air gap is also, of course, an added expense in the construction of the machine, as the parts must be accurately true and extremely rigid to run with a gap of one-sixteenth of an inch or less, as is now customary with rotors several feet in diameter.

The necessity of keeping down the magnetizing current in the induction motor increases its cost in another way, since it requires that a high magnetic induction shall not be used. The induction commonly used in synchronous motors is 100 per cent. or more greater than that used in good induction motors, and the output of the same amount of material is correspondingly increased. This advantage is partially, or often, wholly compensated by the fact that induction motors are worked usually at peripheral velocities higher than those used with any other type of electrical machines, running up often to 6000 or 7000 feet per minute, a practice perhaps justified by the simple, substantial and symmetrical character of the rotor when this is a "squirrel cage" secondary, although a synchronous motor with internal revolving fields is apparently capable mechanically of fully as high a speed. The main object of the high peripheral speed of the induction motor is, of course, to broaden the teeth and slots, with a fixed number of slots per pole and per phase. The comparatively high induction of the synchronous motor is permissible at all frequencies, owing to its better ventilating qualities, especially with unitooth structures, as compared with that of the induction motor, the ventilating ducts of which are seriously obstructed by the finely divided winding.

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*See THE ELECTRICAL WORLD, August 27, 1898, page [illegible], and September 10, 1898, page 258.

In the matter of starting, one type of the induction motor has a great advantage. With a wound secondary and an adjustable resistance in this circuit an induction motor can be started under any load with the same current that that torque would require at full speed. With short-circuited or "squirrel-cage" secondaries, a construction highly desirable owing to its simplicity and durability, induction motors (properly designed with low magnetic leakage) can be started light without excessive currents, and if thrown directly across the mains at standstill will develop a torque two or more times that of full-rated load, which is sufficient to overcome the standstill resistance of any style of commercial load; but unfortunately they take to do this four or five times their rated full load current, a considerable part of which is lagging. By means of voltage-reducing transformers the current drawn from the line and the torque can be reduced, the voltage reduction being limited by the torque required to start, since the torque is proportional to the square of the voltage. Synchronous motors, when constructed for self-starting on the induction principle—the field magnets being arranged to give a more or less effective closed-circuit secondary—have starting properties very similar to those of the induction motor with short-circuited secondary just mentioned, machines of the revolving field type having been constructed which could start, if thrown across the lines at standstill, against their rated-load torque with a current consumption about two and a half times that with the same load at synchronous speed.

The synchronous motor is, of course, out of the question for cranes, elevator and similar work, where a good torque per ampere is required over a great range of speeds. The induction motor with a variable resistance in the secondary behaves with such loads just as does a direct-current shunt-wound motor controlled with a resistance in the armature circuit. The most satisfactory machine for such loads from the standpoint of flexibility is the induction motor with a permanently high secondary resistance, the control being effected by a variation of the voltage, the action of such a motor being closely similar to that of a direct-current series motor on constant-potential circuits with rheostatic control (the speed varying somewhat in the inverse ratio with the load), the main differences being that the induction motor will not run away on no load, as will the direct-current machine, and that its efficiency is low at any and all speeds, owing to the high secondary resistance.

[illegible] down and stops when the load exceeds a certain limit. With induction motors [illegible] higher than the [illegible] low [illegible] induction such motors will carry three, four or even more times [illegible] will carry so many times its rated load that it is impossible as a rule to test its capacity in this respect, the excessive heating de- [illegible] the generator at all loads, while the induction motor with low- [illegible]

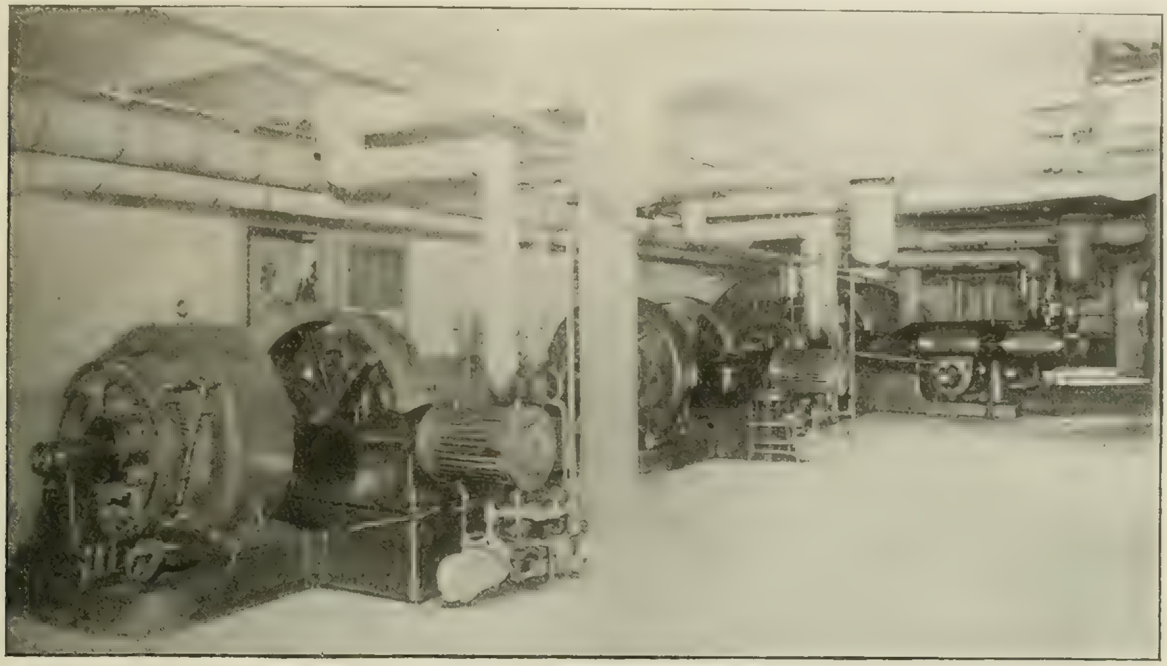
In many cases the greatest advantage of the synchronous motor is its ability to work without lagging or even cause leading currents in the apparatus and lines supplying it. The induction motor is the simpler of the two, requires less skilled attention and no exciter, but takes lagging currents which increase the drop in the generators, the lines and the transformers supplying it by a percentage far greater than the actual increase of the current consumption, owing to the reactive effects. The ordinary method of expressing the relative magnitude of wattless and energy currents —namely, by the power-factor percentage—is, by the way, a snare and a delusion. A power factor of 90 or 94 per cent., values often obtained with large induction motors at full load, gives the impression that the wattless currents are only from 6 to 10 per cent. of the total, whereas, on account of the vectorial relation, the wattless currents are in the one case one-third and in the other case one-half as great as the energy currents, giving in combination with the self-induction of generators, lines and transformers, corresponding reactive voltage drops. Synchronous excited machines, on the other hand, can, by powerful field excitation, be made to take wattless currents leading the impressed electromotive force, which not only do not increase the line drop, but act on the self-induction of the circuit to build up the voltage, and may, therefore, be made to neutralize the ohmic drop and even more than counterbalance it, making the voltage delivered at the receiving end greater than that generated. A synchronous machine, however, requires an exciter or some source of direct current to supply its field winding, and, to obtain good regulation of the line-drop by its means, requires intelligent attendance. Where a large number of small motors is distributed over one circuit the induction motor is undoubtedly the preferable type, owing to the simplicity of its construction and operation, but where the transmission of power is to one or a small number of large motors, and especially where the distance of transmission is great, the synchronous type is preferable, owing to its lower first cost, lower line drop and low cost of attendance per horse-power output. Where power is transmitted to many small motors and also over the same lines to one or a few comparatively large machines, the ideal solution is to make the small machines of the induction type and the large machine or machines synchronous, the latter being made to take sufficient leading currents to balance out the lagging currents of the former.

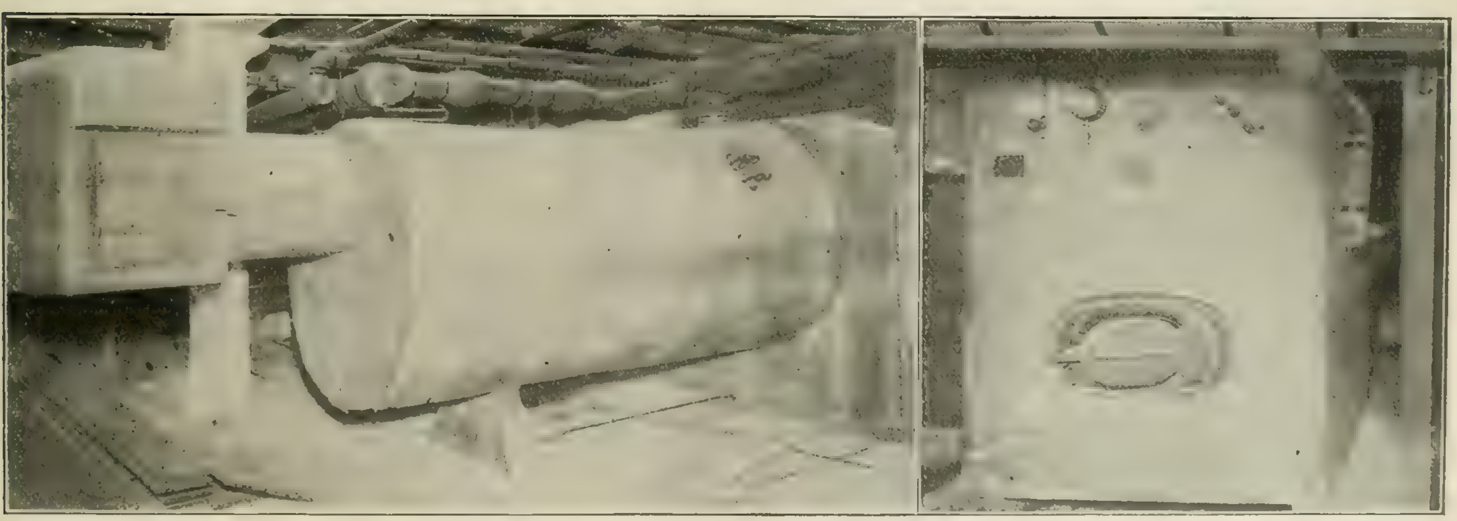
CHANGE IN INTERIOR CONDUIT WIRING.

By the recent ruling of the Underwriters a combination of lead-covered cable and iron-armored conduit is now no longer required in New York City work. Conductors must be braided and taped and may then be drawn into any iron pipe suitably protected against corrosion. This change will undoubtedly be followed in all work, as the construction now allowed is considerably lower, of course, in first cost, but it is doubtful if in the highest class of work the increased cost of the double protection may not be a good investment. The original provision of a lead covering was to avoid "sweating" or the deposition of moisture in the interior of the armor from soaking and thereby lowering the resistance of the insulating envelope, but this has been found a needless provision. An incidental advantage of no small value was obtained with the lead at a point where the conductors emerge from the conduit into the outlet boxes, where the lead sheathing could be carried through, preventing the sharp edges of conduit or box from coming in contact with the insulation and, in case of a sharp turn, cutting the latter. Some simpler method of avoiding this difficulty can, however, probably be found than the provision of a complete lead sheath.

The Heating and Lighting Equipment of the Grand Central Station.

The Grand Central Station, New York City, the only railway station on Manhattan Island and the terminal of the New York Central & Hudson River and the New York, New Haven & Hartford Railroads, has recently been reconstructed in part to bring it up to modern requirements. The station was constructed some twenty-five years ago, and while commendable at that time is badly suited to the traffic now passing through it. The work of reconstruction so far undertaken applies only to the brick structure accommodating the offices of the railroad companies, the train sheds and waiting rooms, the other public parts of the station remaining as before. It has been generally understood that these were to be remodeled at the same time, but this is not the case. The new upper stories are carried on a steel framework, carried down through the old structure to new foundations.


A General View of the Engine Room.


Rear and Front Views of One of the Belpaire Boilers.

The station and adjoining yards were previously illuminated by a small plant situated in a separate structure in the yards, consisting of an Ideal horizontal engine belted to two Edison bipolar dynamos; another small belted plant was added in another part of the yard as the demand for light grew, and the heating system of the station proper was situated at still a third point, the whole giving a very poor economy of fuel and attendance.

The steam-generating and steam-using elements are now consolidated under the Vanderbilt Avenue front of the structure, and in the sidewalk vault on that front. The boiler plant consists of six Belpaire locomotive-type boilers rated at 200 horse-power each. This unusual type of boilers for isolated plant work was chosen because of the lack of head room, which is only 9 feet at the place where the boilers were wanted, a heavy steel girder supporting the street wall of the building overhead clearing the tops of the boilers by a few inches at that height above the floor. In order to gain a little more head room the ash pits of the boilers are 16 inches below the floor level, and are separately drained to a sump pit from which water is lifted to the sewer by an automatic drainer. To prevent ashes getting into the pump the pit is divided by a partition or sill, on one side of which the ash pits drain, forming a settling tank, practically clear water passing over the sill into the other side, from which the pumps draw.

The feed pumps are placed in the boiler room, where the fireman can conveniently control their speed; they draw from a feed-water heater, in which the water level is automatically controlled by a float valve.

The flue gases pass from the boilers through sheet steel breeching to a steel stack 7 feet in diameter and 120 feet high, passing up through the train shed. The boiler and the breeching are covered with several layers of asbestos lagging made by the H. W.

Johns Company, the breeching in particular being provided with an intermediate air space covered with a wire screen and separate thickness of lagging to prevent overheating of the surrounding rooms.

The steam pressure is controlled in part by automatic damper regulators. The steam and water equipment of the building is most complete, many ingenious devices and auxiliary economies having been incorporated with the equipment by the consulting engineer, Mr. R. P. Bolton.

The exhaust steam is used for heating the building in winter, the whole heating plant being laid out on the Warren Webster system, by which back pressure is avoided by means of light suction applied to the drips by wet vacuum pumps. In case the pressure in the heating system rises above atmosphere an automatic valve, consisting of a Locke damper regulator with a 20-inch diaphragm, opens an atmospheric exhaust.

One of the little economies mentioned above is the use of a coil in the blow-off tank, through which all feed-water passes in summer before reaching the feed-water heater; this saves considerable of the heat ordinarily carried away with the blow-off to the sewer.

Another is the use of a condensing header on the top of the exhaust stack, this consisting of a large number of vertical tubes, through which the steam at atmospheric pressure passes, exposed externally to the action of the wind, which condenses a large amount of the exhaust steam, the drip from which is carried down into the feed-water heater. In this way considerable of the water and no small amount of heat is saved.

The pressure of the water supply of the building is maintained by air cushions in three water drums in the basement, which may be cross-connected to each other or separated on two systems of mains, one being the regular house supply and the other a fire main; thus there is always one tank for each of these mains, which may be run at the same or different pressures and one standby.

The electric lighting plant is supplied by a 10-inch main steam pipe over 200 feet long, and the means adopted for taking up the expansion of this header at the engine end are interesting, they consist simply of long horizontal U-shaped bends in the engine branches, as shown in the accompanying illustration of the generating units. Close to the throttle valve of each engine is a steam separator with a trap, draining not only the separator but the [illegible] just above the throttle. The units consist of Ball & Wood horizontal high-speed engines direct-coupled to Crocker-Wheeler generators. Two of these are of 150-kw capacity each, the other two being respectively 75 and 50-kw capacity. The two larger engines are tandem compounds, the smaller being single-cylinder engines.

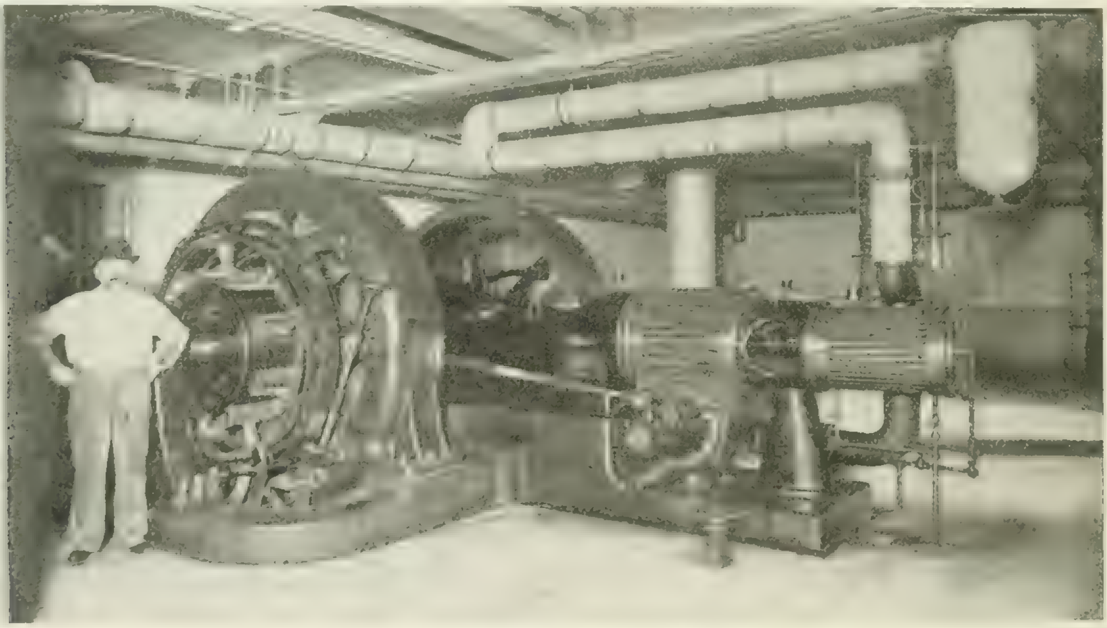
The switchboard of Tennessee marble is very simply arranged, being fitted with [illegible]

Ward Leonard double-pole circuit breakers are used on all the machine circuits as well as the feeders, the independent action of the two poles rendering the use of switches in the same circuits unnecessary. The voltage is controlled by the American Electric Heating Corporation's button rheostats. The back of the board is lighted by a large window immediately in the rear.

The distribution system is one of the last installed under the underwriters' rules requiring both iron-armored circuits and lead-covered cables; it, therefore, has this double protection against injury, the pipes being dipped in enamel paint to prevent oxidation, the whole being laid out with great care. The outlet boxes are all steel, made by the Bossert Manufacturing Company, the lead sheath of the cable being terminated just inside the steel shell of the boxes; the panel boxes are fitted with beveled glass doors.

Practically no motors are in use in the building, the whole load consisting of the lighting of the offices, train sheds and the yards, inclosed arc lights being used, of course, for the latter points. The load is equivalent to 6000 incandescent lamps, and will, of course, be quite steady, owing to the large amount of space continuously illuminated all night.

The plant was installed under the supervision of the consulting engineer, Mr. Reginald Pelham Bolton, the railroad company being represented by its superintendent of motive power, Mr. W. M. Buchanan, the engineer in charge of the new as well as formerly of the old equipment being Mr. A. E. Pollard.



One of the 150-kw Generating Units.

Stoppages of Gas Supply.

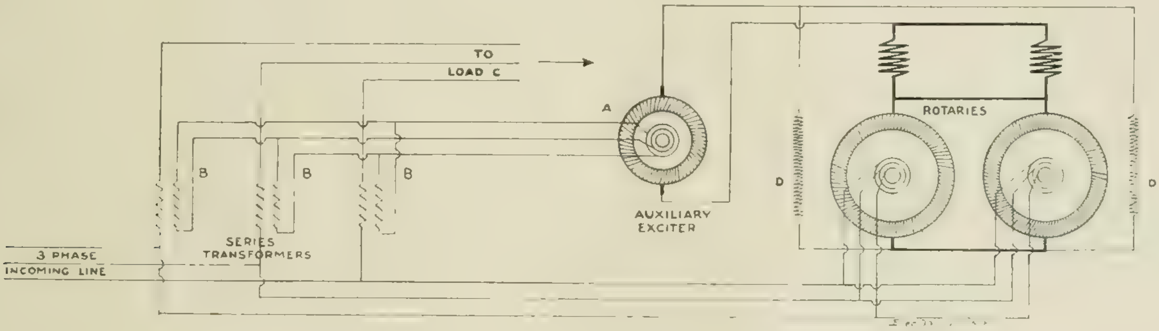
We hear a good deal about the annoyances of failures of electricity supply from central stations, but little is said of the troubles and dangers incident to a failure of the supply gas. In Richmond, Va., a few nights ago, the breaking of a large gate valve in a gas main left the greater part of the city without gas shortly after midnight. Although the superintendent of the gas works soon discovered the cause of the trouble, he feared to turn on the gas again until the next morning, as it would have escaped from jets left burning and probably caused asphyxiations and explosions. A curious sequence of the failure was that the morning newspapers, which use linotype typesetting machines in which the metal is kept melted by a gas flame, appeared the next day with their pages set with such varieties of hand type as they could find at short notice, and most of the late news omitted.

The Production of Copper and Aluminum in the United States.

The official report of the mineral resources of the United States issued by the United States Geological Survey gives the production of copper for 1897 as 491,638,000 pounds, which is valued at $54,080,180, this being an increase of about 7½ per cent. over the previous year. Of aluminum the production is given as 4,000,000 pounds against 1,300,000 pounds for the previous year, the value for 1897 being estimated at $1,500,000.

The Regulation of the Mechanicville Plant.

The system of automatically regulating the voltage of power delivered to the works of the General Electric Company by the transmission line from Mechanicville is unusually elaborate and an interesting application of various principles of alternating-current working. This plant, which was described in The Electrical World of September 3, 1898, delivers power in two divisions to the General Electric Company, one for the testing department and the other for the running of the various motors driving the machinery of the shops. The former is supplied by a motor-generator set, consisting of a synchronous alternating-current motor wound for high-tension supply, coupled to a 500-volt multipolar railway-type generator. The speed of this unit is obviously dependent only upon and equal to the speed in alternations per minute of the generators at Mechanicville and the voltage of the direct-current end is thus obviously not affected by any changes of the voltage of the power delivered by the transmission line. The shop motors, however, are supplied through step-down stationary and rotary transformers, and as the voltage of the direct-current end of this sort of a transforming system is dependent on the alternating-current voltage delivered special means are necessary for properly adjusting the latter to obtain proper pressure on the distribution lines. The means adopted in this case are the use of leading and lagging currents by which the ohmic line drop can be inductively diminished or increased—a means previously used, notably in the St. Anthony Falls line—combined with an ingenious modification of a plan claimed in a patent issued to E. W. Rice, Jr., December 14, 1897.*



Diagrammatic Plan of Connections.

The system is practically compounded for constant potential at the direct-current terminals of the rotaries or it may be over-compounded at that point. The compounding is effected not internally in any machine, but strangely enough in the transmission line itself. The latter consists of three No. 000 wires all mounted on one cross arm. This naturally gives double the self-induction between the two outside wires as between either of them and the wire in the middle, but this effect is neutralized by the transpositions of the lines, another purpose of which is the reduction of inductive disturbances in neighboring telephone circuits. The rotaries at the receiving end of the system are compound wound with quite a heavy series winding, the ampere turns of the two field windings being so proportioned that on no load the excitation of the shunt winding is insufficient to generate at synchronous speed a back e. m. f. sufficient to choke back the impressed alternating-current waves.

The result is that wattless currents lagging behind the impressed e. m. f. enter the rotary armature and automatically increase the field excitation to a proper value. These lagging currents react upon the self-induction of the line, causing a drop considerably greater than that due to its resistance alone, and—the direct-current voltage being practically proportional to the impressed alternating voltage at the rotary rings—the reduction of the latter by means of the increased line drop prevents too great a pressure being delivered from the direct-current end on no load.

As the load rises, however, the action of the series fields of the rotaries begins to assert itself. As the direct-current excitation of the fields increases the wattless currents in the armature necessary to maintain the field excitation fall off until at a point about three-quarter-load the power factor of the incoming current approaches unity and the voltage drop on the line is equal only to the amperes multiplied by the line resistance. On further increasing the load the exciting action of the field windings of the rotaries becomes sufficient to generate a back e. m. f. at synchronous speed greater than that delivered and, as the rotaries cannot change their speed but must remain in synchronism with the generators at the other end of the line, the alternating currents, so to speak, automatically cut down the field excitation by a flow of wattless currents leading the impressed e. m. f. The action of this on the line inductance is the reverse of that of the lagging currents described above. In other words, the line drop is diminished and, in case the leading current and line inductance are of sufficient magnitude, the voltage-boosting effect in the line may even be greater than the ohmic or resistance drop, in which case the voltage at the receiving end is greater than that at the generating end. The direct-current pressure being proportional to the alternating-current pressure delivered, it is in turn compounded or even over-compounded if necessary. The direct-current pressure delivered by the rotaries is thus increased just as though they were engine-driven generators, by the use of a compound winding, but the effect is not immediately due to action of an increased field flux on the armature conductors, but is due to a boosting or depressing action of the inductances of the transmission circuit on the alternating currents therein.

In the case of the Mechanicville-Schenectady system, there is, of course, in addition to the self-induction of the line, the self-induction of the rotaries and stationary transformers and the generator armatures, at least for the present. If at any later time other transmission lines are run from Mechanicville to other cities it will become necessary to excite the generators for constant potential at the switchboard in order to prevent the various lines interfering with each other. In this case the self-induction of the generators cannot be depended upon, but at present the generator fields can be left at constant excitation and the voltage at Schenectady controlled entirely automatically by the compound fields of the rotaries, the self-induction of the generators materially aiding the inductive compounding.

This arrangement alone would be sufficient to obtain proper voltage regulation but for the interference of the load taken by the synchronous motors driving the generators of the testing department. Any increase of the load in this department increases the current in the line, consequently increases the ohmic or resistance drop without the proper compensating effect in the wattless currents taken by the rotary. Any variation also of the phase relations of the synchronous motor load will still further disturb the proper combination of the ohmic and inductive drop on the line, the sum of which two quantities should be, by the action of the rotaries described above, rendered a constant independent of the load. To make the rotaries take leading or lagging currents which shall balance out the disturbing effects of the synchronous machines the following system has been devised, this being as mentioned above a modification of Mr. Rice's recent patent. The rotary shunt fields, as shown at *D D* in the accompanying diagrammatic illustration, are excited from a separate direct-current bus bar which is fed with current from the main bus through an auxiliary exciter *A*. This auxiliary exciter serves to raise the voltage across the rotary fields and is driven by an alternating-current synchronous motor of the same number of poles, thus keeping its armature in step with the alternating system. It has no field exciting winding, but its armature is fitted with three collecting rings into which alternating current may be introduced from the secondaries of three small series transformers shown at *B*, the primaries of which are inserted in the lines feeding the synchronous motor *C*, and any other loads supplied over the same transmission line, with the exception of the rotaries. The armature of the auxiliary exciter is coupled to the synchronous motor at such an angle that the currents introduced from these series transformers, when the load passing through their primaries is of unity power factor, tend to set up a field of force in the magnetic circuit of the auxiliary exciter and build up a direct-current voltage across the brushes thereof; thus the greater the load on the system, *C*, the greater is the boosting action of the machine, *A*, and the greater in consequence the voltage across the field windings, *D*, of the rotaries. Further, if the load on the system, *C*, becomes lagging, tending thereby to still further increase the drop on the transmission line, the currents entering the armature of machine *A* lag also and excite to a correspondingly greater extent the field magnetic circuit of that machine, causing a greater current in the winding, *D*, of the rotaries, which in turn causes the armatures of the rotaries to take a leading current to cut down their excitation, this leading current balancing the lagging current of the load, *C*, and preventing any deleterious effect on the line drop. Vice versa, leading currents of the load, *C*, build down the voltage across the shunt fields of the rotaries, *D*, causing lagging currents to enter the armatures thereof which balance the leading currents and equalize their effect on the transmission system. In this way the load on the system, *C*, can vary in magnitude or phase relation by any amount within limits without affecting the voltage relation at the diret-current terminals of the rotaries.

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*See The Electrical World, February 12, 1898, page 210

Methods of Determining the Frequency of Alternating Currents.*

BY CARL KINSLEY,

INSTRUCTOR OF PHYSICS AND ELECTRICAL ENGINEERING, WASHINGTON UNIVERSITY, ST. LOUIS, MO.

The accurate determination of the frequency is essential for the correct computation of the relations between e. m. f., current, self-induction and capacity. Since the periodicity must usually be squared, it is essential that the determination be made quickly and with but little error.

Dr. John Hopkinson was the first to use a stretched steel wire actuated by an electromagnet and when the condition of maximum resonance was found the periodicity was calculated from the constants of the wire and its tension.

Dr. Campbell[1] proposed the use of an iron rod which was thrown into resonance in the same way. From the constants of the rod and its length the periodicity was computed. The rod he found could be more easily used than the wire.

Another method capable of great accuracy and easy manipulation includes the use of a telephone in the alternating-current circuit and a resonance tube by means of which the periodicity may be calculated from equations, or it can be gathered from tables already computed.[2]

A very satisfactory method will be one which includes the use of a metal strip as the primary resonator whose periodicity may be changed by means of an added weight. An electromagnet may be used, as in the first two cases, to set this into vibration. The periodicity can be computed from the constants of the vibrator or a complete calibration can be made by two determinations. It will usually be more satisfactory to standardize by actually determining the periodicity for two adjustments of the resonator. The equation to be used for that purpose is

t = [illegible] when

t = time of one complete oscillation.

l = distance of the added weight from the support.

M = Mass of the slider.

l = length of the vibrating rod.[3]

B and *K* are the constants of the [illegible] equation, which may be either calculated or obtained by experiment.

The condition of resonance is obtained with great exactness and the determination may be made with as great accuracy as may be desired.

The Electric Railway as an Auxiliary to Coast Defense.*

BY W. J. CLARK.

The rapid history making of the past few months has caused the mention of certain problems, which a year ago would have seemed ridiculous, to be worthy now of the most serious consideration. While it is unwise to bring up for discussion here ordinary matters of state and national policy, it is conceded, I think, that no matter what differences of opinion exist among us on the question of national extension and aggrandizement there is a unanimous feeling among all Americans that this is now a nation begun with an exceedingly large "N," and that the true policy for its future is to strengthen it in every legitimate way, by displaying American intelligence, inventive ability and commercial shrewdness in such a manner as to make it the strongest of all earth's nations in peace, so as to the better preserve such relationship for all times to come.

Certain of the continental powers of Europe have for several years been encouraging the construction of street railways for the avowed purpose of military expediency, going so far as to grant subsidies or extraordinary concessions where the construction of the line filled in some important link in transportation facilities. The great essential insisted upon has been that in their construction such railways should conform in gauge, special work and curvature with the general steam-railway system of the country so that in emergencies the rolling stock of the latter could be operated over the lines of the former. This would be more especially in the case of besieged cities to afford a means of ready transportation to all points within the line of fortifications without breaking bulk, also to make it possible to transport bodies of troops to any points within such district in the quickest possible manner.

All over the United States information is readily obtainable concerning the steam railway systems, with their trackage, routes and rolling stock, as well as their inter-connections and the possibility of temporarily increasing the facilities of any particular road by combination with others. Such was not the condition, however, as regards electric railways when a few months ago we were all worrying for fear that landing parties from the then supposed powerful Spanish navy might make it temporarily uncomfortable at certain exposed points along our Atlantic seaboard, besides destroying much valuable property. It was suggested, therefore, to the writer that he obtain maps of all the existing street railway lines along the Atlantic and Gulf coasts, show their connections and intersections with the steam roads and other street railway lines, and, so far as possible, suggest how much could be done, should military necessity require it, to cause such street railway systems to become an important auxiliary to the steam lines for rapidly moving troops and supplies to any points required along the seacoast. This work involved examination of the possibilities of making connections with the steam lines, the utilizing of such track as would be possible from its type and the form and character of special work, so that steam rolling stock could, if necessary, be operated over the street railway lines, while the possibilities of using the current of one electric railway to help out congestion upon some other, and all similar matters, were most carefully gone into. The work was most interesting, hurriedly though it had to be done, and, to the credit of every street railway corporation along the coast, it should be said that each and all patriotically responded to requests with the fullest information that could be desired concerning their systems, and expensive maps were furnished freely without charge. In fact, the management of certain important systems were so enthusiastic that, had the War Department requested it, it is probable that many miles of new track would have been built by them without waiting to question the possibilities of its future earning power, or waiting for local franchise rights. Of course, it would not be proper for the writer now to give to the world the entire results of the investigation, but to attain a most important object, and to strengthen our electric railway systems where they are weak, it should be said that stretching along the coast from Calais, Me., to Galveston, Tex., are ninety-two distinct street railway systems, any one of which might have been an important factor in transportation for military purposes should Spain have made a demonstration against our coast. The aggregate length of these systems is about 6807 miles, and the capacity of some of these for handling traffic to several coast points is simply astounding, it being frequently two or three times that of steam railways which approach the same localities.

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*Abstract of paper presented [illegible] American Association for the Advancement of Science, Boston, August 1898.

[1] [illegible]

[2] [illegible]

[3] [illegible]

*Paper read before the New York State Street Railway Association, Manhattan Beach, September, 1898. Abstracted.

Rails—Their Construction from a Scientific Standpoint.*

BY A. J. MOXHAM.

The problem of wear upon a steam railroad is a very different thing from that of wear upon a street railroad. The rail in steam railroad use presents a clean head, because the rail is not buried. It has to oppose principally a rolling friction, for the number of times per mile that steam railroad trains are stopped is very few, taking a general average. The street rail, on the other hand, has not only to meet this rolling friction, but has to contend with the grit from the surrounding roadbed, and which stops every few feet.

Being unable to reach positive conclusions as to wear from the published authorities and from personal inquiries with the steel experts of the country, or even from our own experience, it was determined to conduct experiments to this end.

The experiments have lasted for three years. The first endeavor was to take broadly a "soft" steel and a "hard" steel for the rails to be tested, securing the difference by carbon alone, leaving all other ingredients as nearly as possible the same. The experiment with these was started in October, '95, and has been continuous ever since. In June, 1896, additional rails were added to the experiment, supplied by the West End Street Railway Company, of Boston, who at that time had determined (with wisdom as will be seen subsequently) upon a steel both hard and ductile. The conclusions, therefore, are based upon what may be described as

Soft steel.
Hard steel, and
Steel both hard and ductile.

The rails (some thirty-three in all) were laid in the South Eighth Street tracks of the Nassau Electric Railroad of Brooklyn. They were laid continuously, so that the same car is obliged to pass over every rail, and therefore each rail is subject to the same wear, and the wear on the head only is considered. Street traffic is ignored. The point was selected as one that would give great wear in a short time, in order to reach early conclusions, as the cars pass this point at extremely short intervals.

Every rail has been measured at two points, taken about 10 feet from each end, in order to eliminate the special wear at the joints. Each rail has two cast iron boxes bolted to the outside, at the points to be measured, to permit access for purposes of measurement without disturbing the road-bed.

There were seventeen rails of low carbon (viz., averaging 0.28); fourteen rails containing high carbon (viz., 0.59), and two were West End rails. The least wear shown was in the West End rail, the hard rail follows a good second, whlie the greatest wear is shown in the soft rail.

The average monthly wear amounted to 0.0007 inch for the West End rail, 0.0012 for the hard rail, and 0.0017 for the soft rail. The results of the experiments are conclusive on this point.

The carbon of the West End rail is practically the same as that of the hard rail, silicon considerably higher; but the real point of difference between the hard rail and the West End rail lies in the lower phosphorus and higher manganese. It is well known that the low phosphorus, accompanied by an increasing manganese, conduces to greater ductility. On this point, however, a word of caution is necessary. Any decrease of phosphorus from what is known as standard in Bessemer steel, viz., 0.10, can only be achieved at a greatly increased cost of manufacture, and therefore, so far as the chemical constituents of the rail are concerned the whole problem to the street railway man is how far it is economical to go in lower phosphorus, the other hardening elements remaining the same. A steel such as represented by the West End rail, or even a steel still lower in phosphorus, it is possible to make—it is purely a question of cost. On to-day's basis an extra cost of $1.50 per ton on the low-phosphorus steel is a low estimate; it would be safer to take it at $2. Taking the average price of girder rails at, we will say, $25, the extra cost of the low-phosphorus would be 8 per cent. What would be the increased wear of the rails?

The average monthly wear of the hard rail is.......... 0.0012
The average monthly wear of the West End rail is........ 0.0007

On the face of it it would appear, therefore, that those who could afford it were amply justified in demanding and purchasing the low-phosphorus steel, but there is a hope for those who cannot afford it; and there is some doubt as to the advantages to be gained from so doing, which brings us to the lesson of the whole experiment. Pay close attention to what follows.

We all know that we can use a street rail until at least one-half inch is worn away from the head. On this basis, and taking the average wear of the different rails as shown in the test, it would take

25 years to wear away ½ inch with the soft rail;
35 years to wear away ½ in. with the hard rail;
60 years to wear away ½ in. with the West End rail;

and this is the case of a road which represents not average, but excessive wear; the rails in question having borne the wear of heavily loaded cars running on an average of 30 per hour for twenty hours per day, during the time of the experiments, or a two-minute headway. This means during the busy part of the day less than one-half minute headway, and during the night hours a wider interval. Taking the ordinary line its average headway is less than this, consequently the theoretical wear would be greater. Now all of us who are interested in electric roads and have used girder rails are aware of the fact that we do not get anything like this wear, and this being the case we have got to look to something else besides quality of steel. I think we all know what the cause is, and I am glad to again emphasize it because it discloses a great evil we are still suffering from without realizing it to the extent we should—the defect is in the joints.

Had these measurements of wear been taken at the joints instead of elsewhere the lesson would have been different. Rails are taken out of the track to-day, not because the rail as a whole has reached the point of destruction, but because the joints have become too bad for further use. It must be remembered that the experiments in question have not been extended long enough to show the effects upon the rail of the degeneration of the joints. On the wear at the joints reaching a certain point, the wear of the rail increases rapidly.

In the early days of girder rails the joint question was before us all. It was self-evident, in that the earlier construction was so light that the joints quickly went to pieces. During later years, using a heavier rail and larger and better fitting splice bars, we have heard less of this joint question, for as compared with the earlier joints the track is comparatively smooth. Nevertheless, the evil still exists, and a few years from now those who to-day are deluding themselves in the belief that they have a long life for their existing tracks will awake to find out that even the construction of to-day is wasteful and extravagant in this respect. The joint which is accepted now as being passably fair is reducing the life of the rail to one-half, or perhaps even one-third, of what it should be.

The conclusions we are led to seem to me to be as follows:

First. That for street-railway use, a hard rail will give the best results.

Second. That the most economical way to secure this hardness is by increase of carbon, accepting the manufacturers' standard specifications for the other ingredients.

Third. That the next step should be towards an improvement of the joints.

As is well known to all present, the writer has pinned his faith to the electric-welded joint as settling the question once for all, by making the union homogeneous with the rail and possessing an advantage from an electrical standpoint in the matter of conductivity. Nevertheless the cast-welded method also demands careful consideration. It is certainly preferable to anything in the nature of splice bars that we know of, provided one glaring fault can be overcome—viz.: the softening of the steel that occurs from the large body of hot cast metal located at that point—and it would appear that some means could be devised to overcome this evil.

Fourth. After making the joints perfect what we have termed the "West End rail" would certainly justify its extra cost.

I would caution, however, against the use of carbon as high as 0.59, as that was purposely taken high in what we term the "hard" rail in this experiment, the object being to reach an extreme. Carbon should be limited to from 0.50 to 0.55 with the usual leeway to cover manufacturing contingencies. It also remains a question whether the reduction of phosphorus to 0.08 (which may be done within economical limits of cost) will not give results so closely approximating the 0.05 of the West End rail as to make that figure an economical one.

The great lesson I would once more emphasize is that until you get the joints perfect you need not worry about the quality of your steel; anything in the shape of steel—the very cheapest you can buy—will last longer than the joints will permit you to keep your rails in the track.

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*Paper presented before the New York State Street Railroad Association, Manhattan Beach, September, 1898. Abstracted

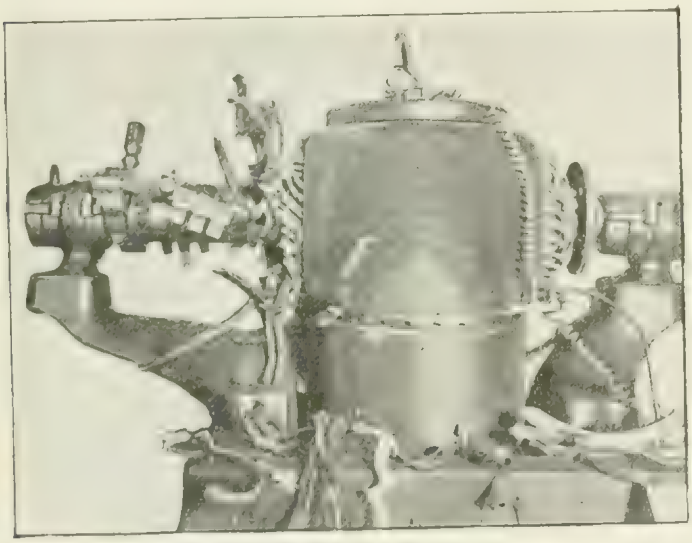
An Odd Wreck.

There appears in the accompanying illustration a view of a 30-kw bipolar compound-wound upright type of dynamo which was, on August 6, subjected to a wreck rather difficult to account for. The details are described as follows by Mr. James T. Freeman, of Rochester, N. Y.:

On the evening mentioned this 30-kw dynamo was called upon to carry a night load of 200 amperes at 110 volts. The load at the time of the transfer was carried by a 75-kw four-pole compound generator of the same voltage. The usual process of bringing the smaller dynamo to voltage and cutting in the equalizing side was carefully gone through with. The instant the main switch was thrown a series of events transpired that came too rapidly to be put carefully on record.

A flash at the switch, the dying down of the lights, the crash of flying material and the throwing off of the belt is the order of events as nearly as they can be given. It would be perfectly useless to attempt to judge from appearances just which happened first, whether the belt was thrown before the commutator went to pieces or after.

The above seems within the range of possibilities, but a look at the machine seems to indicate something different, and makes matters somewhat complicated. The armature indicates in every way that, at the time the commutator was thrown, it was running in a direction opposite to that of the engine. If this was the case the belt was thrown before the commutator went to pieces.



A Wrecked Generator.

The engine, which is rated at 50 horse-power, did not appear to race, and continued running quietly after the accident. The writer, who was present, is sure the dynamo was up to voltage and thinks the attendant at the board pulled the switch almost instantly after it was noticed that something was wrong.

It can be seen in the illustration that the segments indicate a direction of rotation over and toward, while the engine causes a rotation over and from, the point of view.

The dynamo is protected by fuses, but these were not blown. A weakness is found in the commutator, but it would hardly seem possible that at the normal speed of 1300 r. p. m. the centrifugal force alone would cause destruction. It will be noticed that the [illegible] have a short bend at the end and that they are of quite a length. This end of the armature was [illegible].

The force with which the segments were thrown can be imagined [illegible] passed through a window [illegible] presented the [illegible] given an exhibition of his skill at mutilation. The canvas head [illegible]

[illegible]

A plausible theory as to the cause, but one which is not corroborated by present indications, is that, after the dynamo was cut in, the shunt circuit became broken, making a series motor, thus changing the direction of rotation.

Track Construction.*

BY D. F. CARVER.

The essential feature of good track construction and good pavement is a good foundation. In a majority of cases this exists naturally at the depth at which ties are laid. If the natural foundation is not suitable, it can be made so by the use of broken stone or gravel.

The ties should be of the best quality of yellow pine, sawed on four sides, and of size sufficient to give a bearing on foundation of not less than 4½ square feet per tie. A very excellent and economical spacing has been found to be twenty-four ties to a 60-foot rail.

All ties should be thoroughly tamped near the rail, and the joint ties tamped throughout their lengths. The dirt under the base of the rail should also be thoroughly tamped, otherwise there will be a settlement, which will allow the rail stones to be forced down.

The rail used should be of hard steel, and of a section that will give it great stiffness. The tread should be either level or, as is becoming common practice, should bevel, so that the wheels will have a bearing for the width of the tread. This latter arrangement gives greater contact for traction and stoppages, and also does less damage to wheels that are skidded in an emergency stop.

The web of the rail should be as nearly as possible beneath the centre of the tread, so that the resultant of the forces of weight and lateral motion of the wheel shall fall within the width of the base.

As the lightest section of 9-inch rail is more than amply strong to stand the strain of carriage, provided, of course, that every tie has a first-class bearing, it has been found desirable to roll the web down to the thinnest section possible, and accept the small losses due to rail splitting along the web from the tension caused by the very unequal distribution of metal. The breakage above referred to has been found to be, throughout a year's work, about one-fourth of 1 per cent. of rail laid.

The problem of the rail joint has been a trying one, but it is fast approaching a successful and satisfactory solution, the essential features of which are either a welded joint, which makes a rail practically one continuous mass, or the mechanical joint, which avails of the bearing surfaces beneath the head and tram, and beneath the base, and of the upper surface of the base of the rails which it connects. Either joint, to be entirely successful, however, must be laid with tight joints, so that passing wheels will have a continuous bearing.

This method of construction will, in time, force the track out of line, and where the line is curved to any extent will push the curves out of line; and also in renewing any portion of the track in warm weather, it will be found almost invariably impossible to put in new pieces of the same size as the old removed, because the great compression strain closes up the opening. Still, with all these objections, the added length of life of joints gained is of decided advantage.

With the girder rail sections, in block-paved streets, it is absolutely necessary to use a rail filler. We have experimented with the burnt brick, which was found to crumble badly under heavy wagon traffic, and it has been abandoned. In its place is used hemlock planks, which give the best results on the investment.

In paving up the street the portions outside the outside rail and between the tracks should be paved and thoroughly rammed before the sections between the rails are paved. This prevents the crowding of the stones between rails from forcing the track out of gauge.

A bed of concrete between ties has been tried, to prevent the paving blocks from sinking, but such experience as the writer has had with this construction has not been very satisfactory, and as its first cost is great, and also as the interest on this extra investment is, in many cases, greatly in excess of the maintenance charges which it is intended to prevent, he is led to doubt very greatly its utility.

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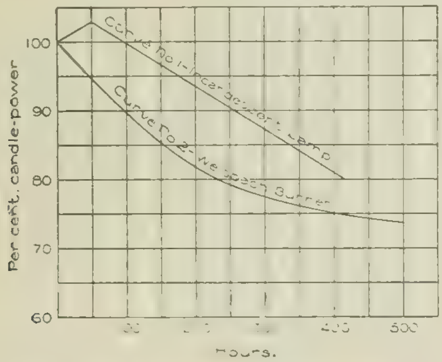
*Paper read before the [illegible] Railway Association, Man[illegible] Beach, September, [illegible] Abstracted.

Deterioration of the Candle Power of Welsbach Mantles.

Gas companies have very generally claimed that the mantles used with Welsbach burners maintain their candle power practically constant until the mantles are destroyed. Recent investigations, however, show that the drop in candle power in Welsbach mantles is as rapid or even more rapid than that of the filaments of incandescent lamps. The accompanying curves, which, with the information, are given on the authority of the General Electric Company, show the average results of a series of tests made on incandescent lamps of its manufacture and Welsbach burners.

Curve 1 shows that a good 32-cp incandescent lamp burns 415 hours before its candle power drops to 80 per cent. of the initial value. Curve 2 shows that a Welsbach burner suffers the same fall in only 230 hours. In other words, the depreciation of the Welsbach mantle is so much greater than that of the electrically illuminated filament that the Welsbach burner drops to 80 per cent. of its initial candle power 185 hours sooner than the incandescent lamp. Even if the drop of the electric filament is measured in terms of its maximum, as some engineers claim it should be, the comparison is but little changed, since 80 per cent. of the maximum is reached only after 350 hours' burning.

Economy dictates the substitution of a new incandescent lamp when the candle power has dropped by at most 20 per cent. of the initial, but taking into account the high first cost of Welsbach mantles and the low cost of operation a mantle would undoubtedly be continued in use until this candle power had dropped much lower. In this case the customer would be obliged to consume the same amount of gas, and thus be at the same expense, although the light obtained would be much diminished in power. For example, if a Welsbach mantle having an initial candle power of 32 were burned for 500 hours its candle power, according to the curve, would drop about 27 per cent., leaving approximately 23.4 candles.



Candle-Power Time Curves of Electric and Gas Lamps.

In 1897 tests were made in Berlin in which two English and three German mantles were tested. The standard of light used was the Heffner amyl-acetate lamp, in connection with a Lummer-Brodhun photometer, the gas being measured by an Elster experimental gas meter. Much care was taken to secure uniform and reliable results, the room being thoroughly ventilated and draughts at the same time avoided, as it has been found that the light is materially affected if there is not an ample supply of fresh air. The horizontal candle power was measured in three directions, 120° apart, and the mean taken as the correct reading, the measurements being taken every twenty-four hours. The final table, which contains practically all the important results, is as follows:

Make of Mantle.	New	Candle Power. 100 Hrs.	Candle Power. 500 Hrs.	Percentage Fall In 100 Hrs.	Percentage Fall In 500 Hrs.
English mantle, No. 1.	36	33.4	14	7.2	61.2
" " " 2.	52.9	49	29.7	7.4	43.8
German mantle, No. 1.	70.3	49.7	28.2	29.3	59.9
" " " 2.	53.5	40.3	33.3	24.7	37.7
" " " 3.	62.6	57.1	47.5	8.8	24.1

An important feature in connection with incandescent gas burners is the proportion of the size of the mantle to the Bunsen flame. In many cases the mantle is much too large for the burner, and in consequence does not become properly incandescent all over; it also shrinks and warps out of shape to a much greater extent than when smaller. The tests also showed that the light absorbed by mica chimneys was about 10 per cent. more than by glass chimneys.

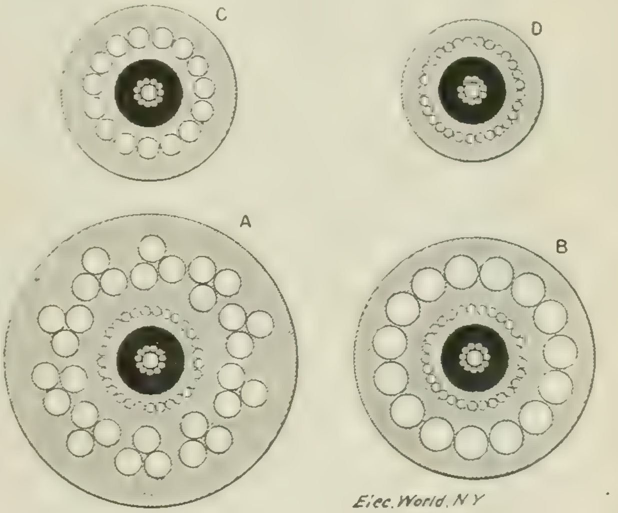
Mr. E. A. Medley, who made the report of these tests, sums up as follows:

"The mantles give a wonderfully good light when new, but the extreme rapidity with which the light falls off and the consequent shortness of their efficient life, even when treated with every consideration due to their somewhat delicate constitutions, make them far from an ideal illuminant. With the possible exception of the German mantle No. 3 a great deal of improvement is necessary before, for domestic lighting at any rate, they can be considered satisfactory."

The deterioration in candle power of Welsbach mantles should be thoroughly considered in connection with the heat given out, consumption of oxygen and contamination of the air, inconvenience of ignition, danger from fire, and other disadvantages which are common to any gas system, and station managers may find from the facts given cogent arguments in favor of eliminating these disadvantages by discarding the Welsbach burner for the more convenient and more satisfactory electric lamp.

The New Cable Between Brest and New York.

The cable which was recently laid direct from the coast of France to New York City, by the French Telegraphic Cable Company, is described in a recent number of "La Nature," from which the following data and the accompanying illustration were taken: The cable has a length of 5700 kilometres (3540 miles), and weighs in the neighborhood of 9,250,000 kilograms (10,000 short tons) of which 5,500,000 kilograms represent the armoring of iron and steel, 930,000 the copper core and 560,000 the gutta-percha insulating sheath. The conducting core is made up of a thirteen-wire copper cable, the central conductor having a diameter of 3.04 millimetres (0.12 of an inch) and the twelve strands surrounding it of 1.06 millimetres (0.04 of an inch). This conductor is surrounded by the gutta-percha dielectric, the thickness of which is 3.5 milllimetres (0.14 of an inch), the weight of this material being about 180 kilograms (400 pounds) per nautical mile. Outside of the copper and the gutta percha, the dimensions of which are uniform throughout the length of the cable, the section differs according to the location. The protecting envelope is made up in four styles, shown respectively at *A*, *B*, *C* and *D* of the illustration. The lightest section is that shown at *D* for deep-sea service, the armoring of which consists of twenty-four steel wires, each with a diameter of 2.29 millimetres (0.067 of an inch). In the intermediate type shown at *C* the steel wires have a diameter of 4.5 millimetres (0.13 of an inch). The coast type shown at *B* has double armoring, the strands of the inside protection being twenty-four in number, with a diameter of 2.29 millimetres (0.067 of an inch), and of the outside, fifteen in number, with a diameter of 6.8 millimetres (0.20 of an inch), while the shore ends shown at *A* are also doubly protected, the inside armoring being the same as the last and the outside made up of ten three-wire strands, each wire of which is 5.6 millimetres (0.16 of an inch) in diameter. The cable is designed to transmit per minute sixteen words of fifteen impulses per word. The cable was built and laid by La Société Industriale des Téléphones.



Cross-Sections of French Cable, Actual Size.

The Meeting of the British Association.

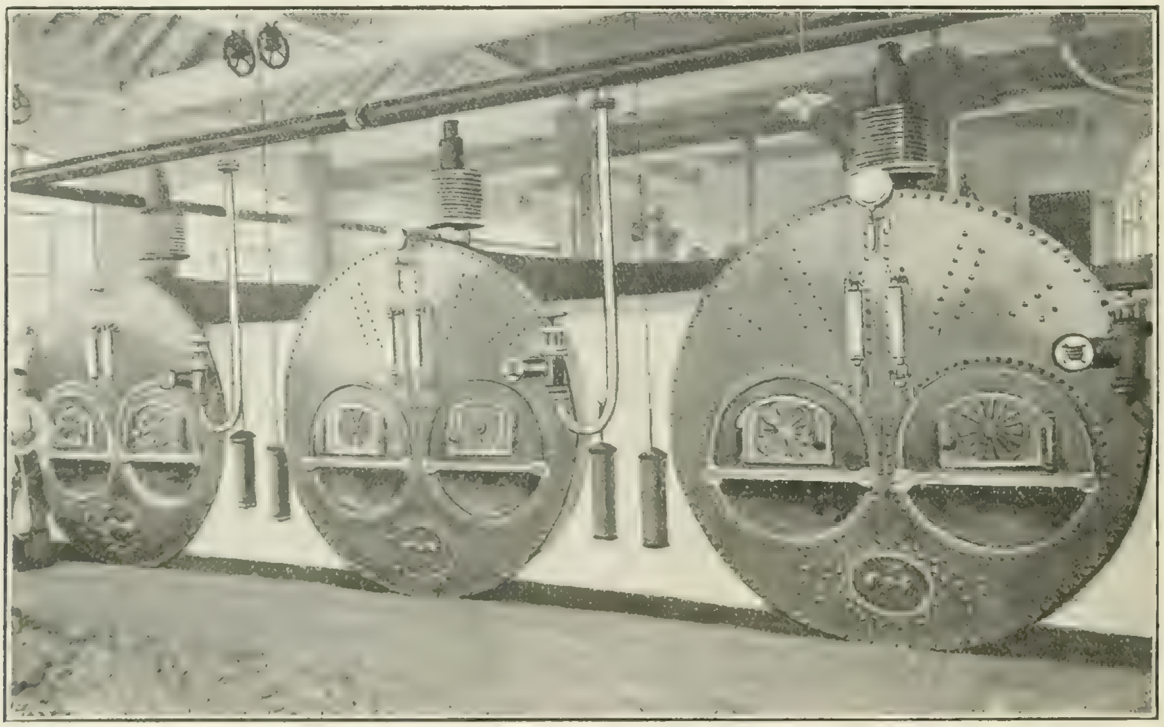
The sixty-eighth annual meeting of the British Association for the Advancement of Science was held at Bristol, September 8-13, with an attendance of over 2400 members and a list of papers and reports which should form a considerable addition to scientific records. Prof. Michael Foster is the president-elect for the coming year and the next year's meeting will be held at Dover, Bradford having been chosen as the meeting place for 1900.

Of the two most notable features of the meeting, one was the cry raised over the disturbances of the measurements in magnetic observatories caused by electric tramways and the dangers of electrolysis from the tramway returns. The English have taken observatory disturbances much more grievously than have Americans, among whom the idea has generally prevailed that, the electric railways being of more vital interest to the public than magnetic observatories, the latter must give way. The other subject which excited considerable interest and on which three papers were read was the electrical transmission and distribution of power. In this line a radical conservatism and a noticeable lack of information on the recent developments in alternating-current work in Switzerland and in this country appeared. One prominent engineer expressed the opinion that wherever the distance did not call for pressures of over 2000 volts direct currents were preferable to multiphase. The papers and discussions in this line brought out practically nothing new to American engineers.

The following is a list of the electrical papers of engineering interest presented at the meeting:

A. A. Cahen and J. M. Donaldson, "Comparison Between Charging a Secondary Cell at Constant Potential and at Constant Current, More Especially as Regards Efficiency"; Prof. Oliver Lodge, "On a Magnifying or Bellowing Telephone"; E. H. Griffiths, "On the Measurement of Small Differences in Resistance"; Prof. H. L. Callendar, "A Platinum Voltmeter"; E. B. Rosa and A. W. Smith, "On the Dissipation of Energy in the Dielectric of a Condenser"; Prof. H. Callendar, "A Quantitative Bolometric Sunshine Recorder"; S. Skinner, "The Carbon-Consuming Cell of Jacques"; J. B. Fawcett, "On Standard High Resistances"; Mrs. Ayrton, "The Drop of Potential at the Carbons of the Electric Arc"; S. Lemström, "Experiments on the Influence of Electricity on Plants"; Dr. E. H. Cook, "The Action of Electricity on Plants"; Discussion on "The Magnetic and Electrolytic Actions of Electric Railways." Communications on this subject were made by Dr. [illegible] Prof. A. W. Rücker, Dr. [illegible] and Mr. [illegible] W. H. Preece [illegible] Prof. J. A. Fleming [illegible] Report of the Committee on [illegible]. Report of the Committee on Comparing and Reducing Magnetic Observations. Report of the Committee on Electric Standards: A. G. Vernon Harcourt, "On a 10-candle Lamp to Be Used as a Standard of Light." Report of the Committee on the Electrolytic Methods of Quantitative Analysis. E. Cannan, "Ought Municipal Enterprises to Yield a Profit in Aid of Rates?" Prof. S. P. Thompson, "Economic and Social Influences of Electric Traction"; A. Siemens, "Electric Power in Workshops"; A. H. Gibbings, "The Application of the Electric Motor to Small Industrial Purposes and Its Effects on Trade and on the Community Generally"; W. Geipel, "Electric Power and its Application on the Three-phase System to the Bristol Wagon and Carriage Works"; H. Faraday-Proctor, "Notes on the Electric Lighting System at Bristol, with Special Reference to Auxiliary Plant"; Prof. Silvanus Thompson and Mr. Miles Walker, "Electric Traction by Surface Contacts"; J. G. Aldridge, "Combined Electric Lighting and Power Plant for Docks and Harbors"; A. H. Allen, "Electric Canal Haulage"; C. Bright, "On the Pacific Cable."

The Blackpool and Fleetwood Electric Railway.


The Boilers of the Blackpool and Fleetwood Electric Railway.

This English electric railway, though of small size, as are all English electric railways, the total length being 8 miles and the proposed number of motor cars twenty-four, is of considerable interest in that it runs largely over a private right of way and that storage battery sub-stations and other unusual electrical arrangements are used. The line is described fully in "The Railway World" of September 8, 1898, from which the following information and cuts were taken. The greater part of the line is practically a light railway construction with centre pole and bracket overhead wire supports, the speed on this part of the line being quite high, the whole 8 miles being covered in twenty-five minutes, which could be diminished were it not for official regulations. The motor cars are all of the double-truck type, weighing loaded 12 tons and fitted with one G. E.-1000 motor per truck.

The generating station contains three Galloway boilers and four open marine-type vertical two-crank compound engines rated at 200 horse-power each driving at a speed of 165 revolutions per minute, a six-pole, 120-kw 505-volt generator, both engines and generators being built by Messrs. Mather & Platt. The cut-off of the engines is varied by hand and the automatic governing is effected by a throttle governor. Ejector condensers take the exhaust. The generators have some peculiarities unknown in this country. In the first place they are shunt wound, the chief feature of interest, however, being a collar (apparently of iron) encircling the armature from pole to pole. This arrangement is said to effectually prevent all sparking, the advantage more than compensating for the magnetic leakage which it entails. The efficiency of the generators is given as 93 per cent., no parts rising more than 25° C. above the atmosphere on continuous full-load running. Three four-pole motor-driven boosters also mounted in the station are capable of building up 200 volts with a load of 130 amperes each. By means of switches any one of the four feeders may be connected to a booster. Two feeders run respectively to two accumulator substations toward the ends of the line. Each of these is fitted with 250 cells made by the Chloride Electrical Storage Syndicate, having a capacity of 300 ampere hours. The batteries are normally "floated" on the line to steady the load coming over the feeder, but any one of the three elements, the battery, feeder or line, may be cut out by switches.

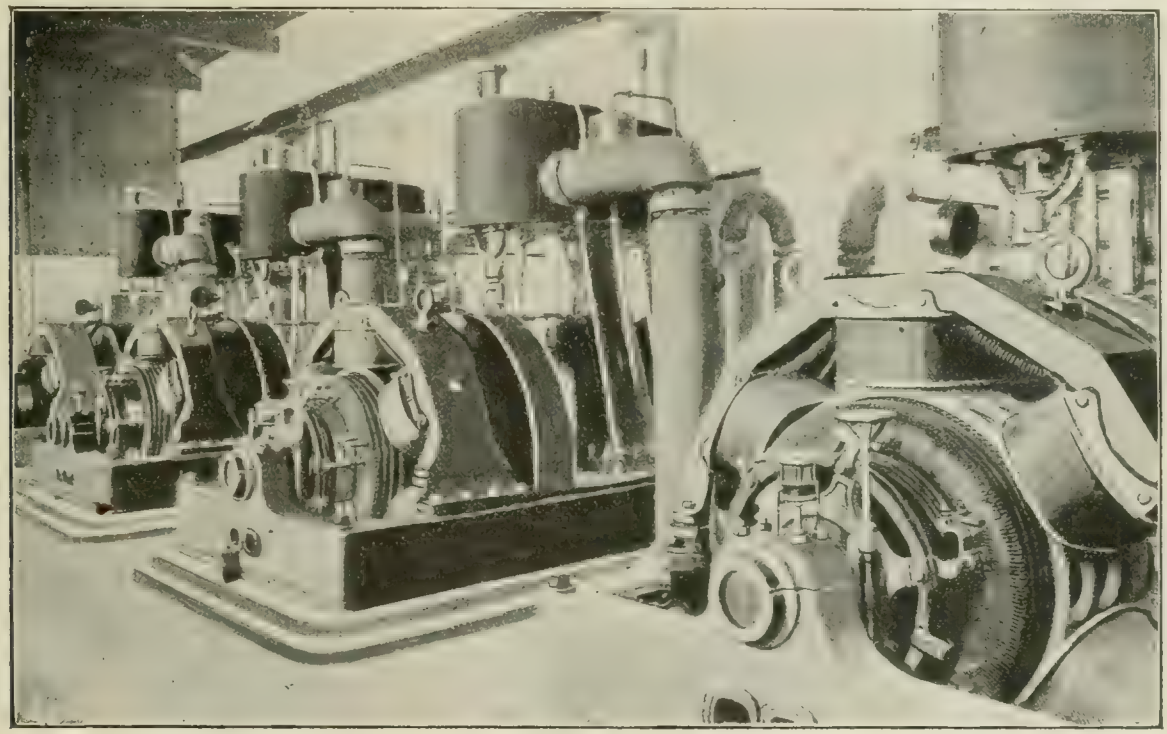
Electric Belts.

The country newspaper having a circulation among farmers and the religious weekly having a circulation among families seem to be the principal places in which one reads advertisements of "electric belts" for the cure of all kinds of disease to which the human frame is liable. As has been pointed out recently in these columns, it seems to be the duty of the electrical press to expose, wherever possible, the fakirs who do so much to bring the profession into discredit and to throw a certain obloquy upon the name of things electrical. Among these are the enterprising manufacturers of the remarkable mechanisms known and advertised as "electric belts." The advertisements guarantee the wearer of one of these an immunity against pretty nearly everything but a violent death, and generally tell, in learned terms, about the benefits to be derived from the more or less powerful currents of electricity generated by their appliances and absorbed into the system of the wearer.

In the first place, if it were true that the beneficial results to be derived from the application of electric currents to the body amount to the half of what these fakirs claim the use of electricity ought to be carefully restricted to practitioners who understand its application. So powerful a medicament can only be dangerous in the hands of the unenlightened, for all the agents of the pharmacopœia that possess great curative power are also able to do equally great damage if wrongly or ignorantly administered. This view of the matter is, however, based upon the purely gratuitous assumption that electric currents have any directly beneficial effect upon the system. If this be true, it certainly is not proven. While, in the hands of competent specialists, the use of electricity in the treatment of disease is a recognized and valuable means, it by no means follows that the mere putting of part of the body in an electrical circuit will have any effect whatever, save a disastrous or at least uncomfortable one, if the current is strong enough. Hence the pretensions of the makers of electric belts are ridiculous, even assuming that their contrivances produce a current at all.

As a matter of fact most of them do not produce a current of measurable volume. They are generally made of bits of copper and some other metal, cut into more or less fantastic shapes, and grouped together in a structure such that they are in contact with the skin of the wearer. Under these circumstances there is, no doubt, some potential difference set up between the metals, but it is, of course, immediately destroyed by the metallic contact between them. If it were not—that is, if there were a genuine potential difference maintained between particles of dissimilar metals in contact with the human skin—the phenomena of cataphoresis would certainly ensue and the substance of the metals or their oxides would be carried locally into the wearer, who would discover this fact by the breaking out of sores where the belt was in contact with him. As a general thing the makers guard against this unhappy possibility by so elaborately short-circuiting their metals that not a trace of a volt can be found anywhere about the belt.

The whole thing is ridiculous, were it not for the fact that sick people are swindled out of their money by the purchase of these things. It is possible that they even sometimes perform a genuine cure, if the disease afflicting the wearer is of nervous origin and he has sufficient faith. It is well known that a potato carried in the pocket will cure those who think they have rheumatism. So will an electric belt, but the potato is just as good and cheaper.



A View of the Main Generators of the Blackpool and Fleetwood Electric Railway.

To Prevent Over-production of Acetylene.

In order to avoid over-production in acetylene generators, in which the pressure of the gas lowers the water from the carbide, from moisture remaining after production should be stopped, it has been proposed in a communication to the French Society to steep the calcium carbide in hot concentrated solution of glucose. In the subsequent production of acetylene a sucrate of lime is formed by the action of the glucose, the calcium and the oxygen, which stops the generation almost immediately on the cessation of the water supply.

An Important Patent Decision.

It has just been decided in the United States Circuit Court at Detroit, Mich., that the lapse of a foreign patent after the filing of the application for United States patent, but before the issuance of the latter, does not affect the term of the subsequent United States patent. This is said to be a favorable precedent for the Welsbach Company in its suit for the control of the incandescent gas mantle.

A New Telephone Repeater.

BY KEMPSTER B. MILLER.

The question of telephone repeaters seems to occupy an important place in the minds of many of our foremost telephone engineers, in spite of the somewhat discouraging views on the possibilities of the repeater expressed by Mr. Thomas D. Lockwood in a most interesting series of articles entitled "Telephone Repeaters or Relays, and Repeating Systems," published in THE ELECTRICAL WORLD in November, 1896.*

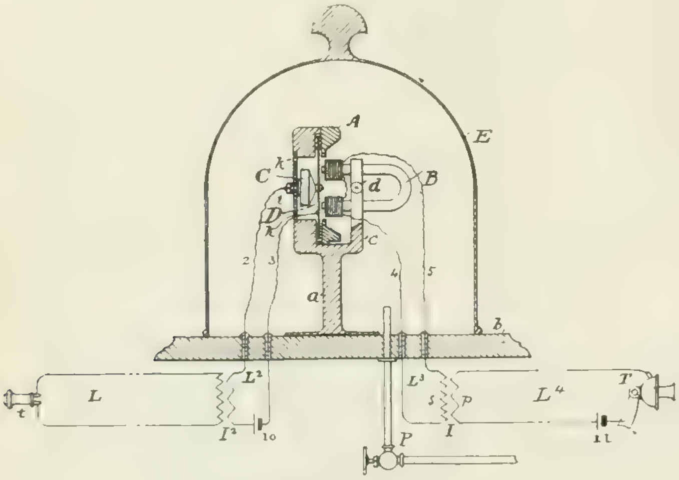


FIG. 1.

A patent has just been issued to Mr. John Stone, of Boston, and assigned to the American Bell Telephone Company, which is well worthy of consideration. While no new circuits and, in fact, no new mechanisms are embodied in this invention, the results claimed are said to be superior to any heretofore attained in this line of work. The repeater, together with the circuits of the two communicating lines, is shown in Fig. 1, in which *T* is the transmitter of the sending station and *t* is the receiver at the receiving station. These are connected with the repeater by the lines L^4 and *L* respectively, the line circuits being associated with the repeater circuits by induction coils *I* and I^2 in the usual manner. *B* is a polarized electromagnet whose poles are in proximity to the diaphragm *D*. *C* is the variable resistance button of a transmitter, the front electrode of which is secured rigidly to the centre of the diaphragm *D*, while the back electrode is rigidly secured by means of the cross piece *i* to the frame *A*, which also supports the diaphragm *D* and the electromagnet *B*. The variable resistance button is shown in section in Fig. 2, and is of [illegible] by those skilled in [illegible] transmitter [illegible] than the [illegible] up to the opposite [illegible] principle. The transmitter *T* [illegible] of the current in line L^4, and [illegible] battery 11. The fluctuations in the current thus produced act inductively through the induction coil *I* and [illegible] the coils of the electromagnet *B*. This acts on the diaphragm *D*, which is of iron, in precisely the same manner that an ordinary telephone receiver acts on its diaphragm, and the vibrations of this diaphragm cause the transmitter button *C* [illegible] between the front and back electrodes *m* and m^2 respectively. This causes fluctuations in the current flowing from battery 10 through the circuit L^2 and these in turn act inductively on the receiving circuit *L*, thus reproducing the original sound in the receiver *t*.

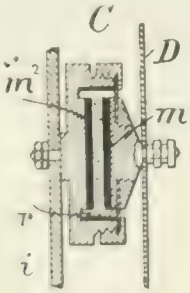


FIG. 2.

The only feature of alleged novelty in this patent is the fact that the entire working parts of the repeater are inclosed in a chamber *E*, from which the air may be exhausted to any desired extent by means of a pipe *P* and any suitable air pump. Just why this gives better results than the ordinary form of repeater is not explained in the specification of this patent, but it is obviously due to one or both of the following causes: first, the removal of the air from the chamber will undoubtedly allow a freer vibration of the diaphragm and its mechanism; and second, the layer of occluded air between the granules of the carbon, to the presence of which Mr. Berliner attributes the action of the microphone, is made thinner if not removed entirely. Probably the former, and not the latter, is the cause for any superior results which this repeater may produce, as Professor Fessenden has, I think, quite clearly shown that Mr. Berliner's occluded air theory plays little if any part in the true action of the microphone.

Concerning the results obtained with this repeater, Mr. Stone says, "The messages automatically transferred by it from one circuit to another are reproduced in the receiving telephone of the second circuit with a well defined gain in volume or loudness, and without any substantial distortion or off-setting loss in clearness of articulation."

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* [illegible]

M. Boucherot's Device for Starting Induction Motors.

As is well known the polyphase induction motor requires, to give high torque on low-current consumption at low speeds, a high resistance in the secondary member, which resistance should be reduced to dead short circuit for efficient running and good regulation as the speed approaches synchronism. An ingenious arrangement for accomplishing this change of resistance without the use of sliding contacts of any kind is described in the London "Electrical Review" of September 2, the arrangement being the design of M. Boucherot. The primary element—which is the external stator—is divided into two parts independently wound, each consisting of the ordinary ring-shaped core of slotted stampings, one being fixed to the framework and rotatable by a hand lever or screw device through one pole angle. Both primaries act inductively across the air gap on the secondary of one rotor of squirrel cage construction, the bars of the one secondary winding running through and taking the induction of both primaries. The squirrel cage is short-circuited at its ends, but at its middle, between the two primaries, the bars are joined together by a strap of high resistance material. In starting, the movable primary is so set that the electromotive forces set up by the two primaries in the bars of the secondary oppose each other, and any currents resulting must find their paths from bar to bar through the high-resistance strap. As the motor gains speed the movable primary may be rotated until its electromotive forces act in conjunction with those of the stationary primary to set up currents in the squirrel cage bars from end to end, the resistance to the flow of these currents being very small; thus the resistance is varied without the use of sliding contacts, but by varying the relative angular position of the two rotating fields.

A Long Underground Telegraph Cable.

The British post office is now laying an underground cable for telegraph service between London and Birmingham, a distance of 105 miles. The new cable is intended to supplement and not to supplant the overhead service and is rendered necessary by the crowded conditions of the pole lines on available routes. The cable will carry seventy-six copper wires, paper insulated, and twisted in thirty-eight pairs. The wires are enclosed in a lead tube 2½ inches in diameter, and this will be drawn into 3-inch iron piping laid about 30 inches below the surface. The wires in their lead casing are made up in lengths of 150 yards and the jointing between wires is effected by means of copper sleeves. At intervals of 5 miles the cables are brought to the surface and fanned out in terminals for testing purposes. These way stations will also be fitted with apparatus for pumping chemically dried air into the tube to maintain a pneumatic head that will keep out moisture which might otherwise enter through faults in the casing. The [illegible] will allow considerable of the overhead wire now used for telegraph purposes to be put into the telephone trunk-line service.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE
AMERICAN AND FOREIGN
By Carl Hering

Dynamos, Motors and Transformers.

ELECTRIC GENERATORS. Parshall and Hobart. Lond. "Engineering," Aug. 26.—In this continuation of their long serial (see "Digest" Sept. 3) they show briefly by means of an example how to calculate the magnetic circuit of a transformer, a fuller description of which is to be given later. They then discuss the magnetic circuit of induction motors, showing how it is to be calculated; this does not admit of being abstracted. A number of examples are given which relate to matters that have been treated in their articles.

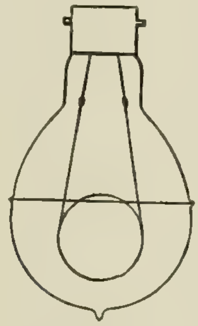
DYNAMOS. Guilbert. "L'Eclairage Elec.," Sept. 3.—Illustrated descriptions of some improvements in dynamos taken, apparently, from patent specifications. The portion concerning the Remon-Casas dynamo is translated in the present issue of The Electrical World.

CALCULATING THE FALL OF VOLTAGE IN A TRANSFORMER. Kapp. "L'Eclairage Elec.," Sept. 3.—A long abstract in French of the article noticed in the "Digest" May 7.

Lights and Lighting.

NERNST INCANDESCENT LAMP.—"Elek. Zeit.," Sept. 8.—The announcement recently made of this new lamp has given the impression to the layman that the present electric light stations will soon be superseded with something entirely new, and it has, therefore, been a check to the erection of new stations. The present note contains a letter from Nernst in reply to an inquiry from the editor asking for a statement. He states that no further information can be given at present regarding the lamp, as it is still in the experimental stage; it is certain, however, that the lamp will be made in practice in such a form that it can be connected directly with existing continuous or alternating current stations of 100 to 220 volts; there is, therefore, no need to fear that the introduction of this lamp will make any change in projected installations.

MAXIM INCANDESCENT LAMP.—Lond. "Elec. Rev.," Sept. 9.—A short, illustrated description of a lamp with a support for the filament. It consists of a narrow strip of mica with slots in it, through which the filament passes, holding it firmly in position; the lamps can therefore be hung in any desired position without the filament bending; it also steadies the filament during transportation. The mica is not sealed into the glass, but is sprung into two small pockets in the widest part of the bulb. It is claimed Maxim's experiments have resulted in the production of a 2.8-watt lamp which compares favorably in light and maintenance of candle power with the average 4-watt lamp.



Power.

POWER INSTALLATION AT BIRSFELDEN.—"Zeit. f. Beleucht.," Aug. 30.—An abstract of the project which is likely to be carried out at this place, near Bale, Switzerland, and which is to supply current and power to Muelhausen and other neighboring places; the fall of the Rhine is used; the installation is to be one of 7000 horse-power.

GAS ENGINE V. ELECTRIC MOTOR.—"Prog. Age," Sept. 15.—An abstract of an article comparing the costs of a small gas engine with an electric motor in the city of Cologne, Germany. Some of the advantages of the electric motor are recognized, but in regard to economy the advantages are in favor of the gas engine; for steady working the gas engine is cheaper by more than 50 per cent., or when used only half the time there is still a saving of 40 per cent. The conditions on which the calculations are based are those existing in that city. The gas engine and motor are both 4 horse-power; the former requires 91.8 cu. ft. of gas per hour, and the latter 3.8 kw per hour; the interest is 4 per cent. and the wear 7 per cent. The total cost per year of the gas engine is about $315, of which the cost of the gas at 2.5 cents per c. metre is somewhat over half; the total cost of the electric motor is $690, by far the greater portion of which is the cost of the current at 5.5 cents per kw hour; the cost per horse-power is 2.6 cents for the gas motor and 5.8 cents for the electric motor. The less they are used the nearer will the electric motor approach the gas engine in economy.

WEST KOOTENAY.—"Can. Elec. News," Sept.—An illustrated description of this long-distance plant for power and light. The Bonington Falls in British Columbia is the source of power, and the current is transmitted to Rossland, a mining centre, 30 miles distant. The falls yield 60,000 horse-power, of which 20,000 is to be developed. All of the machinery is Canadian; there are two three-phase generators of 75 kw and a frequency of about 60; the current is generated at 1100 volts, and is stepped up to 11,620 for the delta connection or 20,100 for the Y connection. The pole line is described in detail, and is said to embody the most improved practice; the difficulties caused by wet snow are so great that the line wires are housed. Medium hard-drawn copper is used for the line. The plant has been in operation for two months.

Traction.

COMBINED ACCUMULATOR AND TROLLEY TRACTIONS. Scott. Lond. "Elec. Rev.," Sept. 9.—The conclusion of his article (see "Digest" last week). He gives a table containing some data for the various electrical and other systems used in Paris. The cable line seems to be the cheapest, after which comes the Serpollet steam system, while the compressed air system is the most expensive; the accumulator system lies about midway; fair dividends have been earned by each of the companies. A short description of the accumulator system in Paris is given. One of the advantages of the combined trolley and accumulator system is in the case of fire, as when the wires are cut down the accumulators can supply the power; also that bonding can be dispensed with in that section of the line where the trolley wire is forbidden, and it is always in the closely built up portion of the city where the electrolysis of pipes is greatest; there is no reason why the accumulators should not be removed at the junction of the trolley wire section.

SURFACE CONTACT SYSTEM.—Lond. "Engineering," Aug. 26.—An illustrated description of the Kingland system, which is on exhibition in London. It is claimed editorially that in this the irreducible minimum of mechanism seems to have been reached, the mechanical and electrical features being the simplest possible and being entirely free from all delicate detail. This is a system in which the third rail is divided into insulated sections, each of which is made alive successively by the car passing over it. The switching apparatus, of which there is one to each section, consists of an electromagnet with two pole pieces, between which there is a soft iron armature, which revolves on an axis, which also carries cylindrical commutators; as the armature is moved through an angle the necessary switching is accomplished by these commutators. Besides the main commutator there is an accessory one, which operates the electromagnet itself, and the current through it is started by the car touching the next insulated rail section in advance of the one in use, thus causing the current to pass through the magnets to earth. The device serves equally well whether the traffic is in one or both directions on the same track; a diagrammatic illustration of the device is given.

GORNERGRAT MOUNTAIN RAILWAY. Berthier. Cosmos," Sept. 10.—A short, illustrated article on this electric rack and pinion mountain road, operated by three-phase currents, to which other references have already been given. The present article contains a plan of the routes, several views, the truck of the locomotive which operates the pinion, and details of the rack.

THE PASSING OF ELEVATED RAILWAYS.—"Eng. News," Sept. 15.—An editorial stating that the four elevated electric railways in Chicago, although well built and efficiently operated, do not pay as business ventures; the chief reason of the failure is found in the rapid evolution of the surface railways from horse cars to electric and cable lines. The mass of the traveling public prefer surface roads whenever these approach even moderate standards of speed and service; including stops, the elevated railroads make only 11 to 15 miles an hour, while the electric railroads in the outlying stations often do nearly as well. Under these conditions it is thought to be clear that we have about seen the end of elevated traction, except in some cases where peculiar local conditions occur, as in the crowded districts of Boston and the long distances down Manhattan island.

CLEVELAND. Fairchild. "Elec. Eng.," Sept. 15 and 22. The conclusion of the illustrated descriptions of the cross country roads leading out from Cleveland (see "Digest" last week). The Akron, Bedford and Cleveland, the Lorain and Cleveland, and the Cleveland and Chagrin Falls lines are described.

Installations, Systems and Appliances.

REGULATION OF VOLTAGE IN ALTERNATING CURRENT INSTALLATIONS. Meyer. "Zeit. f. Beleucht.," Aug. 20 and 30.—An illustrated article in which, after briefly discussing various systems which have been proposed, he describes the following, by means of which the voltage at the ends of the feeders of an alternating-current circuit can be kept constant without any difficulty, and in many respects in a much simpler way than with continuous currents. From the distributing points two wires run back to the station, where they are connected to the secondary coil of a transformer, the primary of which is connected to the poles of the generator; these two coils are connected in opposition to each other; they will, therefore, neutralize each other as long as the voltage at the feeding points is normal; if this voltage falls, however, the current in the primary will be greater than that in the secondary, and the magnetic equality in the transformer will be disturbed, thus generating a current in the secondary coil, which flows to the point of distribution, thereby raising the voltage to the normal. It is evident that the lines leading back from the feeding points must be so proportioned that they can carry this extra current; (but how great this increased cross-section is likely to be is not stated; it would seem that it might be quite great). In many cases it is desired that the voltage at two pairs of feeding points should be kept alike; in this case he applies the same method except that the transformer coils are connected respectively to those points, and not to the generator. In a similar way it is possible to regulate the steam engine or turbine which drives the generator, by making use of the current flowing in this transformer circuit. The method may also be applied to multiphase installations, which he illustrates, the main principle remaining the same. In conclusion he gives a brief theoretical discussion.

STORAGE IN A CENTRAL STATION. Low. "Jour. of El'ty," Aug.—A long, well-illustrated description of the electric storage plant in the Edison station in San Francisco, which has a generator output of 2200 kw; the battery was added in preference to enlarging the generating plant, and has a capacity of nearly 1000 kw hours for one hour; complete engineering data of the battery are given. It consists of two series of seventy-five cells each, nineteen of which are used as regulating cells. The plant is exceeded in size only by the one in Chicago, and is equal to those in Philadelphia and Hartford. The capacity of the battery at various rates of discharge is given in a table.

CENTRAL STATION STATISTICS.—"Sc. Am. Sup.," Sept. 17.—A reprint of two tables of statistics of central lighting stations in the United States, operated by private corporations and by municipalities; the figures are given for each State, and contain ten well-filled columns of data for each; the compilation was made from the late reports of the American Electrical Directory. The totals for stations operated by corporations are as follows: Total number of stations, 2261; capital stock, $229,938,605; number of arc lights, 264,428; number of incandescent lights, 7,234,134; engine power, 970,481. For the stations owned by municipalities these figures are as follows: 333 stations, 26,087 arc lights, 371,440 incandescent lights, and 67,740 horse-power.

Wires, Wiring and Conduits.

RELATIVE COST OF COPPER AND ALUMINUM. Zingler. Lond. "Elec. Rev.," Sept. 9.—A brief reference to Kershaw's recent article (see "Digest" last week). He claims that Kershaw has simply substituted the English market values for those in America. He does not think any claim is ever put forward for insulated aluminum wires, but for bare aerial transmission purposes the following advantages may be pointed out: For equal conductivity, aluminum has half the weight of copper, and about the same breaking strain as copper, if not more; therefore, for equal conductivity the spans may be about double those for copper wire; for equal conductivity with aluminum at 29 cents per pound the cost is nearly the same as of copper. It is therefore evident that there is a great saving in the carriage, labor, posts, insulators and maintenance; the difficulty of the joints is an artificial one, as there are plenty of good mechanical joints.

CABLE SUBWAY UNDER THE MILWAUKEE RIVER.—"Eng. News," Sept. 15.—A note stating that the 4-ft. subway has just been completed by the Milwaukee Electric Railway & Light Company. It is made of cast iron pipes, which are filled with [illegible] ducts, of which there are 110. Two similar subways are to be built soon.

CABLE SUBWAYS.—"Eng. News," Sept. 15.—A note stating that a system of electric subways is to be built at once by the city of Baltimore, for accommodating all overhead wires except trolley wires. One million dollars is appropriated for their construction.

Electro-Physics and Magnetism.

B. A. PRESIDENTIAL ADDRESS. Crookes. Lond. "Elec.," "Elec. Rev." and "Elec. Eng."—Long abstracts of portions of his presidential address to the British Association which met at Bristol. Portions of the address were given in the last issue of THE ELECTRICAL WORLD. The second portion of his address is a critical review of recent progress in various branches of [illegible]

USE OF SIMPLE SINE CURVES IN PROBLEMS. Rhodes. Lond. "Elec. Rev.," Sept. 9.—Bedell, Boyd, Steinmetz and others have argued that for purposes of calculation it is generally quite admissible to replace the actual curve of an alternating current by an equivalent sine curve, which is defined to be that which has the same root mean square value as that of the actual curve under consideration. It appears, however, to be thought that this substitution is legitimate only when the even harmonics are absent, and this, the author thinks, is erroneous, giving in the present article his reasons for saying that it is correct whether the harmonics are odd or even. The condition for this substitution is that there must be only one simple sine curve for given combination of fundamental and higher harmonics—that is, the root mean square value of the actual curve must depend only on the magnitude of the harmonics present, and not on their positions relative to the fundamentals and to each other. He then gives a short, mathematical proof, showing that the power given to the circuit depends only on the maximum value of the fundamentals and harmonics, and on the difference of phase between each component of the current curve and the corresponding component of the voltage curve and these differences of phase are dependent solely upon the time constants of the circuit. It appears, therefore, that in ordinary calculations we may with accuracy assume the e. m. fs. and currents to be simple harmonic functions of the time, provided their root mean square values are taken to agree with the readings of an electrostatic or hot-wire voltmeter and their mean product with the reading of a wattmeter.

MARCONI COHERERS. Blondel. "L'Eclairage Elec.," Aug. 20.—An abstract of a French A. A. S. paper. He calls attention to the great difference between the Branley tubes and the Marconi coherers; with the latter the effect of different metals for the filings can be studied; it appears that the condition for a metal to give good results is that it should be covered with a layer of oxide which is very thin and not too poorly conducting. The results of his investigations show that the Marconi coherer has been well designed, being very sensitive and reliable. He suggests that it might be improved by making the vacuum regenerative by means of a small pocket containing filings.

REACTIONS OF THE COHERER. Leppin. "Wied. Ann.," No. 8; abstracted in the Lond. "Elec.," Sept. 9.—Auerbach showed that the coherer also reacts in the case of sound waves; the present author shows that the coherer is also a sort of microphone, thermometer, and photometer. Inserting a Branley coherer as a microphone, all sounds were distinctly transmitted and reproduced in the telephone; the approach of a hand produced a deflection due to the heat; daylight produced a deflection after a few minutes; the effect is thought to be due to heat only and not to light. These experiments are of importance as showing in what direction disturbances in the normal action of the coherer may be looked for.

ALUMINUM ELECTRODES. Wilson. Lond. "Elec. Rev.," Sept. 9.—A long abstract of the article, a complete reprint of which was noticed in the "Digest" Aug. 6, 13 and 20. A German abstract, with some of the curves, is published in the "Elek. Zeit.," Sept. 8.

ANTICIPATION OF GALVANI AND VOLTA. Lond. "Elec.," Sept. 9.—An extract from the "Dundee Advertiser," Aug. 29, in which certain interesting anticipations are cited. In 1780 Domenico Cotagno found that the muscles of the leg of a mouse which he was dissecting were contracted when touched by the knife; Jean Jallabert, in 1748, published his "experiments in electricity" and gave his theory of dynamical electricity in 1767, founded on the phenomenon produced by placing two metals with the edges in contact, while the rest of the plates were separated by a damp cloth; it seems to be an anticipation of the Voltaic pile. Johann Georg Sulzer, in 1767, called attention to the sensation of taste produced when a piece of lead and a piece of silver are laid above and below the tongue and brought into contact with each other; (in the extract quoted he does not, however, connect this with any electrical phenomena). In 1700 Joseph Du Verney produced the same contraction of the muscles with two moistened metals as Galvani noticed in 1791. Verney also successfully inoculated some of the members of the Royal French family with cowpox to protect them from smallpox about a century before Jenner made his first experiments. Editorially it is stated that Swammerdan, in 1678, showed that when a portion of a frog's leg was hanging by a nerve bound by a silver wire held over a copper support, so that both the nerve and the wire touched the copper, the muscle contracted.

QUANTITATIVE STUDY OF THE HIGH FREQUENCY INDUCTION COIL. Boynton. "Phil. Mag.," Sept.—A very long article in which he develops a mathematical theory of the so-called Tesla coil; it is a modification and expansion of Oberbeck's theory, and is essentially a discussion of a system with two degrees of freedom. After developing the theory he describes the apparatus and experiments with which he made quantitative tests to verify the theory. His conclusions are as follows: "1. The main period of oscillation of the primary circuit is very nearly that deduced from the dimensions of the system. The same may be said also of the maximum potential attained in the secondary circuit. 2. The effective currents and potentials, which are functions of the damping factors, and these in turn of the resistances, would indicate that the resistances of the sparks are of the order of from 10 to 100 ohms, depending upon the amount of current flowing through the spark. 3. It appears that when the secondary circuit is closed by a spark the primary current decreases with the length of the spark, but the secondary current decidedly increases. It still remains to be shown whether this is due to the conditions of the experiment, or is to be explained by a more accurate application of theoretical reasoning." (A similar article in an American journal was noticed in the "Digest" Aug. 6.)

TERRESTRIAL MAGNETISM. Cotterell. Lond. "Elec. Rev.," Sept. 9.—The first part of an article discussing the various possible theories to explain this magnetism and claiming that it is impossible to construct any hypothesis having for its fundamental principle the idea of a material magnet. He seems to question whether the earth is a huge magnet or merely the recipient of an ethereal line of force.

ELECTROMAGNETIC EFFECTS OF ELECTROLYTIC CURRENTS. Sheldon and Downing. "Phys. Rev.," Aug.—A short article describing experiments in which they endeavored to determine whether a current through an electrolyte produced magnetic effects of the same magnitude as those which it did when it passed through a metallic conductor. According to modern theory electrolytic conduction takes place by convection, which is not true of metallic conduction; it was, therefore, thought that the magnetic effects might possibly also be different. The apparatus was similar to that used in determining the magnetic qualities of iron by the method of reversals; a coil was wound around the iron, consisting of a rubber tube filled with the solution, and this was then replaced by a copper wire. The results seem to be practically alike, and appear to indicate an inconsistency between the accepted ideas of the two kinds of conduction as based on the two-fluid theory, but they seem to be in accord with the single-fluid theory; in the latter but one set of ions carries the magnetically active charge, and the electrolytic ampere turns should then produce the same effect magnetically as the metallic ampere turns.

HIGH-FREQUENCY EXPERIMENTS.—"Sc. Am. Sup.," Sept. 10.—An illustrated description, taken from "La Nature," of various experiments recently shown by Radiguet, and similar to those performed by Tesla, except that he used the Oudin resonators of great frequency.

QUANTITATIVE STUDY OF THE HIGH-FREQUENCY COIL. Boynton. "Phys. Rev.," Aug.—Several plates, which should have accompanied the article which was published in Vol. 7, No. 1 (see "Digest" Aug. 6).

Electro-Chemistry and Batteries.

DIFFUSION IN ACCUMULATORS. Juman. "L'Eclairage Elec.," Sept. 3.—The capacity of the positive plate depends partly on the quantity of the peroxide and partly on the quantity of acid which can enter into combination in the reduction of the oxide; the discharge may, therefore, be limited by either of these. If by the coefficient of utilization of the material is meant the ratio between the lead engaged in the reaction and the total lead in the active material, then this coefficient can easily be 0.7 in plates having a very thin layer of active material, while it may be as low as 0.2, or even lower, for thick, positive plates in which the complete utilization of the material is impossible on account of the bad conductivity of the sulphate formed and the lowering of the e. m. f. when the proportion of sulphate becomes too great. Theoretically the amount of lead required is 3.86 grams per ampere hour, or 4.45 of peroxide of lead; when the coefficient of utilization is 0.7, 6.36 gram of the peroxide will be required, while if it is 0.2, then 22.2 grams are necessary, showing the great importance of the diffusion of the acid in the material. The quantity of acid necessary for the reactions can be divided into two parts, one part in the pores of the active material itself, and the other from the diffusion of the acid of the electrolyte; the latter is proportional to the surface of diffusion, the difference of concentration, and the time; this partially explains the variation of the capacity with the porosity of the material, the density of the liquid and the strength of the current; the available surface is always very small, and is made up of pores, and these are reduced by the sulphating, which increases the volume of the material. If his opinion is correct the capacity of the positives when the active material is in excess ought to vary, not only with the porosity, the density of the electrolyte, and the current, but also with the previous state, as after a slow discharge the quantity of sulphuric acid in the material will be greater than after a rapid one, which gave less ampere hours; it is this which he endeavored to verify by the experiments which are described in the article. In these tests he charged and discharged a plate successively, commencing with small currents and increasing the current progressively in each discharge up to a maximum; then decreasing the current again to the minimum in successive discharges, and completing the cycle by again increasing it to the maximum; during each charge and discharge the current was kept strictly constant; the experiments were repeated by discharging to 1.80 and 1.70 volts; also with electrolytes of density of 1.116 and 1.162 at the end of the charge. The results are given in curves and tables. The curves indicate a true hysteresis phenomenon, showing that the capacity for the same rate and under the same condition is a function of the previous states. The phenomenon is more marked as the density of the electrolyte is less, and it is scarcely noticeable when the densities were higher than 1.21. He then discusses the data, drawing some conclusions with reference to the acid in the pores of the plates.

THEORY OF ACCUMULATORS. Dolezalek. "Wied. Ann.," No. 8; abstracted briefly in the Lond. "Elec.," Sept. 9.—He attempts to explain how it is that 94 to 97 per cent. of the current can be gotten out, while the efficiency (in watts) does not exceed 75 to 85 per cent.; this is due to the differences in the charging and discharging voltages; but it is often erroneously supposed that this difference is accounted for by the losses in the process of diffusion by which the concentration of the acid in the pores of the active mass is equalized. The author maintains that the equalization is not carried out by diffusion, but by concentration currents; this is rendered apparent by suddenly reversing the cell, when the charge potential is not assumed immediately. The loss of energy in the accumulator is governed by thermo-dynamic laws, and is equal to the heat produced by the concentrations currents between layers of variously concentrated sulphuric acid in the spongy mass. A formula which he gives represents this law and shows that the loss approaches the vanishing point when the currents are feeble.

ALLEGED DECOMPOSITION OF SULPHUR. Alexander. "Zeit. f. Elektrochemie," Aug. 25.—In an article noticed in the "Digest" July 9 Gross claims to have decomposed sulphur and to have obtained a new element which he calls bythium. The present author subjected the process described to a very careful and thorough examination. The process consists in passing an electric current through a fused mixture of chloride of silver and sulphide of silver; Gross claims to have obtained in this way an unknown body, which he considers to be a new element contained in sulphur. Alexander's results showed that all of the silver and sulphur in the original mixture were accounted for after the electrolysis; he therefore was enabled to verify the claim made by Gross.

PRODUCTION AND APPLICATION OF OZONE. Kershaw. Lond. "Elec. Rev.," Sept. 9.—A brief reply to the criticism of Andreoli (see "Digest" Aug. 27). He merely defends his original statements.

Units, Measurements and Instruments.

COMBINATION OF WESTON AND CLARK CELLS. Jaeger and Kahle. "Wied. Ann.," No. 8; abstracted in the Lond. "Elec.," Sept. 9.—If a Clark cell is reliable to within 0.001 volt and the Weston cell to within 0.0005 volt, it follows that the two cells combined may be depended upon to within 0.0001 volt; this they proved experimentally by comparisons with the standard silver voltameter of the Reichsanstalt. The latter is the ultimate legal standard in Germany, but as it is easier and better to determine a current from a voltage and a resistance than a voltage from a current and a resistance, the sooner the e. m. f. is made the standard the better. They tested sixty-eight cells constructed since 1891; they were tested at intervals of about a year, and the maximum difference observed in the Clark cell was — 0.14 millivolt, and in the Weston + 0.18 millivolt, which, in two years, decreased to 0.08 millivolt. The cadmium cell should be used only between 20 and 70°. A large number of new measurements were made with these cells, and the redetermined values are as follows: H form of Clark cell, 1.4328 international volts at 15° C.; Weston cell, 1.0186 volts at 20° C.; the ratio of the Clark at 15° to the Weston at 20° is therefore 1.40663, and of the Clark at zero to the Weston at 20° is 1.42277, both figures being correct to at least the fourth place. The difference between the Clark at zero and the Clark at 15° is 0.0164 volts. The temperature coefficients are

Clark cell: $-0.00119\ (t-15)-0.000007\ (t-15)^2$.

Weston cell: $-0.000038\ (t-20)-0.00000065\ (t-20)^2$.

These figures give us two standards, the combination of which places the determination of the voltage very close in point of accuracy to the determination of the resistance.

METER. Moellinger. "Elek. Zeit.," Sept. 8.—A very long, illustrated description of the Raab meter for single-phase alternating currents, made by the Schuckert Company. After a brief introduction, in which he describes other similar meters, he gives a full description of this one. He claims that this meter was the first one which solved the problem of an induction meter, the indications of which are entirely independent of the phase-shifting in the current—that is, one in which the effect is recorded as in a wattmeter. This is accomplished by making the main current act together with two shunted currents, one of which, the inductive, is shifted in its phase by a very large amount, and the second, the inductionless, is shifted by a very small amount, as compared with the voltage; each of the two coils acts on a separate revolving disc, together with its own main current coil, the two discs being mechanically connected. For an incandescent lamp current the torque is produced almost entirely by the one coil, but if there is a phase shifting in the current, the torque in that coil would diminish very rapidly; in that case, however, the other coil increases its torque, thus assisting the torque produced by the first. When the phase shifting in the circuit is equal to that between these two coils, then only one of them will produce the total torque; if the two coils are properly proportioned the meter becomes an exact wattmeter for all phase shifting; this he shows analytically, after which he gives a full, well-illustrated description of the meter, showing also the method used in calibrating it, and giving the results of a test.

DOUBLE REGISTERING METER. "Zeit. f. Beleucht.," Aug. 20.—A brief, illustrated description of the one made by the Union Company. There are two registering portions, one of which is permanently connected with the motor, and is therefore always in operation when current is used; the second is connected to the motor only for the time during which a special rate is to be charged; the consumer can then read off at any time the total amount of energy and that for which a lower rate is to be charged; the necessary switching is accomplished by a clock.

DOUBLE READING METER.—"Elek. Anz.," Aug. 14.—A brief, illustrated description of one patented in Germany, in which the necessary switching arrangement is made by means of a contact disc driven by clockwork, which is rewound automatically every twenty-four hours; this switches into the circuit a compensating coil.

SHUNTING ELECTRO-DYNAMOMETERS. Wien. "Wied. Ann.," 63, p. 390; abstracted in "L'Eclairage Elec.," Aug. 20.—A long abstract of the article noticed in the "Digest" last week.

LEGAL STANDARDS IN GERMANY.—"L'Eclairage Elec.," Aug. 27.—A French translation of the laws concerning electrical units in Germany.

Telegraphy, Telephony and Signals.

WIRELESS TELEGRAPHY. Blondel. "L'Eclairage Elec.," Aug. 20.—A brief abstract of a French A. A. S. paper on the theory of the "antennæ" in this system of telegraphy. It is difficult to explain by simple effects of the ordinary propagation of waves the enormous increase of the distance by the use of these antennæ (meaning the terminal wires which Marconi uses). He attributes the effect chiefly to a phenomenon in which the capacity of the antennæ with respect to the earth enters; these antennæ and the earth are the two poles of a condenser. He shows how this theory enables the observed facts to be explained.

WIRELESS TELEGRAPH. Broca. "L'Eclairage Elec.," Aug. 20.—An abstract of a French A. A. S. paper. He explains the part taken by the "antennæ" (see above) in wireless telegraphy. These wires afford a means to produce radiant energy localized in a plane and therefore to concentrate the electric waves independently of their period. He also observed that these waves were polarized. Waves are obtained which are very effective at a great distance in one direction normal to the axis of the antennæ, and this involves no contradiction with the fundamental principles of the electromagnetic theory of light.

EXPERIMENTS WITH HERTZIAN TELEGRAPHY. Tietz. Lond. "Elec.," Sept. 9.—A long translation in abstract of the article noticed in the "Digest" Sept. 10.

TELEGRAPHY AND TELEPHONY IN NEW ZEALAND. Lond. "Elec.," Sept. 9.—A short editorial stating that since the reduction in the tariff from 25 to 12.5 cents there has been a large increase in the number of messages, but a larger increase in the expenditure; the balance of profits is in the right direction in the telephone service, but the growth in the telegraphs is distinctly on the losing side. It seems that when the telegraphs come under Government control there is a downward tendency, though in private hands they are flourishing enterprises; in New Zealand the postal department is a comfortable source of revenue, and the telegraph department a source of loss; it is not necessary that the telegraph should be carried on at a loss, and there are few who really believe that this is so; the post office at home (England) and abroad contrives to make it appear so, but nobody seems to know why.

TIMING TRUNK LINE SERVICE.—Lond. "Elec.," Sept. 9.—An editorial note stating that in London a large clock in view of all the operators is used for timing all messages; it is supplied with a large second hand which moves a quarter of a minute at a time. It is thought that clocks are used in other centres of that country and most continental exchanges; in Berne, however, there is a very primitive but efficient timer in use, namely, the sand glass; two sand glasses are provided for each trunk wire on the switchboard, a minute glass and a seconds glass; this system is as cheap as clocks, and more reliable, and is thought to be quite as useful as many of the more expensive methods.

NATIONAL TELEPHONE COMPANY.—Lond. "Elec.," Sept. 9.—A reprint of an article from the "Statist," the conclusions of which are that the soundest financial policy for the English Government [illegible] would be to buy up the national telephone companies immediately at the market prices.

INTERCONNECTING TOLL-LINE SYSTEMS. [illegible] "West. Elec.," [illegible].—An illustrated article giving a description of a complete toll-line system, showing the usual requirements that [illegible]

Miscellaneous.

B. A. MEETING.—Lond. "Elec. Eng.," Sept. 9.—The proceedings of the meeting [illegible] he discusses [illegible]

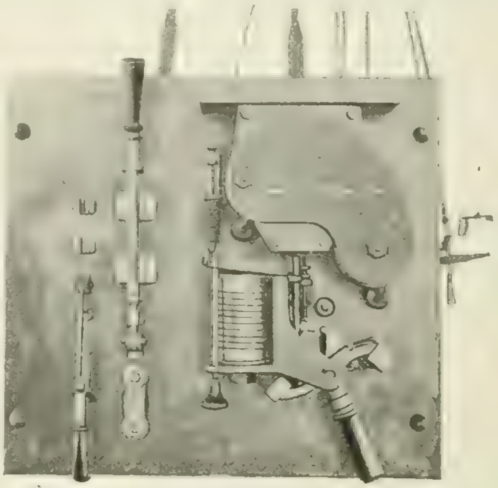
ALUMINUM.—[illegible] "Zeit.," [illegible] [illegible]

six years the price per kilogram was reduced from $200 to 60 cents, and it is now 300 times less than it was in the year 1855.

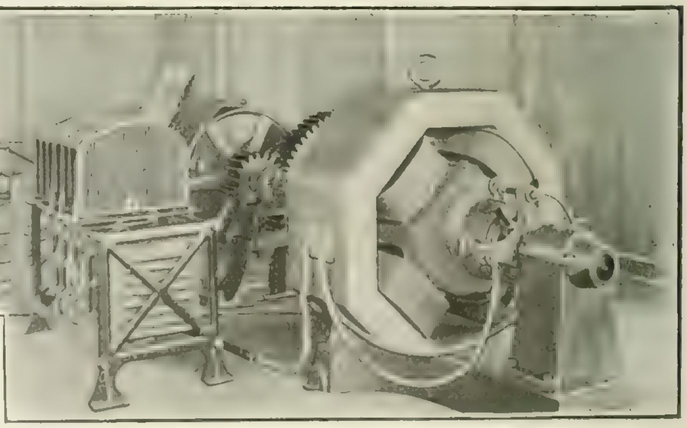
EXPLORING FOR IRON ORE. Nordenstrom. "Eng. and Min. Jour.," Sept. 17.—A reprint in abstract of the article noticed in the "Digest" last week.

A Motor-Driven Swing Bridge.

An electrically operated swing span which presents some unusual modifications is that of the Jackson and Fourth Street bridge in Newark, N. J. The span of this bridge, weighing 450 tons, is turned by one 100-hp, 500-volt, direct-current motor, which also operates its latches and end-lifting wedges, the whole being fitted with a very complete system of interlocking mechanical and electrical controlling devices to prevent any serious effects from mistakes on the part of ignorant attendants.


The Switchboard.

The bridge is supplied with current through the usual lead-covered and iron-armored feeder cables brought up to collecting rings surrounding the centre pin of the draw span. Two contacts bearing on these conduct the current to the motor when it is operating to turn the bridge, and a third or auxiliary contact on one ring is in circuit with the motor when it is used to operate the end wedges. This contact is arranged to be lifted by cams in such a way that the motor can only be run on the wedge-operating mechanism when the bridge is in the proper position for locking or unlocking. The motor is connected to the one commutator contact when swinging the bridge, and to the other when working the wedges, by means of a circuit-controlling mechanism mounted on the operating lever of a clutch which, when thrown in one position, connects the motor shaft to the bridge-swinging mechanism, and in the other direction to the wedge and latch-operating mechanism. Thus the two mechanisms can never be simultaneously operated. The motor is further controlled by an ordinary single motor reversing street railway controller. At all times it drives an air pump compressing air into receiver for [illegible] purposes. Further provision against harmful manipulation is provided by an attachment to the wedges which prevents the clutch lever being thrown over to the side in which the motor may operate the swinging mechanism until the wedges are completely released. The current for the motor is taken from the [illegible] power circuit of the People's Light & Power Company of Newark. The ingenious and novel features of the design are due to the consulting engineers, Messrs. [illegible] & [illegible], of New York City.

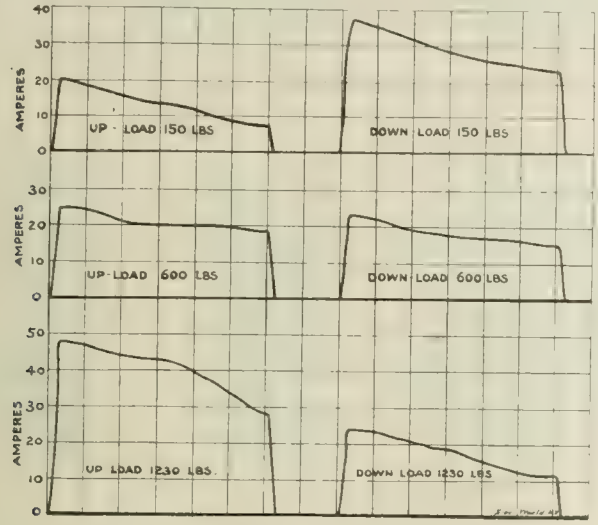

The Motor and Operating Mechanism.

An Improved Elevator Motor.

The [illegible] Electric Company, of Erie, Pa., has designed and placed on the market a new [illegible] motor which is not only a remarkably efficient and [illegible] device, but [illegible] a distinct advance in motor design.

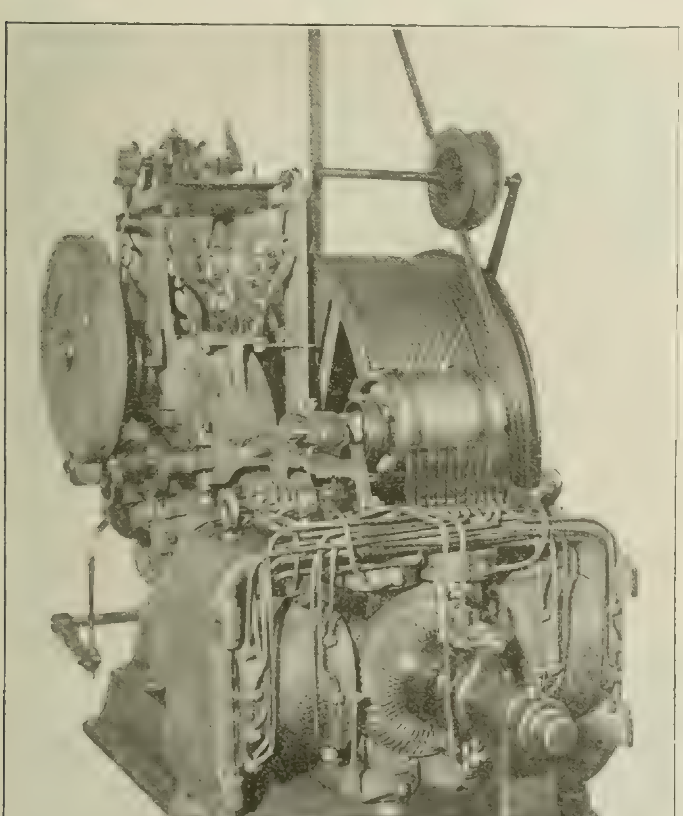
This machine, depicted in the accompanying cut, requires no external [illegible] for regulating the speed and torque, and hence the current [illegible] an important consideration when it [illegible] motor. The torque per ampere is rendered [illegible] strong field when starting, and the current [illegible] further reduced. The company is prepared to guarantee that the maximum current required to start and accelerate the elevator when hoisting more than one-half its rated capacity will not be over 25 per cent. more than that required to operate the same load at full speed.

The regulation of the motor is accomplished entirely by varying the strength of its field, and consequently its back e. m. f. The field is wound for cumulative compounding, having an exceptionally powerful series coil. This coil is divided into numerous sections, and, as the load comes on, the sections are sucessively short-circuited until finally the machine is operating as a simple shunt motor. This varies the strength of the field and the back e. m. f. of the armature. This method of short-circuiting a series coil, in lieu of cutting out external resistance, as the speed increases has been attempted by many makers of motors, but has always been attended by severe sparking at the brushes, due to the weakening of the commutating fringe. The Keystone Class F machine is constructed to avoid this difficulty.



Current Curves.

An inspection of the machine will show that although it is bipolar there are six poles presented to the armature. The three poles on either side of a vertical plane, through the armature shaft, are of the same polarity; that is to say, there are three north poles on one side and three south poles on the other. The upper and lower pole pieces carry shunt windings only, while the central and larger pole cores carry both shunt and series winding, the shunt on the latter being only of sufficient strength to prevent magnetic short-circuiting in the absence of current in the series coils. It will be seen at once that the variation of the field is accomplished only in the central pole pieces, and that the field immediately adjacent to the gap in which commutation occurs is equally intense at all times. By this simple means the strength of the field can be widely varied and yet the brushes will always operate sparklessly.



Elevator Motor and Mechanism.

This improvement in motor design was broadly covered by Mr. W. H. Powell in United States patent No. 608,771, issued August 9, 1898, and assigned to the Keystone Electric Company.

The sections of the series field are short circuited by the automatic movement of a cylindrical drum carrying suitable contacts shown immediately above the motor. The rapidity of the motion of this drum is controlled by a dash pot, and by the simple turning of a screw the rate of variation can be changed to suit any conditions that may arise. A reversing switch completes the electrical equipment.

It will be noted from the illustration that the field yoke is divisible. This is to provide that, if accident overtakes the machine, due to extreme carelessness or abuse, the trouble may be easily remedied. The horizontal coils can be disconnected and the pole swung outward by the removal of two bolts. By taking off the pole shoe the coil can readily be replaced.

A series motor for elevator work has the disadvantage that its speed varies between wide limits, and the desideratum in all elevator motors is constant speed. A shunt motor, on the other hand, while its speed is nearly constant, is objectionable because it requires an excessive current when starting. The cumulative-compound motor, pure and simple, also has a variable speed; moreover, both the series and cumulative motors tend to run away when the car is going down with a heavy load. This motor does away with these difficulties by the cutting out of its series coils, and retains the good qualities of both of the other types. It starts under full load easily and freely, without excessive current, and when once started maintains practically constant speed whatever the load.

The material and workmanship of this motor are of the very highest grade and the company has striven to make it second to none. The extreme simplicity of the apparatus should not lead the prospective purchaser to believe that it is suited only for small hoists or factory elevators; on the contrary the equipment is also exceptionally well fitted for high speed passenger service. This line of motors is made in sizes from 10 to 75 horse-power.

The company has had one of these elevator motors in successful operation in its own factory for over a year; and another of 5 horse-power in an apartment house in Cleveland operating an O'Donnell elevator. This motor has been in continuous service day and night for nearly a year, and is giving such universal satisfaction that the Keystone Electric Company has received several orders for similar motors, to be installed in the same city.

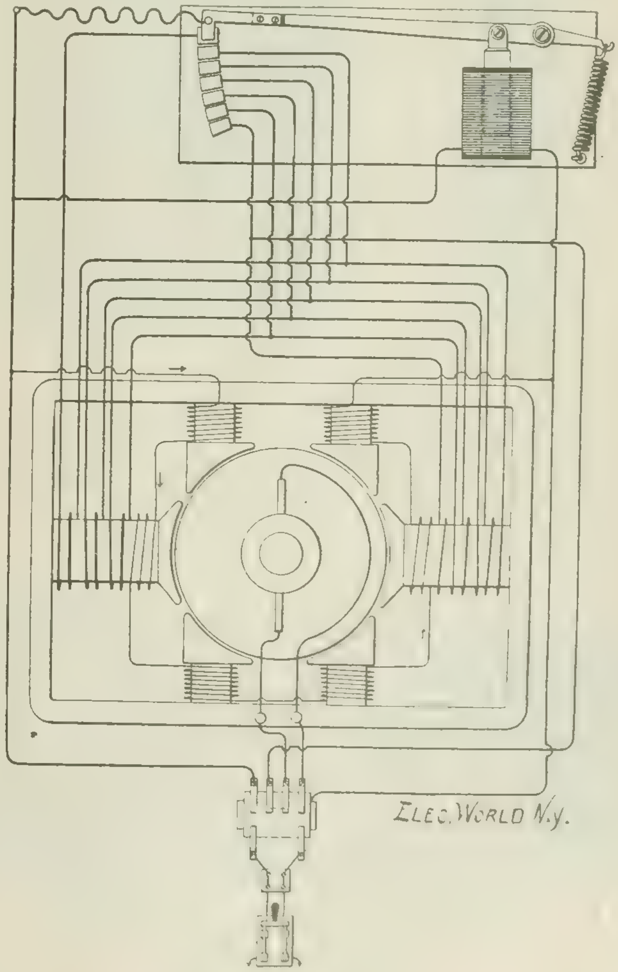


Diagram of Motor Circuits.

The accompanying current curves were made from data obtained in a test which was made by the Cleveland Illuminating Company, in order to ascertain the maximum current required to start an overcounterweighted elevator driven by a 10-hp, 220-volt motor of this type under various loads. The high starting peak common in such work is conspicuous by its absence.

Ironclad Porcelain-Lined Resistance Box.

The most recent form of ironclad porcelain-lined resistance box, as manufactured by the Ward Leonard Electric Company, Bronxville, N. Y., is illustrated in Fig. 1. This box, which is made of cast iron, is about 14 inches square and about 2 inches deep, and is lined with the porcelain enamel of the Ward Leonard Electric Company. The inner face of the lid is also porcelain lined. The resistance material is in the form of a very thin wide ribbon, reflexed edgewise and placed in the box, which is then filled with granular silica and the lid firmly screwed down. A tight and permanent joint is made between the box and the lid by means of a special cement.

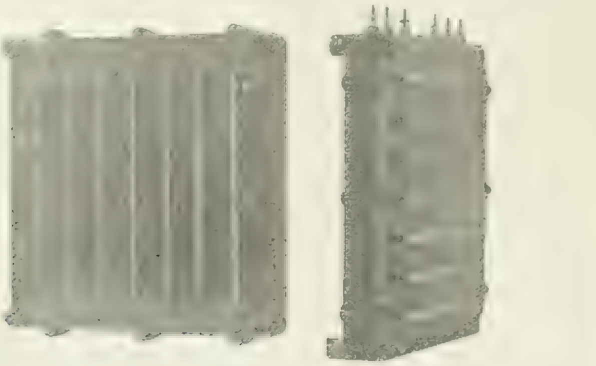


Fig. 1.—Ironclad Resistance Box, Porcelain Lined.

The box when finished weighs about 50 pounds, and its capacity for the absorption of heat developed in the resistance ribbon is extremely high. It is amply large for starting a 25-hp motor. This idea of using a large mass of material around the resistance for motor starting duty is covered by patent No. 566,693, issued to H. Ward Leonard. The construction used in this ironclad box having a ribbon-like conductor used in contact with the large mass of material is claimed to be a very superior and economical one. This feature is covered by United States Patent No. 560,588 to H. Ward Leonard.

One of the most important features of the ironclad resistance box is its high insulation, due to the use of the porcelain enamel lining. This feature is covered by patent No. 603,063, issued to H. Ward Leonard.

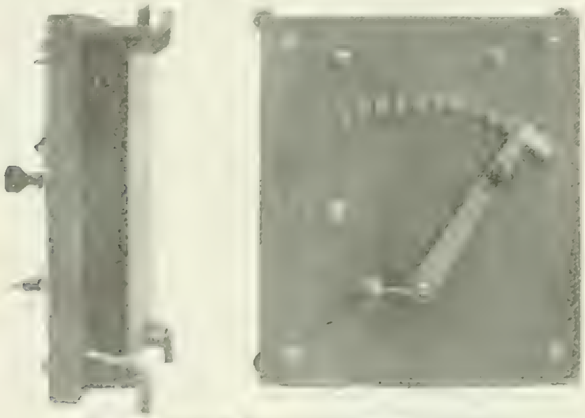


Fig. 2.—25-hp Motor-Starting Rheostat.

Ironclad boxes of this type, the maker states, are being used with much satisfaction by such companies as the General Electric Company, the Westinghouse Company, the Crocker-Wheeler Electric Company, the C & C Electric Company, the Walker Company, the Bullock Electric Manufacturing Company and the Western Electric Company, and in the United States Navy.

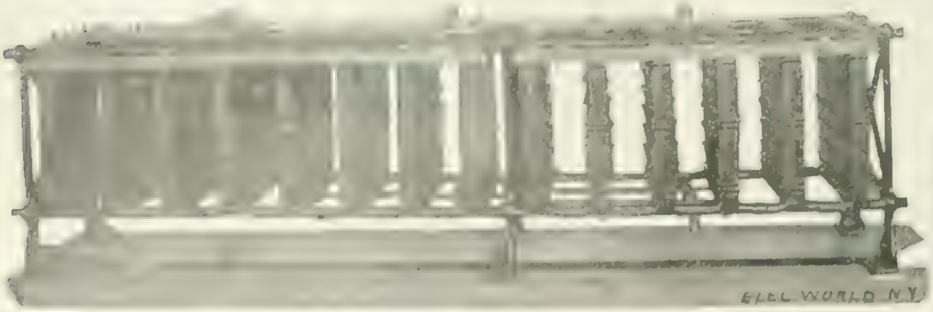


Fig. 3.—Bank of Resistance Boxes for [illegible] Motor.

[illegible]

of very high resistivity and low temperature coefficient and extremely high fusing point. The resistance, therefore, is entirely unaltered by the condition of service. This is of the greatest importance in the application of rheostats for such service as printing presses, elevators, etc.

Improved Form of Primary Battery.

The creeping of salts is one of the annoyances experienced in the use of primary batteries, to overcome which much time, labor and money have been expended, while the results have not always been altogether satisfactory.

Messrs. Meysenburg & Badt, 1504 Monadnock Block, Chicago, have met the problem in a very ingenious manner, as will be understood from what follows: The illustration, Fig. 1, shows the glass jar of the Badt hermetic cell, which is provided with a channel or trough around the upper edge of the neck, the cover, Figs. 2 and 3, having two glass rims, the inner one being concentric with the outer one. The inner rim of the cover rests in the trough, while the outer one surrounds the top of the jar and prevents dust from gaining entrance to the trough. The trough is filled with oil, thus furnishing an air-tight seal, which effectually prevents the creeping of salts. Another important advantage is the additional insulation from the jar and earth thus given to the electrodes, which are in turn insulated from each other by the glass of the cover. Figs. 2 and 3 represent electrodes for the No. 1 and No. 2 cells, respectively. In Fig. 2 the carbon has attached to it a prism (chemical depolarizer), while in Fig. 3 this feature is absent.

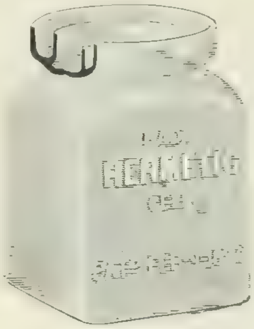


Fig. 1.

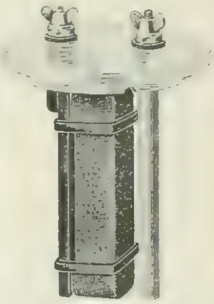


Fig. 2.

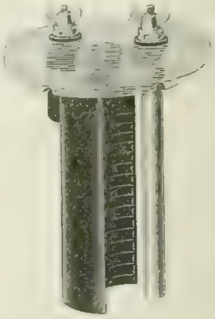


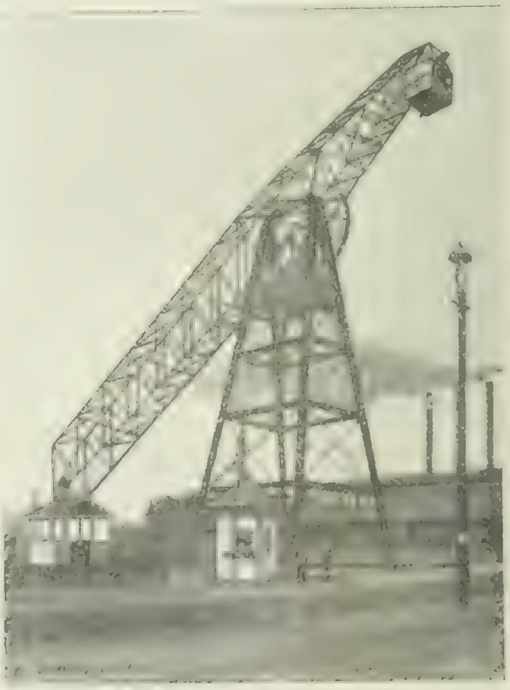
Fig. 3.

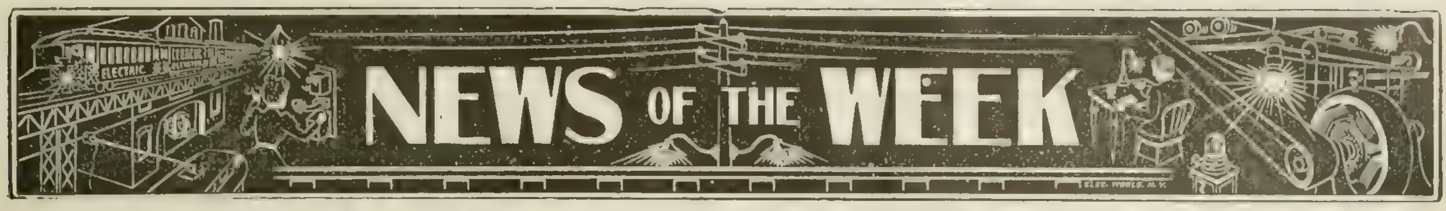
The Giant See-Saw at the Omaha Exposition.

An interesting application of electric power may be seen at the Omaha Exposition, where a giant see-saw is operated by an electric motor furnished by the Triumph Electric Company, Cincinnati, Ohio.

The supporting tower is an open steel structure, with four columns, two of its sides being triangular, and the other two rectangular in shape. The height of the pivot from the ground is 75 feet. Below the pivot is a platform containing the operating machinery. Attached to the swinging frame is a segmental gear, which is connected, through a compound gear, to a worm wheel on the platform below. The motor is of 10 horse-power, compound wound and direct connected to the shaft of the driving worm wheel. It is of the reversible [illegible] type, [illegible] by the Triumph Company, and is controlled by an [illegible] controller, [illegible] on the motor platform. The motor is wound for [illegible] direct current.

The see-saw, [illegible] of square section, is [illegible] feet long. At each end it carries a passenger car, from which at night a Rushmore searchlight is operated. [illegible] of the night [illegible], as [illegible] to illuminate the surrounding country for miles.


[illegible] See-Saw Driven by Electric Power.



NEWS OF THE WEEK

Financial Intelligence.

THE COMMERCIAL CABLE & TELEGRAPH COMPANY has certified to an increase of its capital stock from $100,000 to $500,000.

DIVIDENDS.—The Westinghouse Electric & Manufacturing Company has declared a dividend of 1¾ per cent. on its preferred stock, payable October 1. —The American Bell Telephone Company has declared its regular quarterly dividend of 3 per cent., payable October 15. This dividend makes 10½ per cent. declared so far this year, including one extra dividend of 1½ per cent. declared in June.

NEW YORK EDISON COMPANY'S EARNINGS. The statement of earnings during August of the Edison Electric Illuminating Company, of New York, shows gross receipts of $202,516.26, an increase of $32,168.60, as compared with those of the corresponding month last year. The net earnings were $67,692.06, an increase of $1,469.47. The increase in gross receipts for the eight months ended with August over those of the corresponding period of last year was $379,072.27, and the increase in net earnings for the same length of time was $122,480.52.

THE WESTINGHOUSE WALKER CONSOLIDATION. Mr. George Westinghouse on September 21 made the following announcement in behalf of his company relative to the absorption of the Walker Company by the Westinghouse Company: "The election this day of Roswell P. Flower and Anthony N. Brady as members of the Board of Directors of the Westinghouse Electric & Manufacturing Company to represent the interests of the former stockholders of the Walker Company completes the union of the interests of the Walker Company, of Cleveland, with those of the Westinghouse Electric & Manufacturing Company. The purchase by the Westinghouse Company includes substantially all of the outstanding stock and all but $850,000 of the $2,500,000 of the twenty-year bonds of the Walker Company, the $850,000 remaining a first lien upon the property. The recent sale of the Westinghouse Company of $3,000,000 of debenture certificates has erroneously been connected with this transaction. The entire proceeds of the sale of these debenture certificates were used in retiring the floating and other debt of the company, as previously announced. The increase in the total yearly fixed charges of the Westinghouse Company, due to the purchase of the Walker Company, will be but a little more than the sum that the Walker Company has been expending annually in defending patent litigation instituted by the General Electric and the Westinghouse companies. The acquisition of the Walker Company will, by reason of the agreement of March 31, 1896, between the General Electric and Westinghouse companies, put an end to this patent litigation and very large annual expenditure on both sides. The business of the Walker Company as a controlled company of the Westinghouse Company will be entitled to the protection of the patents of the Westinghouse and General Electric companies, and will, in all respects, be subject to the agreement between these two companies in relation to patents. The Westinghouse Company regards the business and good will of the Walker Company as a valuable acquisition, especially as the Walker Company brings upward of $1,250,000 of unfilled orders. The Walker Company has, in Cleveland, modern and extensive works, equipped with machinery capable of manufacturing the largest types of railway apparatus, and will, with the works of the Westinghouse Company, at East Pittsburg, constitute a manufacturing plant second to none in the country. The capacity and profits of the two companies will be increased by carefully harmonizing the manufacturing and selling operations, and the direct savings thereby effected should exceed the fixed charges incurred by the purchase of the Walker Company. The shipments of both companies, owing to the large orders on hand, have been increasing during the past few months and exceeded $750,000 for August. The total fixed charges of the Westinghouse Company, including those due to the Walker purchase, and the dividends on its preferred stock will be $42,000 per month."

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
9 Murray St., NEW YORK, September 26, 1898.

THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.—Secretary Pope has sent out notices of the next meeting of the institute, which will be held at the usual place, 12 West Thirty-first Street, this city, at 8 o'clock, Wednesday evening of this week. A paper will be read by Mr. Charles P. Matthews on the "Photometry of the Enclosed Alternating Arc."

EDUCATIONAL.—At this time of the year many young men who are engaged in business in the daytime are making their plans to study in evening schools. These are the young men who think, and think to a purpose, and are advanced in business by reason of their increased value to their employers. The Young Men's Christian Association conducts evening classes in commercial, scientific and language courses. At the West Side Branch of the association, 318 West Fifty-seventh Street, New York, the opening exercises of the educational classes will be held in the auditorium on October 3, at 8:15 P. M. Further information may be obtained of the secretary, Dr. D. E. Yarnell, 318 West Fifty-seventh Street, New York.

THE TELEPHONE COMMITTEE of the Merchants' and Manufacturers' Board of Trade of New York held a special meeting at the Hoffman House last Friday evening, and passed a resolution appointing a committee to attend the forthcoming Republican and Democratic State conventions for the purpose of securing in the platform of each party an avowal of the spirit of the resolution as expressed in its preamble. It is there charged that telephone companies in New York and other large cities discriminate against the small and in favor of the large subscribers. Such discrimination, the preamble avers, is unjust, illegal and contrary to the spirit of our laws as applied to similar corporations depending for their life and support upon the people.

EFFECT OF BROOKLYN TROLLEY COMPETITION ON THE LONG ISLAND RAILROAD.—The inroads that electric railways are making upon the passenger traffic of parallel steam roads in many places throughout the country is again exemplified, this time right at our own doors. The Long Island Railroad Company will on October 6 apply to the State Railroad Commission for authority to temporarily discontinue rapid transit stations on the Atlantic division of its railroad between Flatbush Avenue and Chestnut Street, Brooklyn. Decrease of traffic is the cause given as the reason for this application, the loss of business being due to the through service of existing electric street surface and elevated railway lines. The company is constructing a new connection with the Brooklyn Elevated Railroad Company at Flatbush and Atlantic Avenues. When this work is completed the company will restore the existing rapid transit facilities on the Atlantic division, which it is seeking to temporarily discontinue. If the Long Island Railroad could effecct an arrangement with the Brooklyn surface railways to secure trackage privileges and run its suburban trains by electric power through to the ferries and Bridge and New York it might hope to regain some of its lost business. A connection with the elevated railroad is only a partial solution of the problem. The thing for the Long Island road to do is to land its suburban passengers, and through passengers, too, if possible, at the point nearest to their destination without a break in the continuity of the trip, as the electric railways do. Electric equipment and traffic arrangements with existing surface lines seem to be the only salvation for the Long Island Company.

SOME NEW STREET RAILWAY ORDINANCES.—The surface and elevated railroads of this city are just now the subjects of special attention from the Municipal Assembly. Some of the resolutions introduced in that body during the past two weeks might be taken by many to indicate that a concerted attack upon these organizations from different quarters had for some reason or other been decided upon. Some of the conditions imposed upon the railway companies seem to be unnecessarily burdensome. About ten days ago some resolutions with especial reference to the elevated railways were introduced and referred to proper committees. On September 22 Assemblyman Christman introduced an ordinance compelling operating companies to keep their cars neat and clean; providing that signs indicating its destination shall be conspicuously displayed day and night on each car; that each surface car shall be provided with electric annunciators within the reach of every passenger; the abolition of shuttle trains or cars; that fares be refunded to passengers in case of obstruction on the line causing a delay of more than five minutes; that the steps of the surface cars shall be not more than 9½ inches from the ground, and fenders shall be used on all surface cars, with rollers actually touching the rails; that cars of all street railway companies shall be heated whenever the thermometer shall fall below 55 degrees Fahr.; that all cars shall be sufficiently well lighted to enable passengers to read with comfort; that in case of accident, cars shall not proceed on their routes, but shall remain at the place where the accident occurred until the arrival of the police and until released by proper authority; that the penalty for the infraction of each and every one of the foregoing sections shall be $100 for each trip. The ordinance was referred to the Railroad Committee.

AS TO ELECTRICITY ON THE ELEVATED ROADS.—Every once in a while a report is given currency to the effect that the Manhattan Elevated Railway Company contemplates the adoption of electric power on its lines. There have been so many rumors of this character in the past couple of years and so much talk and speculation in connection with the same, with no tangible results, that the people have about come to the conclusion that the company does not intend to nor ever has intended to do anything of the sort. The need for improved and more rapid transportation in our long city streets is a pressing and immediate one, which the "going-to" policy of the Elevated Railway Company does not in the least satisfy. The latest report about electric power on the elevated road is somewhat refreshing in that it differs somewhat from its many predecessors. Coming from a director of the company it may reasonably be regarded as reflecting the sentiment of other members of the board, if not the majority. After all the hopes that have been held out to the suffering public this gentleman states that it has "not yet been demonstrated that electricity will be either a safe or an available power for Manhattan." If the directors of the Metropolitan Street Railway Company entertained a similar view with respect to that company's lines the people of New York would be justified in rising up in their might and demanding what they are entitled to at the hand of the transportation companies in return for the privileges enjoyed by the latter. The enterprise of the Metropolitan Company and the resulting splendid service is, however, fully appreciated by the people, as is evidenced by their liberal patronage of the same. People prefer to take a surface car rather than climb two or three or more flights of stairs, if the street car can take them to the point nearest their destination within a reasonable time. The result upon the elevated railway traffic of the improved surface traction is very marked. The elevated trains are not so numerous as they were a year ago, and the number of cars per train has been reduced. This is striking evidence [illegible] that is long due for them by the surface railways; on the other hand it is a rebuke to the inaction and indifference of the elevated railway people. The fact that the tide of nickels is turned in favor of the surface cars is proof of this. Circumstantial evidence seems to be accumulating that something quite out of the ordinary is pending in Manhattan Elevated affairs. There are, in fact, intimations that a new corporation is to be formed to undertake the electrical equipment and operating of the Manhattan Elevated Railway, and so, perhaps, facilitating an operating alliance with the Metropolitan Street Railway. It is even said that the papers for this new corporation have been drawn, and that its title is to be the New York Railway Company.

BUFFALO AND NIAGARA FALLS NOTES.

BUFFALO, N. Y., September 21, 1898.

SLOW DEVELOPMENT of the demand for Niagara electric power seems to be inevitable under the circumstances. The two industries here, grain elevating and flour milling, which were expected to lead the demand for power, are earning less money than they should, and are very conservative. Some of the solicitors for business are preparing to depart for other fields temporarily.

THE GENERAL ELECTRIC COMPANY has obtained the contract for furnishing the Buffalo General Electric Company with about 60,000 feet of cable to go into the new subways in the city. The cost will be about $39,000 and about ten sizes will be used. The company expects to have it all in before winter. The cables just put in by the Standard Underground Cable Company are paper insulated, but the new contract calls for rubber insulation.

THE SCHOELLKOPF HYDRAULIC CANAL COMPANY, at Niagara Falls, has completed the line for connecting the power house in the gorge with the new factory for the production of chlorate of potash, and the plant is now running satisfactorily. This canal company has about 14,000 horse-power available. It supplies the Gorge and Youngstown trolley lines with power and the city with light, and has about twenty factories, large and small, on its list that receive power and light regularly. So far the management has not made any effort to obtain business from distant towns, though it may do so when the demand at home reaches its limit.

ST. LOUIS NOTES.

ST. LOUIS, MO., September 22, 1898.

THE ELECTRIC CONNECTING RAILWAY COMPANY filed articles of incorporation last week. The capital stock is $2000. John H. Bobring, M. T. Chestnut and James D. Houseman are stockholders. The corporation intends to operate a street railroad.

STREET CARS FOR JAPAN.— A St. Louis car company has received an order from Japan for 250 street cars. They will cost $300,000, and are to be delivered within ninety days. This is the first order of this kind from Japan. St. Louis has been furnishing Mexico with street cars for some time.

TROLLEY LINE TO DE SOTO.—The United Traction Company of St. Louis will build an extension of either the Tower Grove or Carondelet lines from the southern limits of the city into Jefferson County to De Soto. The company's plans cannot be definitely known until the Messrs. Scullin return [illegible] that the line is to be built before cold weather sets in.

THE FOURTH STREET AND ARSENAL RAILROAD was sold last Tuesday to John H. Overall, attorney for the Central Traction Company, for $191,000 cash. It is generally conceded that Mr. Overall represents the Central Traction Company, though some think he bought in the interests of the bondholders. The bonded indebtedness is represented by $150,000 of first mortgage [illegible] figure paid for the [illegible] in interest and arrears.

CANADIAN NOTES.

OTTAWA, Ont., September 23, 1898.

[illegible] COMPANY is about to [illegible] The new portion will [illegible] about [illegible]

[illegible] the city of Hamilton, Ont., for a proposal to purchase the street railway there has been [illegible]

[illegible]

[illegible] etc. [illegible]

FRENCH NOTES.

(From Our Own Correspondent.)

PARIS, September 2, 1898.

THE ELECTRICAL TRANSPORTATION COMPANY AT THE EXPOSITION.—This company has been incorporated with a capital of 2,000,000 francs, divided into 20,000 shares, par value 100, all subscribed for and with one-fourth of the capital paid in. The object is to carry on the business of the Intramural Railway at the exposition, according to the plans elaborated by M. de Macomble. Provision has been made for increasing the capital.

THE EXPOSITION OF 1900.—At the last meeting of the Committee on Electricity for the Exposition of 1900 M. Picon, chief engineer of electrical works, read a report on the installation and operation of the generating machinery for 1900. It has been decided that exhibitors may furnish the exposition with electrical energy. They are to submit plans for the approval of the exposition administration. They will do their own erecting. Each machine, whether alternating or direct, will be direct connected to its engine, and will be furnished with a special switchboard. All transformers needed are to be furnished by the exhibitors. The period during which electrical energy must be furnished will cover about 205 days; from April 15 to November 5, 1900. A rotational service will be arranged so that the hours of work will not exceed seven per day. The exhibitors who furnish electrical energy will be paid a compensation for the expenses of installation and operation.

ELECTRIC LIGHT FOR THE BOIS DE BOULOGNE IN PARIS.—In accordance with the public wish, which has been expressed for some time, the authorities have decided to install electric light in the Bois de Boulogne. It will, of course, be possible to light only the chief avenues, which will leave plenty of corners for those who like to prowl in the dark, and for others. The plans are ready; they were prepared under M. Bareaux, Director of Parks and Public Grounds. The completed plan includes the lighting of the long avenue running from the Maillot Gate to the Suresnes Bridge, through Longchamps, with two pathways from Longchamps to the end of the ponds and to the Dauphine gate; the lighting of the drives around the ponds and the lawns of La Muette; and also the Avenue de l'Hippodrome, running from the ponds to the hippodrome of Longchamps, together with a part of the Queen Marguerite Road, lying between the Longchamps Road and the Avenue to the Hippodrome. These three divisions constitute three "pressing needs," which can all be done at once or one after the other. The lighting will be done by candelabra supporting very powerful arc lamps, after the manner of those on the Paris boulevards. Current will be furnished either by a municipal power station built for the purpose, or else by the central station at Puteaux. The cost of construction, including the conduits, the erection of supports for the lamps and the lamps themselves, will come to about 435,000 francs, being divided as follows: 205,000 francs for the first division, 140,000 francs for the second and 90,000 francs for the third. The execution of this project is, of course, subject to the approval of the Municipal Council, which meets in October, and which will vote the necessary money, if after due discussion the conclusion is reached that the proposed work is desirable. It is quite probable, however, that the measure will be passed, although not without opposition. For while there are many in favor of it, there are also some dissenting voices heard. Those in favor of the scheme, and among these are the cyclists (the cyclist press having maintained a very vigorous campaign in favor of it), point to the advantage of having the light to help in clearing the park of the bad characters that now infest it. Hidden in the shadow of the bushes and the underbrush, where the police cannot reach them, these people watch for a chance to attack with a club or a knife some unsuspecting person who may happen to venture beyond the Chinese Pavilion. Or they will stretch a string between two trees across an avenue, so as to throw some cyclist, who is then knocked on the head for the sake of getting his machine. With the avenues lighted other inhabitants of Paris, as well as the cyclists, can go and breathe a whiff of fresh air in the evening, a thing which will soon be brought within the reach of all, since the new tram line from Porte Maillot to Suresnes, which skirts the sunken fences of the park, will enable those who possess neither horses nor carriages to ride at small expense. The lighting of the park is therefore a democratic measure, and that is a reason which will insure its approval by the Municipal Council.

MEETING OF THE FRENCH SOCIETY OF CIVIL ENGINEERS.—1st. M. R. Soreau, in a paper entitled "Steam, Oil and Electricity for Automobiles," takes up the following questions: A. How do the advantages and disadvantages of the various methods for producing power compare with one another when considered with reference to their application to automobile carriages? B. What improvements may be reasonably expected to take place from now on? Without in any way attempting to formulate rigorous answers to these questions (which would be a rather foolish thing to do considering the state already attained by an industry which is scarcely fifteen years old), M. Soreau takes up the problem in a general way, from the two points of view so aptly termed by Mr. Clarke the anatomy and physiology of motors. He presents some information on Serpollet's new generator; he dwells on the different phases of the cycle of petroleum motors, he shows how it happened that M. Diesel was led to design his remarkable device which trebles the thermal efficiency; lastly, he takes up the electric motor and analyzes the chief results and facts brought out by the recent cab competition. 2d. M. F. Drouin makes a report on electrical traction by means of quick charging accumulators. He describes the system of traction in use on the lines of the Madeleine in Paris. This plant, which was put in operation in [illegible] by the Industrial Electrical Motor Company, differs from methods hitherto employed, in that the charging takes place [illegible] at the end of the line while the car is standing. Before proceeding to [illegible] the details of the system, M. Drouin speaks of the mixed [illegible], both trolley and battery system which led to the invention [illegible] A series of comparative tests conducted by Mr. [illegible] the system to give good results and to be satisfactory. The [illegible] in Hanover, Dresden, Berlin, etc., make use of the mixed system. [illegible] to the Madeleine lines, since [illegible] overhead trolleys in this district [illegible] batteries would not do because it [illegible] required [illegible] charging stations to handle the batteries. The system [illegible] to use batteries which admit of being charged in the cars during the short stop which the latter makes at the terminal station. The severe treatment to which the accumulators are subjected under such a rapid rate of charge necessitates an unusual arrangement, which is attained in the case of the Tudor battery as follows: A. By the use of plates having enormous surface. B. Charge at constant voltage and by working the battery below its maximum capacity. The cars weigh 13.7 tons, of which 7900 pounds are due to the accumulators. The battery has 200 cells stowed under the seats. A small switchboard is provided for connecting the battery either to the charging or to the discharging circuit. Flexible cables are used to connect the car with a charging box, in which are the terminals of the underground feeders that connect with the power station. The charging pressure is 600 volts. The power station is located on the Quai National, at Puteaux, and has three groups of generating machinery of 120 kilowatts each. After showing slides of the cars and power house and detailing some of the results of the experience acquired during the operation of these lines M. Drouin concluded his paper with a description of some experiments that were made to determine the frictional resistance to tractive effort for these cars. On a straight, level track this frictional resistance, including the motor when turning dead, and for speeds lying between 5 and 25 kilometres per hour, is given by the formula

$$R = 3 + \text{[illegible]}$$

where R is expressed in kilogrammes per ton and v in kilometres per hour. For the car alone without the motor the formula is:

$$R = .4 R.$$

Experiments were also made on curves. The results differed widely, according to the state of the rail, and the amount of inclination, etc. At a speed of 10 kilometres per hour on a curve of 40 to 50 metres radius the force required reaches about 25 kilogrammes per ton. On a curve without any inclination the frictional resistance increases rapidly with the increase of speed.

General News.

THE TELEGRAPH AND TELEPHONE.

BOSTON, MASS.—The Erie Telegraph & Telephone Company added 756 subscribers to its system during the month of August. The total number connected September 1 was 27,677.

LOUISVILLE, KY.—The Monticello & Jamestown Telephone Company has been incorporated with the capital stock fixed at $3000. The incorporators are J. B. Patterson, W. W. Jones and W. F. Rowe.

LEWISTON, PA.—The Huntingdon County Telephone Company has been chartered. It has $25,000 capital, with offices at Saltillo. C. Kapp, John Kapp, G. Sleeman, Frank Harkleroad and Henry Taylor are directors.

CLEVELAND, OHIO.—The Cuyahoga Telephone Company, Cleveland, has been incorporated, with a capital of $3,000,000, to build telephone and telegraph lines in Ohio. The incorporators are E. W. Moore, J. B. Hanna, J. B. Hoge, H. Clark Ford, John Sherwin, H. A. Everett and H. B. McGrew.

CHEYENNE, WYO.—The North Park Telephone Company has filed articles of incorporation. The company will erect and maintain a telephone line from Walden, Col., to Laramie City, Wyo. The capital stock is $15,000. The stockholders are Monte Blevins, J. O. Mosman, George F. Scott, C. E. Mosman and M. C. Ward.

MORAVIA, IA.—The Moravia telephone line has been sold to the Ottumwa Long Distance Telephone Company. The line purchased connects the towns of Moravia, Albia and Blakesburg. It is the intention of the purchasers to extend the service to Ottumwa, Centreville, Moulton and Bloomfield, Ia., and to several important points in Missouri.

JANESVILLE, WIS.—The Wisconsin Telephone Company has completed its long distance metallic circuit from this city through Monroe to Gratiot, and will extend it through Shullsburg, Darlington, Platteville, Lancaster, Fenimore and other villages to Dubuque. This will place Janesville in metallic telephone connection with all Southwestern Wisconsin.

NOBLESVILLE, IND.—The County Commissioners of Hamilton County have granted the right of way to the New Long Distance Telephone Company of Indiana over the roads and highways of Hamilton County for its poles and wires. There is much interest in this city in the independent telephone movement. The New Long Distance Telephone Company will connect with the exchange of the Noblesville Telephone Company, which is a prosperous and successful institution of this city. A line from here to Indianapolis will be ready for immediate use upon the completion of the New Company's plant at Indianapolis.

ELECTRIC LIGHT AND POWER.

OCALA, FLA.—The Council is arranging to make extensive improvements to the electric plant.

HAVANA, CUBA.—The electric plant at Cardenas has suspended public lighting, the municipality being in debt $300,000 to the concern.

CHARLOTTE, N. Y.—The Stanwix Engineering Company, of Rome, is preparing plans for a light and water plant to be erected at Charlotte.

SHELBINA, MO.—The city of Shelbina, Mo., has awarded its order for one 2000-light alternator and one 200-hp Hamilton-Corliss engine to the Royal Electric Company, of Peoria.

CLEVELAND, OHIO.—The Fanner Manufacturing Company, 1521 Pearl Street, will build a factory, which will be equipped with its own electric plant. Contracts are not yet let.

NEWTON, ILL.—The electric light plant at this place was started on September 16. A 60-kw alternator, bought by the city from the Royal Electric Company, furnishes the light.

TRENTON, N. J.—Chancellor McGill has filed an opinion deciding that a receiver should be appointed for the Franklin Electric Light Company of Cape May. The application was made by the Fort Wayne Electric Corporation, a judgment creditor.

PITTSBURG, TEX.—J. A. McFinney, of this place, has placed an order with the Royal Electric Company, of Peoria, for a 40-kw alternator for the electric light plant he is erecting.

KALAMAZOO, MICH.—The Kalamazoo Valley Electric Company has been organized with a capital of $100,000, to develop the water power of the Kalamazoo River near Allegan and distribute electric current to the towns within a radius of several miles.

SEABRIGHT, N. J.—The Seabright Electric Light Company's power house caught fire on the night of September 14, and was totally destroyed. The town was consequently in darkness. The building was erected last spring at a cost of $12,000, and was insured for $8000. The light supply to the hotels and seaside cottages was shut off.

PITTSBURG, PA.—Arrangements are now being made by the officials of the Pennsylvania Tube Works Company for the installation of a complete electric plant in its works on Second Avenue to cost $100,000, and the operation of the entire plant by electricity. This will be the first large iron mill in the United States to adopt electricity for power. It has been calculated that an immense saving will be made in the use of the new power. It is the intention of the tube company to erect one central power plant of about 1000 horsepower, and distribute the electricity through the lap and butt weld departments to about twenty-five motors, of 40 horse-power each, that will be placed near the various machines. This installation will do away with a large number of engines and the labyrinth of steam pipes that causes such annoyance in a great mill. The plant will be located near the river, where the coal supply of the company is received, and boilers capable of producing about 750 horsepower will be added to the present battery. It is believed by electrical experts that many changes will be made in the next few years by the steel mills, for all have been making money and can afford to pay for the alterations.

THE ELECTRIC RAILWAY.

CLEVELAND, OHIO.—The directors of the Cleveland Electric Railway have declared a quarterly dividend of 1 per cent., payable in October.

MONTREAL, QUEBEC.—On September 16 fire destroyed the car sheds of the Montreal Street Railway Company, entailing a loss estimated at $100,000.

BENNINGTON, VT.—A small cyclone passed over this town recently wrecking the power station of the Bennington & Hoosic Valley Electric Railroad and causing a damage estimated at $3500.

BROOKLYN, N. Y.—It is stated that the work of equipping the Fifth Avenue and Lexington Avenue branches of the Brooklyn Elevated Railroad with electricity will begin on October 15. The change will involve an expenditure of $750,000.

COLORADO SPRINGS, COL.—It is reported that the owners of the Cog Road running up Pike's Peak have decided to change the motive power from steam to electricity. It is estimated that the cost of making the change will be about $50,000.

NEW YORK, N. Y.—President Guggenheimer of the Council is preparing an ordinance to compel street car companies to place the steps on their cars not higher than 9 inches from the street, and to compel the cars to stop when a passenger signals.

MUNCIE, IND.—The County Commissioners have granted Indianapolis and Chicago capitalists a franchise for an electric railway line from Albany, this county, to Camden, Jay County, via Dunkirk. Albany has granted the projectors an indefinite franchise.

COHOES, N. Y.—It is understood that the State Railroad Commission will refuse to grant the Waterford, Mechanicville & Stillwater Electric Railway Company permission to cross the D. & H. tracks at North Third Street, Waterford, at grade. This decision, it is said, has been arrived at since the Cohoes railroad disaster.

HANNIBAL, MO.—The Hannibal street railroad, recently bought by the Farmers' and Merchants' Bank of this city, has been sold to a Philadelphia syndicate for $17,000. It originally cost $75,000. The new owners announce that they will spend $150,000 on improvements, including an extension of the line to Mt. Olive Cemetery.

SAN FRANCISCO CAL.—The Bakerfield & Los Angeles Railway Company has been incorporated by Claus Spreckels, John D. Spreckels, A. B. Spreckels, Robert Watt and A. H. Payson, to build a railroad from Bakersfield over the Tejon pass to Los Angeles, 200 miles. It will connect with the Southern California Railway, a branch of the Santa Fé, running from Mojave to Los Angeles.

PHILADELPHIA, PA.—John Lowber Welsh has resigned the presidency of the Union Traction Company, the corporation that controls all the street car lines in this city. It is believed his successor will be George W. Elkins, a son of William L. Elkins, one of the principal stockholders of the company. The directors at a meeting on September 19 decided upon an assessment of $5 a share upon all stockholders, making $17.50 paid in on a par value of $50.

DURAND, MICH.—The Long Lake, Durand & Corunna Railway Company has asked the Vernon Township Board for a franchise. Vernon City, Durand and Fenton have granted franchises, and the Durand one has been accepted by the company. As soon as the matter is settled in Vernon township bids for the construction of the road will be called for. Work will commence January 1, 1899, and the road will begin operations in the spring. It will run from Fenton to Corunna.

PETERSBURG, VA.—The Hustings Court has entered an order in the suit of the Upper Appomattox Company against the Petersburg Electric Railway Company and the Farmers' Loan & Trust Company against the same, ordering a sale of the road to be made on Thursday, the 10th day of November next, in order to pay off the liens which have been secured against the company and the bonds amounting to some $50,000, which were secured by deed of trust upon the property.

WILMINGTON, DEL.—The Wilmington City Electric Company is making many and extensive improvements to its plant on Fifth Street. A storage battery of 2000 ampere-hours' capacity will be installed and will be so designed that it can be increased to nearly double capacity at some future date. The present boilers will be torn out, and one 600-hp Morrin Climax boiler will be installed. The engine plant will also be improved by compounding the engines and making them direct connected with the dynamos.

CHICAGO, ILL.—The statement that the South Side Alley "L" has passed under the control of the Chicago City Railway Company lacks official confirmation. A prominent official of the elevated company makes the statement that he has no knowledge whatever of any such deal, and that, furthermore, it has not been a subject of discussion at any directors' meeting. It is unofficially stated that by the deal the Alley "L" is absorbed by the surface line, the latter assuming $750,000 outstanding bonds and guaranteeing 4 per cent. on the $10,328,800 of capital stock of the elevated road.

NEW YORK, N. Y.—The Safety Third Rail Electric Company was incorporated at Albany during the past week. The capital of the company is $1,000,000, and the incorporators are Emerson McMillin, Sr., Emerson McMillin, Jr., W. F. Douthirt, C. F. Scoville, William M. Keepers, R. H. Beach, David F. Halstead, J. McLeod Murphy and Louis Steckler. Mr. Murphy states that a public test of the system will be made at once over the short line at Manhattan Beach, owned by the Manhattan Beach Land Improvement Company, and running between the Manhattan Beach and Oriental hotels. It is expected that the test will be made in sixty days.

YONKERS, N. Y.—It is said that the Union Railway Company, which is now in control of the local lines, is paving the way for a franchise to build a big bridge connecting Mt. Vernon and Yonkers over which to run its cars. The company was met, it is declared, with a flat refusal from the Hudson River Railroad people for a permit to cross the Harlem Railroad tracks at the present terminus of the Yonkers Avenue line. The proposed bridge would be the only means of crossing the tracks, and this would necessitate a franchise from both the cities of Yonkers and Mt. Vernon, as the bridge would probably extend from Sherwood Park in Yonkers to the top of what is known as Bocks Hill in Mt. Vernon.

EDUCATIONAL NOTES.

THE INTERNATIONAL CORRESPONDENCE SCHOOLS, Scranton, Pa., have added to their courses of instruction one in telephony. Mr. Kempster B. Miller, the well-known telephone expert, is the instructor in this course. The schools have just issued a pamphlet giving a brief synopsis of the course in telephony, and judging from its contents the subject has been most completely covered.

THE BROOKLYN INSTITUTE OF ARTS AND SCIENCES has just issued its prospectus for 1898-99. It is a book of 168 pages, and contains a preliminary announcement of the anniversary meetings, addresses, lectures, exhibitions, department meetings, concerts, dramatic readings, schools, courses of instruction and the other work which will be conducted by the institute and its departments during the year 1898-99. The season begins on September 29, 1898, and closes on June 3, 1899. In the department of electricity regular meetings will be held on the first Friday evening of each month, commencing with October 7. Eight illustrated lectures on current topics of interest in electricity have been arranged for the season, and additional lectures will be given from time to time on subjects of special and current interest.

LEGAL NOTES.

THE ELECTRIC STORAGE BATTERY COMPANY, through its attorneys, A. B. Stouten, of Philadelphia, and F. P. Fish, of New York, has filed in the United States Court a petition asking that an injunction be granted restraining the Wilmington City Electric Company, Wilmington, Del., from putting in its proposed storage battery plant. The complainant alleges that the local company has made and constructed and threatens to use secondary [illegible] infringement on patents the Electric Storage Battery Company holds, having purchased them from Charles F. Brush, the inventor. Judge Bradford granted an order compelling the Wilmington City Electric Company to come into court on October 12 and show cause why a temporary injunction should not be granted.

[illegible] COMPANY, of Philadelphia, has appealed from the decision against it in the United States District Court in the suit brought by the owners of the Steiringer electric fixture pat- [illegible] and the appeal was to set that aside. The case involves the right to the use of an insulating joint used to support the fixture. The defense set up that its joint was not [illegible] the suit was brought in the interest of a New York fixture trust, who were endeavoring to control the trade. It also alleged that the present case was an invalid reissue of an old patent, which had previously been defeated several years ago in a [illegible] represented [illegible] the Horn & [illegible] Samuel Gustine Thompson of Philadelphia. The court took the case under [illegible]

PERSONAL NOTES.

MR. CHARLES [illegible]

MR. WILLIAM [illegible] of Steam and electrical engineering, University of Nebraska, has been appointed professor of electrical engineering at the University of Illinois, Champaign, Ill.

CAPT. F. S. DE RONDE, of the Standard Paint Company, New York, is lying dangerously ill at his home in Englewood, N. J., with typhoid fever. Mr. De Ronde is captain of Company F, Second New Jersey Volunteers, and returned home a few days ago from camp. His many friends hope for his early and rapid restoration to health.

MR. H. BEVIS, manager of the General Electric Company, Ltd., of England, is in this country for a brief business visit. Mr. Bevis is arranging for the handling on this side of the Atlantic of some of the General Electric Company's well-known specialties, including the "Hunningscone-Deckert" microphone, and the Aron electric meter, recently approved by the British Board of Trade. His address is the Hotel Imperial, New York.

MR. S. JEVONS, director of the Gem Dynamo Brush Company, of Birmingham, England, is in America for a short time to arrange for the manufacture and sale in this country of the "Sparkless Gem" wire gauze brush. The sale of this brush in Europe has been very large, owing to the excellent satisfaction it has given to users, and there is believed to be an extensive field for it in the United States and Canada. Mr. Jevons is at the Westminster Hotel, New York, where he may be addressed. He will be glad to call upon or communicate with anyone interested in the "Gem" brush.

MR. F. E. PETTINGELL, who on account of illness was compelled to sever his connection with the Pettingell-Andrews Company, of Boston, several years ago, has now fully regained his health, and states that he expects soon to re-enter the electrical field. Mr. Pettingell has a very large acquaintance in the trade, and any manufacturer who secures his services will be very fortunate, as Mr. Pettingell's acquaintance, to say nothing of his ability as a salesman, is of the greatest value. THE ELECTRICAL WORLD wishes him success and a continuance of his regained health. Mr. Pettingell is at present residing at 16 West Twenty-seventh Street, New York City.

OBITUARY NOTE.

MR. WILLIAM T. RYLE, president of the Edison Electric Illuminating Company, of Paterson, N. J., died at his cottage at Cape May, N. J., a few days ago at the age of forty-one years. The cause of death was hemorrhage of the stomach, after an illness of one day. He was largely interested in the Sauquoit Silk Manufacturing Company, of Philadelphia, and was besides an importer and manufacturer of raw silks.

Trade and Industrial Notes.

THE WESTERN ELECTRIC COMPANY, which carries a complete line of iron armored conduit, has recently increased its stock of fittings for conduit.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Chicago, states that the demand is steadily increasing for the divided circuit toll line system. The system is said to be better than the bridging system, and in no way infringes the Carty patent.

AFTER CHEAP LAMPS.—Messrs. Walker & Kepler, 521 Chestnut Street, Philadelphia, have been deluged with letters containing 8 cents for a sample of their lamps. They have no 8-cent lamps. Through a typographical error in a recent number of this journal the price per sample lamp was made to read 8 cents instead of 18 cents. Hence the rush for the cheap lamps.

CONTINUED DEMAND FOR FAN MOTORS.—Although summer is at an end the Western Electric Company reports that the demand for its fan motors continues. The public has become educated to the advantages of good ventilation, and the fan motor has been found to be one of the best means of preventing stagnation of air. It is also useful for drying purposes in photograph galleries, engraving establishments and laundries.

MESSRS. EUGENE MUNSELL & CO., of New York and Chicago, importers and wholesale dealers in mica, report a very gratifying demand for their India mica. They carry a large stock at both their warehouses in New York and Chicago, and are, therefore, in a position to execute orders promptly. This concern was one of the pioneers in the preparation of mica for electrical purposes, having sold to the Edison Company at a time when the latter concern employed but two armature winders. This was in the eighties.

THE ELECTRIC APPLIANCE COMPANY, Chicago, has taken the general Western agency of the Utility Shade Company, manufacturer of the Utility shade in paper and celluloid. These shades are something new in the electrical line, and are destined to find a very large field, as they possess a great many points of merit, among which may be mentioned the following: They are very light in weight, neat in appearance and practically indestructible. They require no separate shade holder and are low in price. They are made in a number of different shades and colors. The Electric Appliance Company has issued a special catalogue of these goods, a copy of which it will be pleased to send to the trade upon application.

THE CARBORUNDUM COMPANY, of Niagara Falls, N. Y., has just issued a most interesting and instructive illustrated catalogue of its carborundum specialties, which also contains a very complete description of the manufacture and development of carborundum at the company's Niagara Falls works. The carborundum wheels for grinding and polishing purposes manufactured by this company have distinct characteristics of their own, which are of the greatest value to [illegible] who require a perfect wheel combining other qualities than those possessed by the regular emery wheel. Everyone interested should have one of these catalogues, a copy of which will be furnished upon application to the Carborundum Company, Niagara Falls, N. Y.

STREET RAILWAY DIRECTORY.—The first number of the American Street Railway Directory has just been issued by Mr. E. L. Powers, publisher, New York and Chicago. [illegible] as part of the "Standard Electrical Directory," which covered the lighting and railway fields in one. In its new form it is corrected up to date and is authentic. It will be published quarterly with corrections. A very carefully collated and compiled table of street railway statistics gives the track mileage, capitalization and car equipment of street railways in the United States by States. This table, the publisher states, can be depended upon for accuracy.

THE WESTERN TELEPHONE CONSTRUCTION COMPANY, Chicago, has just issued a very neat and carefully gotten up catalogue of its various manufactures, including switchboards and telephone equipment for independent telephone companies. The catalogue contains 136 pages, and after a little address to the independent telephone companies it describes and illustrates the switchboards and exchange equipment manufactured by the company. The various styles of switchboards covered in the descriptive matter include the Western express board, equipped with combined self-contained removable spring jacks, drop and coils, and a like board for multiple transfer systems. A combined telephone and switchboard is also shown and described. The catalogue is very complete, and will be of great interest to all connected with the telephone service.

THE RASTER CARBON RHEOSTAT COMPANY recently moved into new quarters at 231 South Canal Street, Chicago, where it has a fine office and complete factory appointments, which facilities permit of the company's handling an increased business. The carbon rheostat business has rapidly developed in the last few months, and the company reports that it is highly pleased with the appreciation shown by the trade in its product. Some flattering reports are being received, and some yearly contracts have lately been closed. All of the company's devices are covered by patents which it claims to control or to which it has a legal right. The company is manufacturing a full line of automatic motor starting and regulating rheostats, as well as all kinds of theatre dimmers, field regulators and elevator controllers. Since the close of the war its business has shown a marked increase. It has established offices in St. Louis, New York and Milwaukee, and has lately made foreign shipments. Carbon rheostats, as made by this company, are said to be satisfactory mechanically and electrically, and the company reports that the underwriters have lately rendered the same decision, which further substantiates the claims of the company.

Directory of Scientific Societies, Associations, Etc., an Meetings of the Same.

THE NEW YORK ELECTRICAL SOCIETY.—President, Gano S. Dunn; secretary, George H. Guy, 120 Liberty Street, New York.

ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA, Pittsburg, Pa.—Meetings, third Tuesday of each month.

CANADIAN ELECTRICAL ASSOCIATION.—President, William H. Browne, Montreal; secretary, C. H. Mortimer, Toronto, Ont.

HENRY ELECTRICAL SOCIETY meets every other Friday evening between October and May. Headquarters, 115 West Twenty-eighth Street, New York City.

CHICAGO ELECTRICAL ASSOCIATION.—Meetings, first and third Friday of each month, from October 1 to June 1; J. R. Cravath, secretary, Monadnock Block, Chicago, Ill.

NORTHWESTERN ELECTRICAL ASSOCIATION.—President, F. A. Copeland, La Crosse, Wis.; secretary, Thomas R. Mercein, Milwaukee, Wis.

MASSACHUSETTS CHARITABLE MECHANIC ASSOCIATION, Boston, Mass.—Exhibition of Motor Carriages, October 10 to December 3, 1898.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK.—President, G. Tracy Rogers, Binghamton, N. Y. Secretary, Henry A. Robinson, New York City. Next meeting, Ithaca, N. Y., September 12 and 13, 1899.

NATIONAL ELECTRIC LIGHT ASSOCIATION.—President, A. M. Young, Waterbury, Conn.; secretary, George F. Porter, 203 Broadway, New York. Next meeting, New York, May or June, 1899.

AMERICAN STREET RAILWAY ASSOCIATION.—President, C. E. Sergeant, Boston, Mass.; secretary, T. C. Penington, 2020 State Street, Chicago, Ill. Next meeting, Chicago, 1899.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS.—President, W. W. Ryder, Chicago; secretary, P. W. Drew, Milwaukee, Wis. Next meeting, Wilmington, N. C., June 19, 1899.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, New York.—President, Dr. A. E. Kennelly; secretary, Ralph W. Pope, 26 Cortlandt Street, New York. Meeting, fourth Wednesday of each month, from September 1 to June 1. Next meeting, September 28: Paper, "Photometry of the Enclosed Alternating Arc," by Charles P. Matthews.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES.—President, R. R. Bowker, New York; secretary, Wilson S. Howell, P. O. Box, 114, Newark, N. J. Next meeting, 1899.

THE PACIFIC COAST ELECTRIC TRANSMISSION ASSOCIATION. President, W. F. Pierce; secretary, George P. Low, 427 Tenth Avenue, San Francisco, Cal.

THE OHIO ELECTRIC LIGHT ASSOCIATION.—President, Emil C. Schmidt, Sandusky; secretary and treasurer, Samuel Scovil, care of Cleveland Illuminating Company, Cleveland. Next meeting place, Cleveland, 1899.

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION.—Dr. C. R. Dickson, Toronto, Can., president; Dr. John Gerin, Auburn, N. Y., secretary.

PENNSYLVANIA STATE STREET RAILWAY ASSOCIATION.—President, Robert E. Wright, Allentown; secretary, S. P. Light, Lebanon. Last meeting, Scranton, Pa., September 7-8, 1898.

ASSOCIATION OF FIRE AND POLICE TELEGRAPH SUPERINTENDENTS AND MUNICIPAL ELECTRICIANS.—President, J. W. Aydon, Wilmington, Del.; secretary, H. T. Blackwell, Jr., New York. Next meeting, Wilmington, Del.

THE SOUTHWESTERN GAS, ELECTRIC AND STREET RAILWAY ASSOCIATION.—President, Carl F. Drake, Austin, Tex; secretary, E. L. Wells, Jr., Marshall, Tex. Next meeting, Austin, Tex., April 19, 1899.

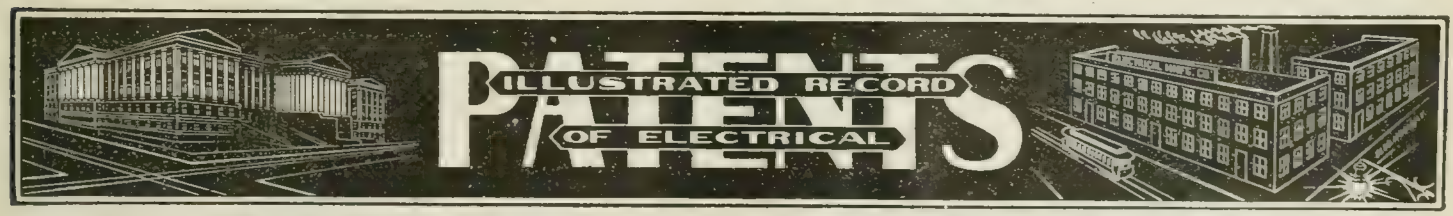
INDEPENDENT TELEPHONE ASSOCIATION OF THE UNITED STATES.—President, Judge James M. Thomas, Chillicothe, Ohio; secretary, W. J. Vesey, Fort Wayne, Ind. Next meeting, June, 1899. Place to be named hereafter.

FRANKLIN INSTITUTE (Electrical Section), Philadelphia, Pa.—Secretary, William H. Wahl. Next meeting September 27. Papers to be read: "Rail Bonding, with Especial Reference to Cast Weld Joints," by W. E. Harrington; "The Present Status of the Storage Battery," by Herbert W. Lloyd.

THE BROOKLYN INSTITUTE OF ARTS AND SCIENCES, Brooklyn, N. Y. Henry T. Weed, secretary. Meetings: October 7, lecture by A. L. Riker on "Electric Carriages," illustrated by lantern photographs; November 4, illustrated lecture by T. C. Martin; December 2, lecture by Prof. William E. Geyer, Stevens Institute; January 6, lecture on "The Electro-Metallurgy of Copper," by John B. F. Hereschoff; February 3, lecture and experimental demonstrations by Prof. M. I. Pupin; March 3, illustrated lecture on "Electricity in the Navy," by Captain Zalinski, U. S. N.; April 7, lecture on "Cable Telegraphy," by A. E. Kennelly; May 5, lecture by Prof. William A. Anthony.

Business Notice.

THE ILLUSTRATIONS in this issue were made by the Photo-Engraving Company, 9-15 Murray Street, New York City.



UNITED STATES PATENTS ISSUED SEPTEMBER 20, 1898.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

610,887. AUTOMATIC CIRCUIT BREAKING SWITCH; W. F. Bossert and William D. Pomeroy, of Utica, N. Y. App. filed July 12, 1897. In an automatic circuit breaking switch, an electrical catch for securing the switch in open position, the said catch being operated by a normally open subcircuit closed by the switch in open position with reference to the main circuit.

610,895. CONTROLLER FOR ELECTRIC MOTORS; F. E. Case, of Schenectady, N. Y. App. filed April 2, 1898. In a controller for electric motors operated in pairs in series and parallel, three-blade cut-out switches for each motor, two of the blades of which shift the motor connections, and the third blade of which opens a connection common to all the switches.

610,898. ELECTRIC ARC LAMP; M. Harris, of New York. N. Y. App. filed Oct. 27, 1897. In an arc lamp, the combination of a fixed outer globe provided with an opening in its bottom, a cover removably attached to said opening, a movable inner or arc enclosing globe and a support for the same wholly enclosed within the outer globe, means for lowering the inner globe with its support through the opening in the outer globe, and means for sustaining it in its lowered position, substantially as described.

610,899. ELECTRIC METER; C. D. Haskins, of Newton, Mass. App. filed June 24, 1898. The method of calibrating an electric meter, which consists in changing the current flow in the starting coil to compensate for local errors without changing the current flow in the armature circuit.

610,903. CIRCUIT BREAKER FOR THREE-WIRE SYSTEMS; E. M. Hewlett, of Schenectady, N. Y. App. filed Sept. 7, 1897. The combination with a series coil carrying the main current and the trip of a circuit breaker, of a shunt coil acting to open the circuit and controlled by exterior contacts.

610,904. SAFETY DEVICE FOR DYNAMO ELECTRIC MACHINES; E. M. Hewlett, of Schenectady, N. Y. App. filed April 4, 1898. The combination with an electric generator, a steam engine driving the generator, a governor for the engine, and means controlled by the governor for interrupting the circuit of the generator when the engine tends to race.

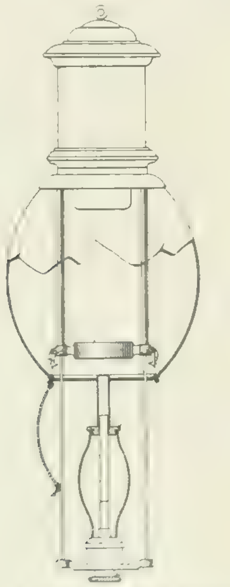
610,908. ELECTRIC BRAKE; John B. Linn, Schenectady, N. Y., assignor to the General Electric Company, New York. App. filed Jan. 7, 1898. In an electric braking apparatus, the combination, with a number of dynamo electric armatures and brake mechanisms upon common axles, of means for passing the current from one armature through the field of another of the dynamo electric machines.

610,909. RAIL BOND; J. E. Lloyd, of New York, N. Y. App. filed Nov. 12, 1896. In a rail bond, the combination with the rail and wire, of a washer adapted to be inserted in the rail and provided with a tapered passage having a plurality of tapers, said wire having a tapered or enlarged end to fit said passage, substantially as described.

610,927. TROLLEY; O. W. Swanson, of Tacoma, Wash. App. filed Sept. 18, 1897. A centre member provided with opposite hubs, squared at the outer extremities, and provided with an annular recess between said member and extremity.

610,928. ELECTROSTATIC MEASURING INSTRUMENT; E. Thomson, of Swampscott, Mass. App. filed March 27, 1897. In a measuring and indicating instrument, the combination of a vibrating needle and stationary indicators separated from each other by an insulating medium, with a shield enclosing the moving parts of the instrument.

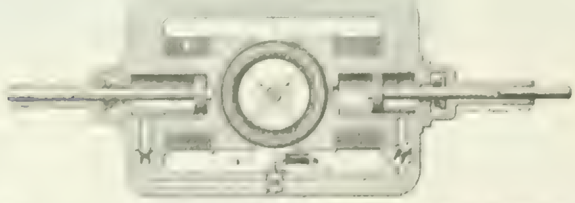
610,999. ELECTRIC HEATER; J. F. McElroy, of Albany, N. Y. App. filed March 18, 1895. An electric heater, consisting of a casing provided with a metal front piece, the upper portion of which is perforated and projects through a perforation in the riser of the car seat, a rabbeted portion extending behind and below said riser, a suitable support with openings therein to permit air to enter from below, a non-conductive lining at the back and top of said casing, a resistance placed therein, a car body provided with a seat, a riser placed beneath said seat and entirely closed except where said perforated plate is inserted, said seat arranged to provide for an air passage between the back of the seat and the outer wall of the car, substantially as described.



No. [illegible] Electric Arc Lamp.

611,000. ELECTRIC COUPLING; J. F. McElroy, of Albany, N. Y. App. filed Jan. 9, 1896. In an electric coupler, a block provided with two openings, a metallic plate secured within each of said openings, a metallic finger secured to each of said plates, a means for connecting said plates with a stationary core, a connecting cable provided with a handle containing a metallic cylinder adapted to fit upon said finger, substantially as described.

611,001. ELECTRIC HEATING SYSTEM; J. F. McElroy, of Albany, N. Y. App. filed July 6, 1896. A switch composed of a spindle, metallic contacts thereon, brushes adapted to rest on said metallic plates, a notched plate secured to one end of the switch, one surface of said plate irregular in form and indented at intervals, a plate mounted on said spindle, to which is hinged a latch adapted to engage in the indentations on said notched plate, a post projecting from said plate carrying said hinge, an auxiliary spindle, combination with a piston and suitable valve mechanism, substantially as described.



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611,012. ELECTRIC BATTERY; V. Jeanty, of Paris, France. App. filed Oct. 21, 1897. An electric battery, comprising a receiver, an electrode in said receiver, a non-conducting and impervious trough located in the receiver, said trough being closed at the bottom and open at its upper portion, and another electrode in the trough, the upper edge portion of the trough being at approximately the same level with the upper edge of the electrode in the receiver.

611,056. ELECTRIC RAILWAY CONSTRUCTION; W. Chapman and P. W. Davies, of Pittsburg, Pa. App. filed Nov. 23, 1897. A contact rail for electric railways of inverted-trough shape, in combination with a clamp having jaws for gripping the rail edges, a block provided with a socket for the supply conductor, a plastic bond between the block and the rail and a wedge between the block and the clamp.

611,087. CONTACT FINGER FOR CONTROLLERS OR ELECTRIC SWITCHES; T. V. Zweigbergk, of Cleveland, Ohio. App. filed Feb. 23, 1898. In a contact finger, the combination of a frame, a spring arm carried thereby, a contact knob carried by the spring arm and adapted to normally stand in position to be engaged by a controller segment, and a hook pivoted to the frame and adapted to hook the knob back out of the path of the controller segment, substantially as described.

611,088. GOVERNING, REVERSING AND BRAKING CONTROLLER; T. V. Zweigbergk, of Cleveland, Ohio. App. filed Feb. 23, 1898. The combination with an electric brake and a controller adapted to apply the brake, of an automatic switch inserted in the circuit to the electric brake, and adapted to increase the resistance to the current in that circuit as the strength of the current increases, substantially as described.

611,089. METHOD AND MEANS FOR CONTROLLING AND CUTTING OUT ELECTRIC MOTORS; T. V. Zweigbergk, of Cleveland, Ohio. App. filed April 29, 1898. The combination with a controller having a series of contact plates and fingers and a motor suitably connected with the fingers, of mechanism adapted to hold a certain contact finger out of the path of the plate, and thus cut out the motor, substantially as described.

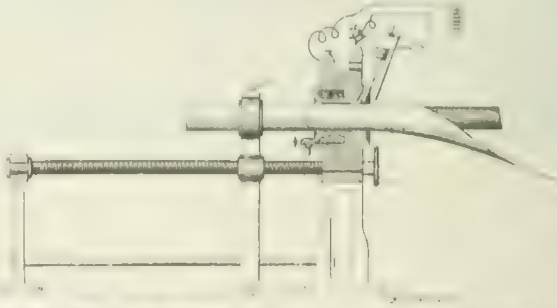
611,090. CONTROLLER; T. V. Zweigbergk, of Cleveland, Ohio. App. filed April 29, 1898. In a controller, in combination, a reversing cylinder, a reversing lever, a shaft for the latter independent of the reversing cylinder, a locking device adapted to lock said shaft to the reversing cylinder or to release the reversing cylinder and lock said shaft to a stationary member, substantially as described.

611,151. SYSTEM OF ELECTRICAL DISTRIBUTION; C. F. Scott, of Pittsburg, Pa. App. filed Oct. 22, 1897. A system of distribution for alternating currents, comprising two circuits carrying currents differing in phase and each embodying two main conductors and a neutral or balancing conductor, adapted to supply translating devices in multiple series, a fourth conductor for one of said circuits connected at one end to one of the main conductors of the other circuit, and a connection between the other main conductor of the last-named circuit and the balancing conductor of the four-wire circuit.

611,162. ELECTRIC ARC LAMP; E. S. Worsley, of London, England. App. filed March 15, 1898. An electric arc lamp provided with short circuiting devices, comprising in combination with the main coil of the lamp and its core, a piece or block of magnetizable material with which said core is adapted to come into contact and short circuit the carbons when their proper feeding is interrupted, and a spring adapted to tend to keep the core and block apart, substantially as described.

611,185. RHEOSTAT; C. H. Richardson and L. McMakin, Jr., of Philadelphia, Pa. App. filed Feb. 3, 1898. The combination, in a rheostat, of the case, the resistance track, the movable contact arm, the handle for turning said contact arm, provided with a dial plate, and the index supported in fixed relation to the rheostat case, substantially as described.

611,206. CIRCUIT INTERRUPTING DEVICE; D. M. Moore, of Newark, N. J. App. filed July 3, 1897. A break wheel of metal filled in between the contact surfaces with vitreous insulating material.



No. 611 2[illegible].—Method of and Means for Manufacturing Metal Tubing.

[illegible] ELECTRIC CONTROLLER; S. [illegible], of Twinsburg, Ohio. App. filed May 2, 1898. The combination in an electric controller of a pair of [illegible] two sets of fixed fingers [illegible] arranged to [illegible]

[illegible] METHOD OF AND MEANS FOR MANUFACTURING METAL TUBING; [illegible] of New York, N. Y. App. filed [illegible] The [illegible] which consists in progressively folding the web into a tube, with the meeting edges in abutment [illegible] progressively [illegible] welding temperature, whereby said edges [illegible] and [illegible] the said welded tube for finishing, substantially as described.

The Electrical World.

Vol. XXXII. NEW YORK, OCTOBER 8, 1898. No. 15.

PUBLISHED EVERY SATURDAY BY

THE W. J. JOHNSTON COMPANY,

9 Murray Street, New York.

Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York.

New England Office, 620 Atlantic Ave., Boston.

Western Office, 936 Monadnock Block, Chicago.

Philadelphia Office, 929 Chestnut Street.

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THE ELECTRICAL WORLD,

9 Murray Street, New York.

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SIMPLE METHODS OF MULTIPLE-RATE CHARGING.

The basis of rates charged for electrical energy by two large supply systems will be found on other pages of this paper. One, that of the Edison Electric Illuminating Company, of New York City, makes a sliding scale, according to the number of hours of average daily use of the equivalent of the total load wired up; that is, if the consumer has twenty 16-cp lamps connected, the total power consumption of which would be about one kilowatt, and takes current to an amount per day that would operate these lamps for one hour—that is, uses one kw hour per day—he is charged for this at the rate of 20 cents per kw hour. If he uses, however, two kw hours, the second is charged for at 15 cents; similarly, the third at 10 cents and the fourth and all above that at 5 cents. This gives a sliding scale from 20 cents per kw hour to about 5.1 cents in case the load is taken continuously.

The other system referred to above is the electricity department of the Corporation of Manchester, England. For current taken from this municipal plant a fixed charge amounting to about $2.10 per month is made per kilowatt capacity of the load wired up, whether the current is used or not; and for current used, as measured by the meter, a further charge is made of 3 cents per kw hour. Comparing this with the New York Edison rate, one hour's use per day of the equivalent of the load connected costs only 10 cents per kw hour instead of 20 cents as on the New York Edison, and this rate falls continuously with added use of the load connected, to about 3 cents for continuous use.

Comparing these methods with those generally advocated of late—namely, the use of the Wright-demand and two-rate meters—it is obvious that they do not distinguish between consumers who draw heavily at the time of the peak of the station and those who draw at some other time. Thus two consumers with the same number of lamps and with similar high peaks, one occurring in the late afternoon and the other in the forenoon, would be charged at the same rate, although one would be much more desirable than the other to the station. This disadvantage would not be remedied even by a Wright-demand meter, but would be by a two-rate meter system. It is obvious that sliding scales obtained in this way are closely similar to those obtained with the Wright-demand meter, the only difference being that in the one case the maximum demand is estimated from the load connected, while in the other case it is measured by an instrument. If the maximum demand were always proportional to the lamp capacity connected, the system would be a perfectly equitable one, but as between, for example, a consumer who sometimes uses all of his lamps and another who never uses more than half, the systems outlined above would not distinguish, while the Wright-demand meter would. With many companies it would be a very hard matter to estimate the lamp capacity wired up, and consumers with an insight into the system could readily obtain low rates by deceiving the inspectors into a belief that the load connected was lower than it should be properly estimated.

THE PROPER USE OF ELEVATED ROADS.

In a recent issue of "The Engineering News" the financial failures of the various roads in Chicago are noted, and it is concluded that the days of usefulness of the elevated road have ended with the substitution of electric traction for the horse car on surface railways, owing to the fact that this change has so improved surface traction as to annul the advantages which the elevateds formerly possessed over street-car lines. The financial difficulties of such roads in this country are so universal that there must be some common cause. Of the four proposed for Chicago, one has not been built; another is in the hands of a receiver; another is not paying dividends, and the fourth has recently gone into the hands of its rivals on the surface. The two in Brooklyn are both in receivers' hands and the one great and prosperous example in New York City is rapidly losing business, as the street railways paralleling it are equipped electrically. But the elevated still has its uses and is in certain instances finding them. With the improvement in surface traction and its great advantages for short rides the only hope for the elevated is in long-haul traffic, and to obtain this it must increase its speed, cut down its number of stations, run express trains and extend its lines to districts which cannot be reached by surface street roads without serious loss of time. One way to accomplish this is to run through trains to suburban districts over the roads of connecting trunk lines or over light railways with surface rights of way in the less populated districts. This is already being done in Brooklyn. The elevated road, however, makes itself most useful to the community in general when it is run in conjunction with the surface lines. Over the latter passengers can reach all points, either directly or by transfers, but satisfactory speed cannot be given for distances above two or three miles. By running elevated roads in connection with the surface lines with a suitable transfer system, or better, by running incline approaches whereby a through service can be given over the combined system with slow-speed distribution at terminals on the surface and high-speed transportation between terminals on the elevated, the ideal of the passenger is most nearly approached. Such a system is now planned for Boston.

SYNCHRONIZING ALTERNATORS.

There may be found on another page a short article by Mr. Edward P. Burch, describing, from his experience with the St. Anthony Falls power plant, the difficulties found in the paralleling of large alternators. These difficulties show again the need of some more accurate means of determining the relative speed and phase relation of machines before throwing them in multiple with each other. The ordinary "phasing" lamp gives only a rough indication of the difference in speed between the two machines, which is proportional to the rate of beats shown on the lamp, and a rough indication of the phase relation, which is indicated at any instant by the luminous intensity of the filament. There are no means of guessing which machine is running the faster. An ingenious indicator which does show this is one used in some German installations, consisting of three lamps triangularly mounted on the board and respectively connected with phasing transformers attached with the three sides of three-phase machines in such a way that, if the machine to be synchronized is running faster than [illegible] lamp to lamp around the triangle in one direction, while if the machine is running more slowly it travels in the other direction. [illegible]

A still more accurate indicator which has been publicly proposed, but never put into use, consists of a small alternating-current [illegible] of which machine was running the faster; the position of the indicator serving as an exact determination of the phase relation and its remaining stationary in the proper position giving the signal for the closing of the switches. Such an instrument would be applicable to machines of one or any number of phases.

The strains involved in jerking an alternator into synchronism with others, when its speed differs slightly from theirs, are enormous, owing to the brief time during which this must take place and the currents interchanged are correspondingly large. With 60-cycle machines, for example, thrown together when in proper phase relation, but differing from each other in speed by 1 per cent., the speed must equalize within one second's time or the machines will become to each other a mutual short circuit. This sudden acceleration or retardation of the heavy fly-wheels of direct-coupled machines introduces tremendous strains into the armatures, fields, shafts, etc.

The remedy proposed by Mr. Burch, which consists in throwing in a new machine without exciting its fields, is liable to involve a serious danger. The current choking action of such a machine is not alone due to self-induction, but the machine soon synchronizes itself, generating by armature reaction a magnetic flux in its field iron. This is as liable to be in a direction the reverse of that given by the exciting winding as in the same direction, and in the former case would take, as long as the machine continued running, heavy lagging currents to maintain the reversed magnetization.

TRANSFORMER REGULATION ON INDUCTIVE LOADS.

There may be found on another page a paper by Dr. Frederick Bedell, outlining a simple method of obtaining the drop between no load and full load of a transformer with non-inductive or inductive loads. For transformers in ordinary lighting service the drop is so nearly equal to the product of the current and the resistance that this may be taken for all practical purposes as the regulation, at least in all transformer testing by station engineers. For transformers on power circuits, however, the case is different, and with a resistance drop of 2 per cent. the real fall of voltage on full load may be double that amount or even more, so that the means outlined in the article referred to are of value to those using transformers with such loads.

The Use of Electricity in the "Argonaut."

The submarine wrecking craft styled the "Argonaut," and designed by Mr. Simon Lake, of Baltimore, has recently made a trip to New York City. Contrary to previous published descriptions, electric power is not used for driving the craft when below the surface, as in the Holland submarine boats. The "Argonaut," which is built with wheels for running as a wheeled vehicle on the bed of the ocean, is driven at all times by a gasoline engine of about 30 rated horse-power. When below the surface the air supply and exhaust of this engine reach the atmosphere through standpipes or through flexible hose attached to a float. The craft is, however, electrically lighted, being fitted with a small Riker dynamo driven by friction from the fly-wheel of the main engine. A small storage battery supplies low candle-power lamps when the dynamo is not running. With the generator running there is sufficient capacity for an arc light fitted with a projection reflector shining through a dead light in the bow of the vessel, and also for a high candle-power incandescent lamp mounted in a water-tight projecting apparatus, which a diver outside the craft can carry in his hand. The boat is also fitted with a telephone system, one instrument being mounted in the engine room, one in the diver's room—which is isolated from the rest of the craft by an air lock and arranged for compressed air supply—and one in the diver's [illegible]

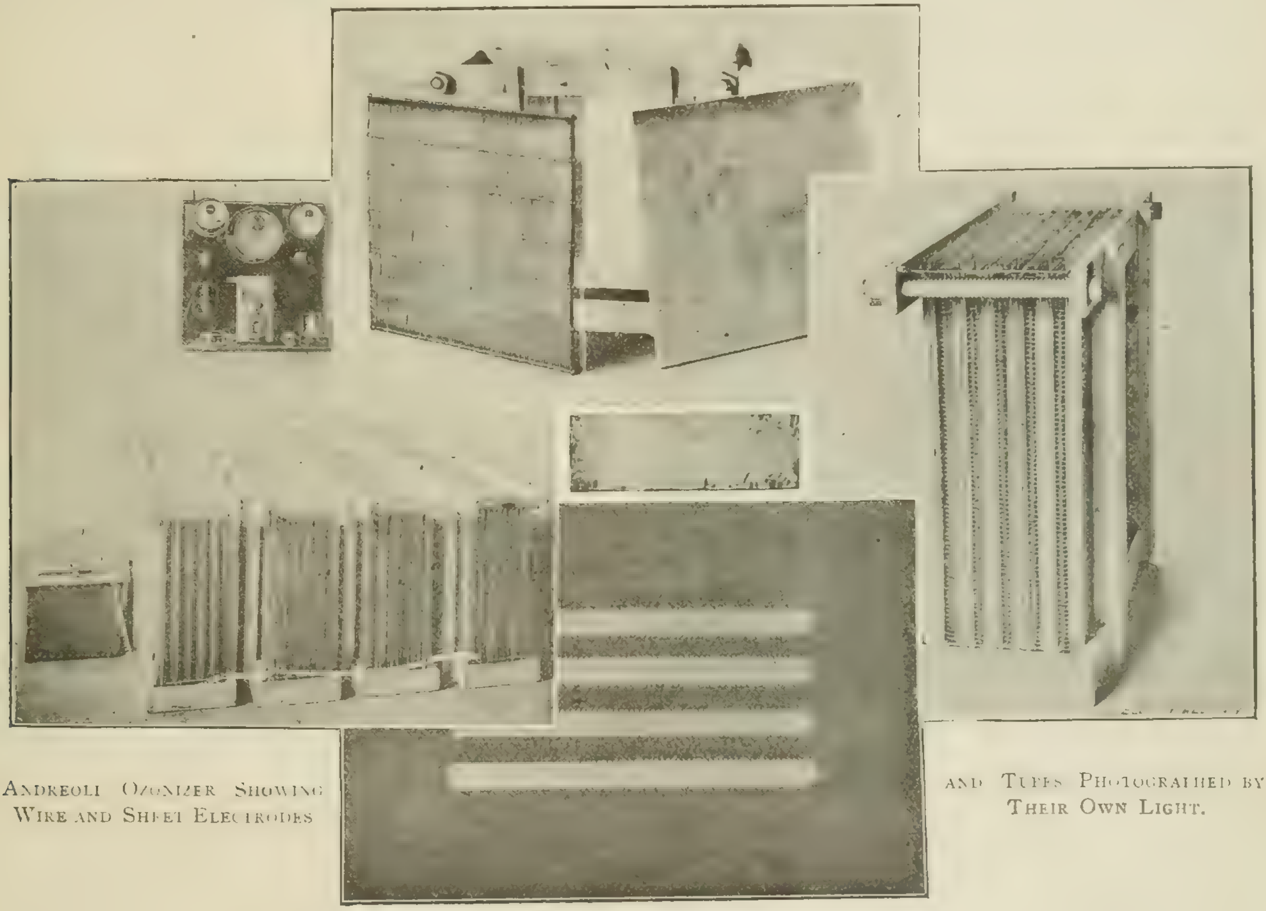
The Production of Ozone.*

BY JOHN B. C. KERSHAW.

During the last year a considerable number of new investigations relating to the production and utilization of ozone have been published, and in the present article the writer proposes to give a brief description of each of the different forms of ozonizer now before the public, and then to examine the financial aspects of the use of ozone for the various purposes that have been proposed.

The latest form of ozonizer patented by Andreoli is of the "open" type—that is, the ozonized air is in direct contact with the metal forming the electrodes, and only one dielectric surface separates the latter. These electrodes are now made of aluminum, and may be either both of the "grid" design, or one may be a plain surface of aluminum, while the other is of the "grid" variety.

The plain aluminum electrodes are formed by covering a wooden board of the size required with thin aluminum sheet; while the "grid" electrodes are formed by stretching a large number of serrated aluminum wires across a wooden frame having crossbars at intervals to keep these wires in position. (See illustrations.) The two electrodes and the sheet of glass acting as dielectric are clamped together in a wooden carrier, and any number of these units can be built up to form an ozonizer of the desired capacity. Alternating currents of high voltage are used for working these ozonizers; the 8-unit ozonizer (one-half kilowatt) being worked with a current of 6 amperes at 85 volts in the primary circuit, and 0.13 ampere at 2800 volts in the secondary circuit. This form of ozonizer is said to yield 125 grams ozone per kw hour, a great advance upon the 40—64 grams per kw hour which was obtained with the earlier form. No cooling is required, but the air used must be perfectly dry and free from dust. The Electric Ozone Syndicate is manufacturing these ozonizers in all sizes for industrial use, and they are said, by the makers, to be the simplest and most effective yet designed.



Andreoli Ozonizer Showing Wire and Sheet Electrodes and Tubes Photographed by Their Own Light.

Otto's ozonizer is made in two forms, oblong and circular. Each element is composed of a thin sheet of metal laid upon a sheet of glass, or fixed between two glass plates. In the oblong form the air enters at one end and travels in a zigzag manner between the several elements forming the ozonizer; in the circular form the air enters at the centre of the discs and passes away at the circumference. The alternate elements in each case are connected in parallel to the positive and negative poles of the transformer. Otto's chief discovery has been that of the fact that the output of ozone is dependent on the periodicity of the alternating current used to work the ozonizer. The output per electrical hp hour he states is at a maximum when a periodicity of 80 per second is used. Working under these conditions he has obtained a yield of 155 grams ozone per electrical hp hour.

The Yarnold ozonizer consists of a flat-shaped box containing a number of horizontal plates of glass, coated on one side with gold leaf. These metallic films are connected alternately in parallel to the two poles of the transformer. The air or oxygen is passed into the space between two neighboring plates, and does not come into contact with the metallic film. An alternating current of about 15,000 volts potential and 83 periodicity is used in working this ozonizer, and no cooling is required. Messrs. Yarnold & Rosenblum state that the yield of ozone with this form of ozonizer is 175 grams per electrical hp hour, a yield higher than any yet published.

The Siemens & Halske ozonizer consists of a number of tubes placed together to form a "tube-trellis." Each separate unit is made up of an inner metal tube and an outer glass tube covered on its external surface with tin-foil. Water is led through the inner tube in order to keep down the temperature, and the air to be ozonized is passed through the annular space between the metal and glass tubes. The output of this form of ozonizer is stated by Dr. Frölich to be 20 grams ozone per electrical hp hour; and use has been made of it at Grieffenburg in Germany since 1894 in connection with bleaching operations.

UTILIZATION OF OZONE.

Numberless uses have been suggested for the ozonized air produced in the manner described above; of these the following have all received experimental trial with more or less success:

1. Aging wood for musical instruments.
2. Maturing wines and spirits.
3. Sweetening foul beer casks.
4. Drying and thickening oils.
5. Bleaching waxes and fats.
6. Seasoning linoleum.
7. Bleaching fabrics and yarns.
8. Sterilizing drinking water.

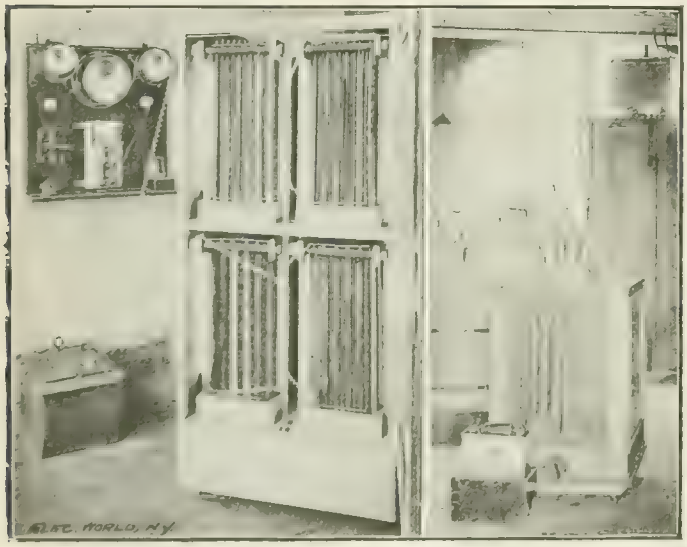
---

*Abstracted from the London "Electrical Review."

As regards some of the suggested applications the results desired can only be obtained by the use of ozone. In many cases, however, other oxidizing agents are applicable, and it thus becomes necessary to take into account the relative costs of these before deciding in favor of ozone. Designers of apparatus for the production of ozone have too often ignored this question of relative cost and been disposed to assume that if ozone effected the oxidizing or bleaching result desired, its adoption for the purpose upon a commercial scale was certain, in spite of the fact that some other agent was attaining the same end at a lower cost.

The three oxidizing agents most commonly employed on a large scale are bleaching powder, manganate of soda and bichromate of soda.

The figures of cost prove conclusively that bleaching powder is the most economical oxidizing agent yet produced, and for all purposes in which the desired result can be attained satisfactorily by the use of this form of chlorine it is absurd to speak of ozone supplanting it. The industrial applications of ozone will therefore be restricted to those processes or operations for which at present the two sodium salts or atmospheric air are the customary oxidizing agents. As regards cost ozone occupies a fairly favorable position; while its ease of application and non-production of solid or liquid by-products give it a great advantage as compared with the troublesome acid mixtures that have to be handled in the case of sodium bichromate and of sodium manganate.



A[illegible] Electrode [illegible] Case. O[illegible]ter and Sterilizing Tank.

There is, therefore, every reason to expect that the use of ozone in the manufacture of oils, fats, and organic chemicals will rapidly [illegible].

Turning now to those manufacturing or other processes in which at present the oxygen of atmospheric air is the customary oxidizing agent, the advantages of ozone are not so striking. The agent in each case is a gas, and produces no liquid or solid by-products. In the one case it costs nothing; in the other 61½d. per kilo. of active oxygen. To balance this expenditure we have only a decrease in the time required to produce the desired result.

There is also the further danger that ozone may prove too active an oxidizing agent, and in the case of spirits, wines, etc., may oxi- [illegible] ents of the liquid. The future of ozone in respect to its application [illegible] therefore, in the writer's opinion, less certain; and further experiments may prove that the older oxidation processes, though much slower, are, nevertheless, the more economical.

Transmission Plant in Victoria, British Columbia.

[illegible]

Transformer Regulation.

BY DR. FREDERICK BEDELL.

In this paper it is proposed to give a simple working formula for determining the regulation drop in lighting and power transformers:

The difficulty—it might almost be said the impossibility—in directly measuring the drop in voltage at the secondary terminals of a transformer when delivering current has again been emphasized by Mr. A. R. Everest in a recent article[1] in THE ELECTRICAL WORLD. In this article Mr. Everest gives a method for calculating this "regulation drop," and compares it with a similar method employed by the writer and described[2] in THE ELECTRICAL WORLD a year ago.

In each of these articles the method employed is elaborately developed, the discussion being thorough and possessing considerable scientific value. Mr. Everest's article is particularly clear and exact. His method, however, would be exceedingly laborious in practice. This is likewise true of the present writer's method, as published a year ago. In practice, however, it has been reduced to the following useful working form, so simple that it should always be included in transformer tests:

METHOD FOR LIGHTING TRANSFORMERS.

The secondary load in such transformers is non-inductive.

Let x be the per cent. reactance drop. (For example, $x = 5$; but not $x = .05$.) The square of the reactance drop is found by subtracting the square of the resistance drop from the square of the impedance drop, measured by methods described in the articles referred to above.

Let i_μ be the per cent. exciting current, magnetizing component. The determination of i_μ will be referred to later.

The total per cent. regulation drop is found by adding to the per cent. resistance drop the effective reactance drop, computed by the following formula:

$$\text{Effective reactance drop} = \frac{x^2 + 2x\,i_\mu}{200}.$$

EXAMPLE FOR LIGHTING TRANSFORMER.

Let the reactance drop be 5 per cent.; $x = 5$.

Let the magnetizing component of the exciting current be 4 per cent.; $i_\mu = 4$.

Let resistance drop = 2 per cent.

$$\text{Regulation} = 2 + \frac{5^2 + 2 \times 5 \times 4}{200} = 2 + 0.325.$$

Regulation = 2.325 per cent.

Here the resistance drop is 2 per cent. and the effective reactance drop is 0.325 per cent. Mr. Everest works this same example at length by his method and obtains 2.28 per cent. as the regulation drop. The difference between the two results is of no significance, being one-fiftieth of a volt in a fifty-volt secondary circuit.

METHOD FOR POWER TRANSFORMERS.

Here the load is inductive. The power factor is the cosine of the angle of lag of the load. Let us use the term "reactive factor" to designate the sine of the angle of lag. For any given power factor we have the total regulation drop equal to the reactance drop multiplied by the reactive factor, plus the resistance drop multiplied by the power factor.

If c is per cent. resistance drop,

$$\text{Regulation} = c \cos \theta + x \sin \theta.$$

EXAMPLE FOR POWER TRANSFORMER.

In the same transformer as above:

Reactance drop = 5 per cent.; $x = 5$.

Resistance drop = 2 per cent.; $c = 2$.

What is regulation on inductive load with power factor .5?

Reactive factor [illegible] = 0.866.

Regulation = [illegible] 0.866 [illegible] 1 + 4.33 = 5.33 per cent.

[illegible] FOR LIGHTING TRANSFORMER.

Let I_o be the primary open circuit current. This may be resolved into two components, namely, I_h and I_μ.

I_h is an energy component to supply the core losses and is in phase with the e. m. f. It is equal to the core loss (in watts) divided by the primary e. m. f. (in volts) and in this way it is determined.

---

[1] [illegible]

[2] [illegible], The Electrical World, August 14, 1897.

I_μ is the magnetizing component at right angles to the e. m. f. It is computed from the formula

$$I_\mu = \sqrt{I_o^2 - I_h^2}.$$

The diagram of these currents on open circuit is shown in Fig. 1.

When current is taken from the secondary the diagram of primary current is as shown in Fig. 2. Here I_1 is the total primary current; I_p is the portion useful for transformation of energy to the secondary. It is equal to the secondary current multiplied by the ratio of transformation. I_o, I_h and I_μ are the same as above.

If we express these currents in per cent. instead of amperes, and represent them by small letters, we have

$$i_o = \text{per cent. open-circuit current} = 100 \times \frac{I_o}{I_1}.$$

$$i_h = \text{per cent. energy component} = 100 \times \frac{I_h}{I_1}.$$

$$i_\mu = \text{per cent. magnetizing component} = 100 \times \frac{I_\mu}{I_1} = 100 \sin \theta.$$

In Figs. 1 and 2 E represents the counter e. m. f.

The primary e. m. f. E_1 (see Fig. 3) is equal to the counter e. m. f. E, plus the primary resistance drop A in the direction of I_1, plus reactance drop x at right angles to I_1.

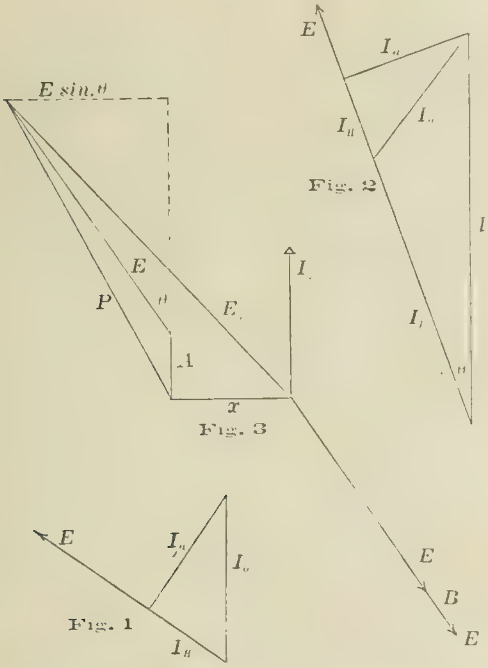


Fig. 1.—The Two Components of the Primary Currents of a Transformer on Open Circuit. Fig. 2.—The Two Components of the Primary Current of a Loaded Transformer. Fig. 3.—Regulation Drop in Loaded Transformer. A Is Primary Resistance Drop, x Is Reactance Drop, B Is Secondary Resistance Drop.

The secondary e. m. f. E_2 is equal to the counter e. m. f. E, minus the secondary resistance drop B. (The line E appears twice in Fig. 3, once as part of the primary e. m. f. and once in the secondary.)

In lighting transformers the secondary resistance drop is all effective. The primary resistance drop is practically all effective and may be so taken, for the power factor of a lighting transformer on full load is practically unity.

The effective reactance drop is the difference between E_1 and P in Fig. 3.

$$P = \sqrt{E^2 \sin^2 \theta + E_1^2 - (E \sin \theta + x)^2} = \sqrt{E_1^2 - x^2 - 2\,x\,E \sin \theta}.$$

Putting 100 for E_1 (to express in per cent.) and i_μ for $E \sin \theta$.

Effective reactance drop* $= E_1 - P$

$$= 100 - \sqrt{10{,}000 - x^2 - 2\,x\,i_\mu} = \frac{x^2 + 2\,x\,i_\mu}{200}.$$

This last is an approximation allowable because x and i_μ are small compared with 10,000. It introduces no appreciable error when dealing with commercial transformers.

FOR POWER TRANSFORMERS.

For power transformers this becomes approximately

$$\text{effective re~~sis~~actance drop} = \frac{x^2 + 2\,x\,i_\mu + 200\,x \sin \theta}{200}.$$

The x^2 and the term with i_μ may be neglected as small as compared with 200 x sin θ. (When the load is almost non-inductive and sin θ is small these terms may be retained.) We have accordingly:

Effective reactance drop $= x \sin \theta$, where sin θ may be taken as the reactive factor of the load, the power factor being cos θ.

The effective resistance drop (both primary and secondary) is very nearly equal to the total resistance drop multiplied by the power factor. Hence: Regulation drop $= x \sin \theta + c \cos \theta$.

This formula has not such a degree of accuracy as the one for lighting transformers, but is useful for practical purposes.

---

*This formula was first given by the writer in a paper read before the Cornell Electrical Society, May 4, 1897, and published (without proof) in the "Sibley Journal of Engineering," June, 1898.

Regulations Affecting the Supply of Electricity in Manchester.

The rules and regulations to be followed in the construction and installation of wiring and fixtures for the consumption of electricity in Manchester, England, are published in a convenient handbook, a copy of which has been kindly forwarded by Mr. C. H. Wordingham, the electrical engineer of the corporation. It may be remembered that Manchester operates its own municipal lighting plant, the supply being entirely of continuous current, the distribution system being of five wires in the central districts with 400 volts between the outers and three wires in the outlying districts with the same voltage between outers. Some of the regulations which differ from those in force in America are noticed below. The required division of the load is rather interesting, any demand up to 2½ kilowatts (except for motors) being supplied from one pair of terminals. In the five-wire districts the loads between 2½ and 5 kilowatts must be divided into two circuits of approximately equal load and above that into four divisions. Motors up to a capacity of three-quarters kilowatt will be supplied at 100 volts; up to 2½ kilowatts at 200 volts, and above 2½ kilowatts at 400 volts. The usual regulations as to the nature of insulation and installation of wiring are given, no fittings such as switches, fuses, rosettes, sockets, etc., being allowed except of styles and makes which have been tested by the city electrical engineer. With regard to conductors they must all be of tinned copper and must be covered first with a layer of pure rubber, then with a layer of vulcanized rubber of approved thickness and the whole must be protected with a layer of braiding or taping rendered impervious to moisture. Either interior conduit or moulding work is allowable, the only specification as to the material of the conduits being that it must be incombustible. Porcelain cleat work is allowable in fireproof buildings with conductors "out of reach." With regard to motors, it is specified that the motor frame must be permanently connected to earth by a copper conductor having a cross section equal to that of either of the two main conductors up to ten square millimetres cross-sectional area. A similar requirement applies to all electric heating and cooking apparatus. In the specifications of enclosed motors arrangements are called for whereby the interior may be ventilated by means of air drawn from the outside of the building. The rates and methods of charging are also of interest. The consumer is given his option between a straight meter rate of the equivalent of 10 cents per kw hour or a fixed charge of about $8.50 per quarter per kilowatt of capacity wired in addition to a charge of 3 cents per kw hour of current metered. The rates for motors are the same except where the consumption is not less than 4 horse-power for forty-eight hours per week, when the fixed chaarge is omitted, a simple charge of 3 cents per kw hour being made on the metered consumption. Over and above these charges a rental is charged on the meters, varying from 85 cents per quarter for a 5-ampere meter to $1.60 for a 150-ampere meter. The corporation reserves the right to demand a money deposit sufficient to cover the estimated cost of one winter quarter's consumption of energy, interest being paid at the rate of 4 per cent. per annum on such deposits exceeding $2.50 for every six months during which the deposit is kept.

A Comparison Between Charging a Secondary Cell at Constant Potential and at Constant Current.*

BY A. V. ALLEN AND J. M. DONALDSON.

Till a short time ago, it has been the custom to charge secondary cells with a constant, or approximately constant, current, but lately the experiment has been tried of charging at constant potential, thereby reducing considerably the time needed for charging. The saving of time thus effected is often of very great importance, but in other particulars the method may be inferior to the more usual one—namely, that of charging at constant current. It was in order to compare the efficiencies (more especially) obtained with the two methods that the following series of tests were carried out in the laboratories of the Central Technical College, South Kensington.

The same cell was tested by the two methods, in order to afford a just comparison. It was charged, in the first series of tests, at constant potential difference, and discharged at constant current; in the second series it was charged at constant current and discharged at the same constant current as in the first series.

The cell made use of was of the Tudor type, known as No. 11 L. A., and had five plates, two positive and three negative, the former being unpasted and the latter pasted.

Its capacity was listed thus				
	Capacity (amp. hrs.)	140	120	108
	Discharge current (amps.)	14	24	36
	Charging currents (amps.)	20	20	20

Its outside dimensions were—length, 9½ inches; width, 5½ inches; height, 18 inches.

The plates were kept about half an inch apart by glass tubes.

It must be mentioned that the cell had been subjected to a number of charges at constant potential difference before the present tests were carried out.

In using each method the cell was repeatedly charged and discharged without intermission until it had arrived at a "steady state"—that is, until precisely the same results were obtained in successive cycles. This was shown by the charge and discharge curves for successive cycles becoming coincident.

On February 24, 1898, after a preliminary discharge the cell was charged at a constant potential difference of 2.508 volts, and charging was continued until the current had fallen to 10 amperes. The cell was then discharged, at a constant current of 36 amperes, until the potential difference had fallen to 1.815 volts. The interval between charge and discharge was usually only one minute and seldom exceeded two minutes, being sometimes as little as half a minute. Any recuperative effects were thus practically eliminated. In all fifty charges and discharges within the same limits as the above were carried out, the fifty-first charge being given on March 4, and the cell left charged.

On March 7, 1898, after a preliminary discharge, charging at constant current was begun. The charging current was kept constant at 20 amperes, and charging was continued until the potential difference at the terminals of the cell had risen to 2.508 volts. This point was decided upon chiefly because the rise of potential difference was here most rapid and so the precise moment for stopping the charge could be most accurately obtained. Discharge took place with precisely the same limitations as after a constant potential difference charge—namely, the current was kept constant at 36 amperes and discharge was continued until the potential difference had fallen to 1.815 volts.

However, as the watt hours that could be put into the cell when charging at constant current were only about 137, as compared with 230 put in by a constant potential difference charge, it was decided to charge still further. Therefore in the twenty-third and all following charges the potential difference was let rise to 2.58 [illegible] that obtained by the constant potential difference method. It was [illegible]

This small capacity caused us to surmise that the large currents [illegible] an interval of twenty-five minutes, the cell having been discharged [illegible] show that the capacity obtainable by this method had not appreciably diminished, and, after seven charges and discha-ges, a final charge was given, and the experiments were brought to an end on March 18, 1898.

The cell at the end of the tests showed no outward signs of deterioration. The plates were quite straight and the amount of sediment at the bottom of the cell had not notably increased.

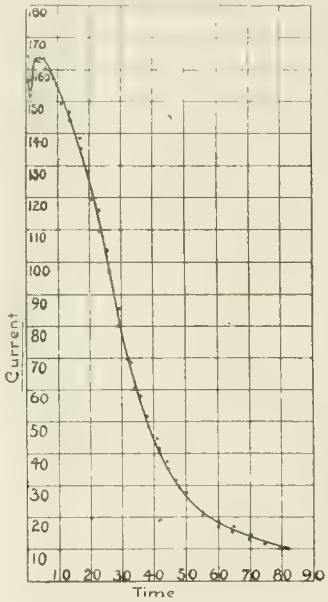


FIG. 1.

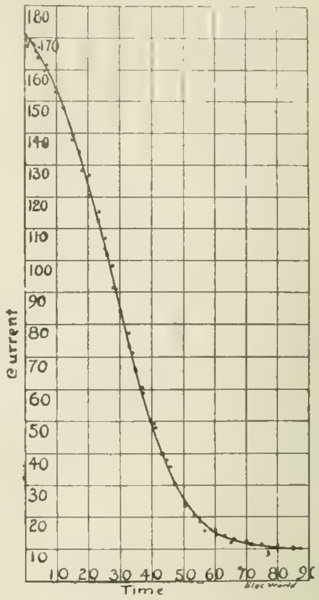


FIG. 2.

CHARGING AT CONSTANT POTENTIAL.

After the first twelve charges and discharges of the first series of tests the cell seemed to have settled down into a more or less steady state, but the efficiency varied from test to test in a somewhat unsteady way. This was, no doubt, partly due to the difficulty in determining the exact minute of the discharge when the potential difference had fallen to 1.815 volts. An error of a minute is quite easily made, and when discharge takes place at 36 amperes this means a mistake of 0.6 ampere-hour in the capacity. Hence, if the discharge is stopped one minute too soon, the efficiency for that test will be lower, and for the next higher than what it really should have been.

Fig. 1 shows the curves connecting current and time for charges 44 and 45 of the first series, and Fig. 2 the same curves for charges 6 and 7 of the second series of constant potential difference tests. It will be seen that the two sets of points lie practically on the one curve, showing that the cell had attained to a steady state.

The results of tests 37-46 (inclusive) of the first series were averaged to get the mean efficiency, and the results of tests 6 and 7 of the second series were also averaged. The results of tests 13-49 of the first series gave an average efficiency very nearly the same as the former, and all the three sets of efficiencies and capacities are set forth below:

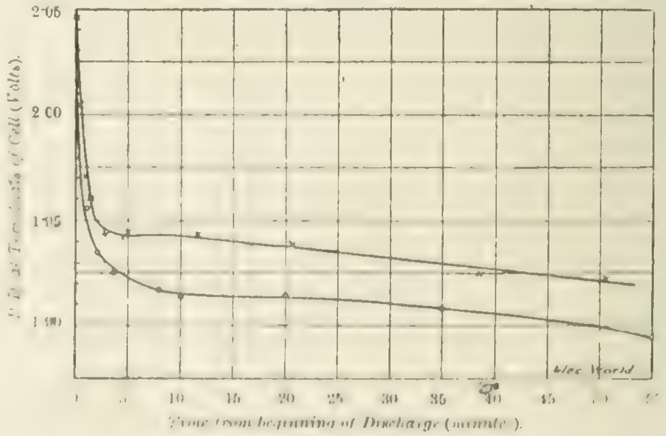


FIG. 3.

Tests.	[illegible]	Watt hours put in.	Amp. hrs. taken out.	Watt hrs. taken out.	Quantity efficiency. Per cent.	Energy efficiency. Per cent.
First series 37-46	91.50	130.4	86.07	163.5	93.7	71.00
First series 13-49	91.67	129.7	85.00	163.2	93.48	70.76
Second series 6-7	92.6	[illegible]	84.2	161.0	91.01	68.52

[illegible]

"Gasing" (by which is meant evolution of hydrogen bubbles at the negative plate) was found to occur when the rapid fall of current had ended—that is, when the current and time curve had begun to bend round so as to become nearly asymptotic to the axis of time. The current at this point is about 20 amperes, and it occurs when about two-thirds of the charging time has elapsed.

In the last charge it was noticed that, quite at the beginning, minute bubbles of gas (presumably oxygen) were freely liberated at the surface of the positive plates. This action became very small at the end of the charge, and was at no time at all comparable with the evolution of hydrogen.

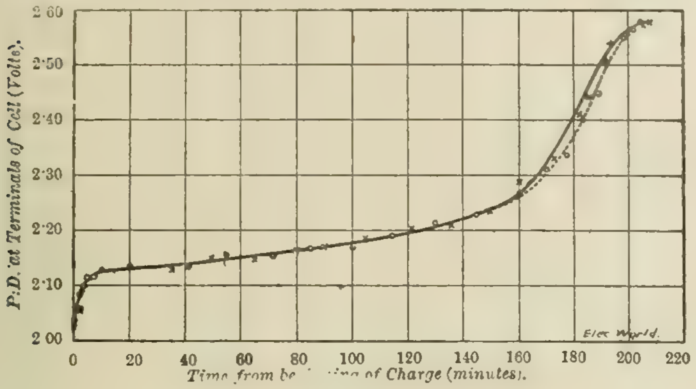


FIG. 4.

The way in which the current falls as charging proceeds may be seen in Figs. 1 and 2. Neglecting, for a moment, a curious initial feature of the curve, it may be seen that the current at first remains for about five minutes at a high value and then falls at a very rapid rate till the charging time has about half elapsed. After this the fall in current is much more gradual, and the curve shows a tendency to become asymptotic to the axis of time.

On most occasions it was noticed that the current rose from its initial value before beginning to fall, but it was not until the latter part of the test that it was found that the current first fell, and then rose again to a maximum before the rapid fall started. Unless frequent readings are taken it is easy to miss this point.

It was thought that this fall might be due to the evolution of an enormous quantity of hydrogen, more than was needed for the reduction of the lead sulphate, and that this increased the resistance of the cell or introduced a high back e. m. f. When the surplus gas had been taken up this resistance or e. m. f. would fall, and the current would, of course, rise, but would fall again as the e. m. f. of the cell increased, as charging was continued.

To test this theory, during charge 50, first series, air was blown into the cell through five tubes; but no difference in the curve was noticed, the jets of air having probably been too coarse to expel the hydrogen, this latter being the object of the operation.

There is a notable difference between the shapes of the discharge curves after a charge at constant potential difference and after a charge at constant current. In Fig. 3 are shown, side by side, discharge curves as given by the two systems. After a constant potential difference charge the initial fall of potential difference during discharge is all over in five minutes, and the potential difference remains nearly constant for some time after. But after a constant-current charge the initial fall of potential difference is not so abrupt, and extends over nearly ten minutes, and after this drop the potential difference falls continuously without a level portion.

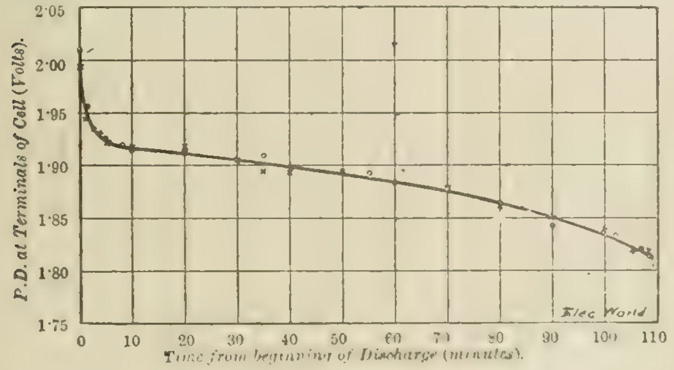


FIG. 5.

CHARGING AT CONSTANT CURRENT.

As mentioned before, charging was at first carried out at 20 amperes, and was continued until the potential difference at the cell terminals had reached 2.508 volts. This gave such a very low capacity that it was decided to charge to a still higher potential difference. The range of discharge it was not thought advisable to alter, as it had given satisfactory results in the constant potential difference tests. Charging, therefore, was carried out until the potential difference had reached 2.58 volts. This had the effect of increasing by about 10 per cent. the energy that would be taken from the cell, but even this was comparatively low. It did not seem probable that charging still further would have increased the "useful capacity," as "gasing," at a potential difference of 2.58 volts, was considerable, and the curve connecting potential difference and time from the beginning of the charge was turning over and becoming nearly horizontal, showing that the back e. m. f. of the cell was nearly constant. The increased capacity after charge 23 (when the range of charging was altered) lasted only until the end of charge 28, when it fell. But it recovered its old value at experiment 40, and remained fairly constant thereafter.

It was evident from the curves of charge and discharge that the energies put into and taken out of the cell had become practically constant during the last three or four experiments. Figs. 4 and 5 show charge and discharge curves for experiments 44 and 45, and the mean results of these two were taken as representative working values. They are given below:

Ampere hours put in.	Watt hours put in.	Ampere hours taken out.	Watt hours taken out.	Quantity efficiency. Per cent.	Energy efficiency. Per cent.
68.35	152.1	65.25	123.1	95.4	80.95

Taking the ratio of the total energy put in to the total energy taken out, from experiment 23 to experiment 45, we get the "average efficiencies" given below:

Average quantity efficiency, 95.08 per cent.
" energy " 81.02 "

COMPARISON OF THE TWO METHODS.

The physical characteristics of the two methods of charging have already been compared, and it now remains to contrast what may be called the "commercial" results. For the same cell, charged by two methods, the chief points we have to consider, in order to get a fair estimate as to relative merits of the systems, are:

(1) The discharge capacity, or the energy that can be got out of the cell.

(2) The time needed for charging.

(3) The storage efficiency, best taken as the ratio of the watt hours taken from the cell to the watt hours given to the cell.

(4) The constancy of the potential difference during discharge.

(5) The life of the cell.

The first three matters are best compared in the table given below:

Method of charging	Time of charging. Min.	Ampere hours taken out.	Watt hours taken out.	Quantity efficiency. Per cent.	Energy efficiency. Per. cent.
Constant current	206	65.25	123	95.5	81.0
Constant P. D........	82	86.0	103	93.5	70.5

From this it is seen that by charging at constant potential difference the time of charging is less than half that required to charge at constant current. The capacity obtained in a constant potential difference charge is about 30 per cent. greater, the energy efficiency being, however, 10 per cent. less than that from a constant current charge. This loss in efficiency is due, in all probability, to the excessive heating caused by the large initial charging currents.

With regard to article (4) it has already been pointed out that the discharge after a constant potential difference charge takes place at a much steadier potential difference than is the case in a discharge after a constant current charge.

Finally, with regard to the life of the cell, it remains to be seen whether or no constant potential difference charging will injure the cell. A long-life experiment on some cells, charging by the constant potential difference method, is needed to make this clear. All that we are in a position to say is that, after fifty charges at constant potential difference, the cell had not been noticeably injured.

The conclusion to which our experiments have led us is that charging at constant potential difference affords a very speedy method, and enables one to store more energy in the cell than if a constant current charge were employed. After a constant potential difference charge the potential difference remains more nearly steady than after a constant current charge, but one loses somewhat in efficiency by the former method.

The Photometry of the Inclosed Alternating Arc.*

BY CHARLES P. MATTHEWS, W. H. THOMPSON AND J. E. HILBISH.

Arc light photometry, in so far as it involves the mere determination of luminous intensity, yields unsatisfactory results for three chief reasons: The first of these is the marked difference in quality between the light of the arc and that of any of the ordinary standards. The photometrist realizes the general unsatisfactory character of the existing standards for the study of sources of a quality similar to that of gas light. Nevertheless, he is vastly better off, in this respect, than he is in the matter of a standard of suitable quality and intensity for arc light measurement. The eye estimates accurately an equality of brightness in two surfaces only when those surfaces are of the same tint. Moreover, with a color difference the judgment of an equality differs with different observers. It should be said, however, that the difficulty arising from difference of color is less troublesome in the case of the inclosed arc than in the case of its progenitor, the open arc. The inner, opalescent globe absorbs the rays of short wave-length in greatest proportion, a fact which brings the color of the arc nearer that of the standard. When an outer globe of milky glass is used—the standard being a glow lamp maintained at, or above, its normal voltage—there is no annoyance from color difference.

The second obstacle to careful measurement is to be found in the variability of the quantity to be measured. These variations are largely due to the wandering condition of the arc—a peculiarity that is especially noticeable in the open alternating arc, and in both types of the inclosed arc. Indeed, it is to this feature of the inclosed arc that the flat-ended carbons are due. The change in luminous intensity corresponding to a shifting in the position of the arc from one side of the carbons to the other side is enormous. An attempt to get at the intensity of such a source by a few readings might easily lead to results discordant by 100 per cent. or more. The only hope of securing a result that will show the mean intensity of the arc is in taking a large number of settings, distributed as to time with some degree of uniformity. To accomplish this it would seem desirable to do away with the considerable and variable interval of time used in the ordinary process in reading the bar. [illegible] by the use of a mechanical de- [illegible] made by means of a drum immediately below the photometer bar. This permits the [illegible] on the photometer disc, so that all the major fluctuations may be readily followed and recorded, and this without the visual fatigue resulting from intermittent [illegible] from the photometric screen. The act of depressing a rod attached to the carriage makes a permanent record on the paper surrounding the drum, and at the same time advances the [illegible] so that the record may be subsequently identified.

[illegible]

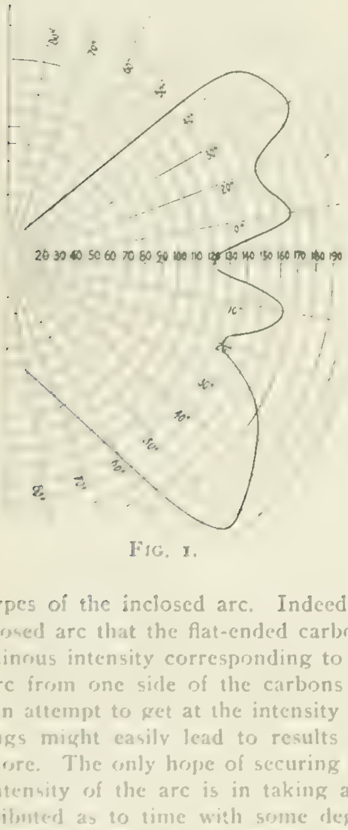


FIG. 1.

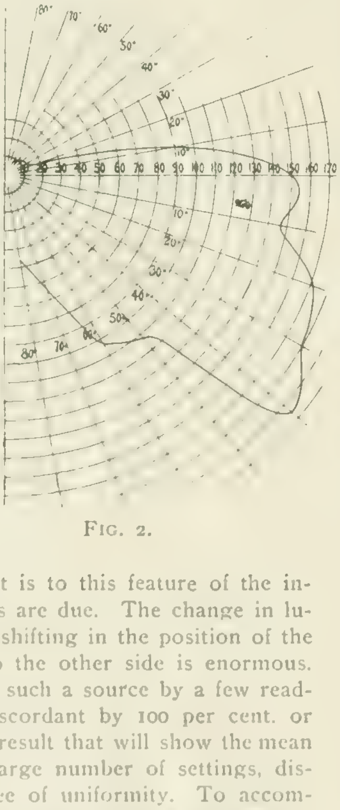


FIG. 2.

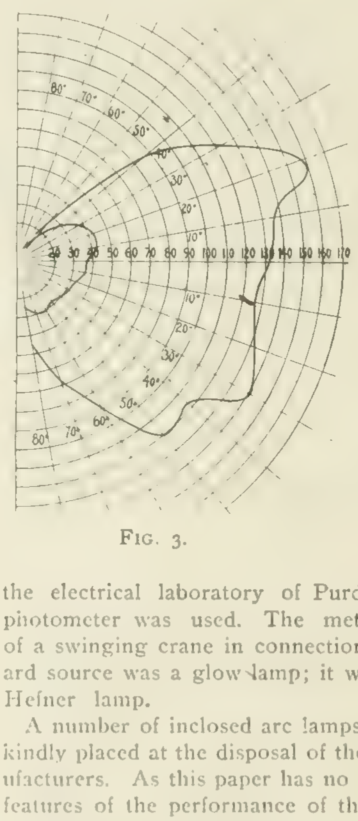


FIG. 3.

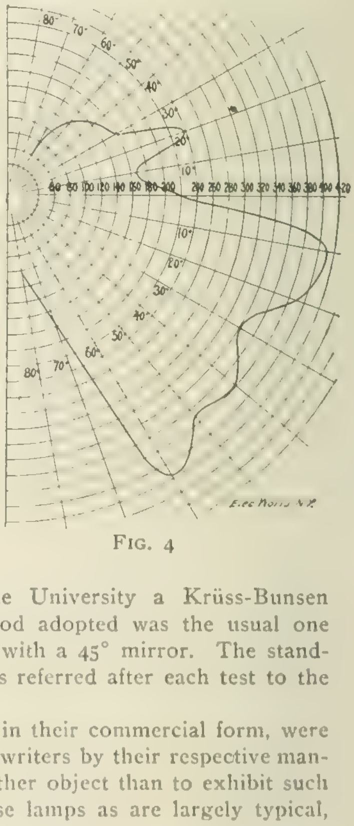


FIG. 4

"candle power" as a measure of worth in illuminants. For the sake of clearness, let us first consider what the term means. A 16-cp lamp, for example, is one that produces at a distance of four units the same illumination that one candle produces at one unit. That is, if two similar surfaces be illuminated separately by these two sources, at these distances, and if they be viewed in juxtaposition from the same direction, they appear equally bright. This is, in fact, what the photometer shows, and is really all that can be affirmed with a result of the comparison. Having established a distance ratio of 4 : 1, the observer applies the law of inverse square to calculate an intensity ratio of 16 : 1. This intensity ratio is numerically equal to the illumination ratio on two surfaces at unit distance, but it is important to note that an observer would be quite unable to assign a numerical value to the relative illumination of these surfaces. In other words, the optical stimulus varies as the inverse square, but, by Fechner's law, the sensation varies as the logarithm of the stimulus—a fact of which we cannot take direct cognizance. Thus the intensity or "candle-power" ratio of two sources is a derived quantity, of indirect significance, whose chief value is to be found in the fact that it enables one to calculate an indefinite number of pairs of distances, at each of which will be found an equality of illumination. If two sources be compared by some method which takes account of their quality and which gives as a result the ratio of their total luminosities—determined, say, by the relative value of their component rays in distinguishing characters—something quite different from their "candle-power" ratio may be obtained.

For the photometric measurements which were carried out in the electrical laboratory of Purdue University a Krüss-Bunsen photometer was used. The method adopted was the usual one of a swinging crane in connection with a 45° mirror. The standard source was a glow lamp; it was referred after each test to the Hefner lamp.

A number of inclosed arc lamps, in their commercial form, were kindly placed at the disposal of the writers by their respective manufacturers. As this paper has no other object than to exhibit such features of the performance of these lamps as are largely typical, the lamps will be designated only by letters.

The distribution of intensity from lamp *A* is shown in the polar diagram of Fig. 1.

The following is a summary of the results of the test of this lamp:

Volts	103.2
Amperes	5.84
Apparent watts	602.
True watts	407.
Watts in mechanism	80.
Watts in arc	327
Power factor	0.67
Mean spherical intensity	110.5
Watts per mean spherical Hefner unit	3.68
Watts in arc " "	2.96

The lamp was intended for an electromotive force of 104 volts.

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* [illegible]

* 1 Hefner unit = 0.88 candle-power.

and the attempt was made to keep it at this pressure, but at the close of the test the average electromotive force proved to be 103.2. The power factor is due to the inductance of the mechanism, as it has been clearly established by Blondel that, in the arc itself, the electromotive force and current are strictly in phase. It is easy to confirm this fact by current, pressure and power readings taken with reference to the arc alone.

The upper and lower lobes of the distribution curve do not yield quite the same mean values. The discrepancy is due, no doubt, partly to the fact that the bulb about the arc is not of symmetrical curvature, and partly to the greater reflection from the parts of the lamp situated just above the arc. The shape of the distribution curve alters somewhat as the burning of the carbons progresses. The general shape of the curve is not far from that which has been obtained for the open arc. In the inclosed arc the lobes of the distribution curve are shorter, blunter, and extend outward at smaller angles with the horizontal. These changes are due to the shape of the carbon points. It may be pointed out that the distribution curve as plotted above is a half-section of the mean photometric surface, which is a surface of revolution. The actual photometric surface—so far from being a surface of revolution—is continually swelling, contracting and twisting in a marvelous fashion. As to whether the light thrown upward is of value will depend on whether the light is suspended in the open air or under a reflecting ceiling. In most cases considerable benefit will be obtained by the use of a reflector, as is illustrated in the following figure.

Lamp *B* was provided with a bell-shaped reflector of milky glass. The effect of the reflector on the distribution curve is very noticeable, the upper lobe being largely removed. (Fig. 2.) The minimum corresponding to the horizontal is displaced downward by about 10 degrees. This peculiarity cannot be ascribed to the presence of the shade, as it was found in one or two cases where the lamps were fitted with inner globes only. It is quite surely due to the fact that the carbons so burn that the planes of their ends, although parallel, are rarely normal to their axes.

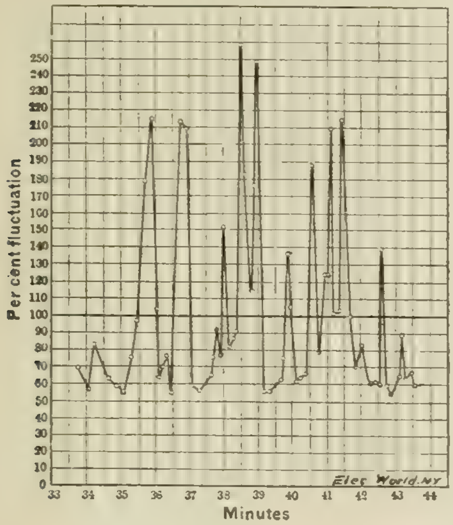


Fig. 5.

Lamp *C* was provided with an outer spherical globe of milky glass. The data obtained for the distribution of intensity are plotted in Fig. 3, where the inner curve shows the distribution with the outer globe in place. This distribution is in some respects anomalous. The larger area below the horizontal is due to the presence of a narrow reflector placed inside the outer globe. No reliable reason can be given for the presence of the maximum at 20° above. It may be due to some lack of accurate centring of the carbons. The peculiar shortening of the radii of the inner curve in the lower angles baffled the observers for some time. It was finally found that the milky glass of the outer globe was much more dense in the lower hemisphere than in the upper, and the absorption was correspondingly greater.

It should be said in connection with the inner curve that the amount of light cut off was in reality not so great as the figure indicates. The dispersion is so great with a globe of milky glass that the globe plays a strong part as a radiant. Now, the mirror used was not sufficiently large to furnish rays on the photometer disc from all parts of the globe, and hence the lamp was not given quite full credit for what it was doing.

The results of the test of this lamp may be summarized as follows:

Volts	110
Amperes	7.0
Apparent watts	770.0
True watts	484.0
Watts in mechanism	116.0
Watts in arc	364.0
Power factor	0.63
Mean spherical intensity	83.8
Watts per mean spherical Hefner unit	5.76
Watts in arc " " "	4.34

In Fig. 5 are shown the fluctuations in intensity which occur in the inclosed alternating arc. With the recording device already described it is possible to get settings of fair accuracy with a considerable degree of rapidity, as is here shown. The large changes in intensity are plainly noticeable in watching the arc, but the eye does not furnish an estimation of them comparable with that to be gained from the curves, for the psycho-physical reason already referred to. It will be noted that the higher values shown in Fig. 5 are of more infrequent occurrence than the lower values. Indeed, it is only when the arc is toward the photometer and flaring out so that both craters are inclined toward the disc that these extreme values are obtained, and then they last but an instant. For all other positions of the arc, whether on the sides or on the back, only the lower values are obtained.

Two causes, it was thought, might contribute to such fluctuations—namely, the changing length of the arc and the "wandering" character of it. To test this the curve in Fig. 5 was taken with a fixed length of arc, the clutch being entirely out of action. The result plainly shows that the chief cause of the fluctuations is the hunting of the arc. While the intensity varies with the length of the arc, the motion of the carbons is so slight in a well-regulated lamp that it plays little if any part in causing the variations shown.

Measurements were made on a direct-current lamp of the same manufacture as lamp *A*, with a view of bringing this type of lamp under conditions identical with those of the tests of the alternating arc. The lamp was fitted with an inner opalescent globe only. The distribution of intensity is plotted in Fig. 4. This curve was taken with great care, and may be taken as typical of the distribution due to the inclosed arc fed by a direct current. The peak at 20° above is due to the small crater of the negative carbon. Here also the depression in the curve due to the low luminosity of the arc is found displaced by 10° above the horizontal. This lamp will give an excellent illumination at points somewhat remote, because the curve is so full in the region just below the horizontal. A shade would still further improve the lamp in this respect. Detailed results are given in the following table:

Volts	108
Amperes	4.96
Watts	536.
Watts in mechanism	152.
Watts in arc	384.
Mean spherical intensity	197.3
Watts per mean spherical Hefner unit	2.72
Watts in arc " " "	1.95

As regards efficiency, or better economy, say in watts per Hefner unit, the direct-current lamp is superior to its alternating-current competitor. The performance of lamp *A* was the best found in these tests, that of lamp *C* the worst. The other lamps tested showed different degrees of economy lying between the limits set by these two.

The writers feel justified in saying that the lamps of low economy could, by improvement in mechanism, be brought to a performance equal to that of lamp *A*. All the lamps tested, with one exception, were furnished with the same brand (Electra) of carbons, and all had opalescent inner globes. With similar carbons and similar globes a difference in economy must be attributed largely to the mechanism.

If the alternating arc be regarded apart from any regulating device, the physical reasons for its poorer qualities as a light source are to be found in the lower temperature of the glowing points and in the diminished area of crater surface. In the direct-current arc we find two bright surfaces of unequal area and of widely different temperature. In the alternating current arc we find two bright surfaces of the same area and of the same temperature. According to Rossetti, the temperatures in the first case are 3900° C. and 2700° C. Now the points in the alternating arc are as much positive as negative, and hence, whatever the unknown law connecting the temperature of glowing carbon with the intensity of the light due to it, we should expect the mean spherical intensity of the alternating arc to have a value intermediate between the values of mean hemispherical intensity for the upper and lower lobes of the distribution due to the direct-current arc. A comparison of lamps *A* and *D* shows this point, although the total power is not the same. If the power consumption of the alternating arc were raised from 327 to 384, it is very probable that the mean intensity would be found raised from 110.5 to a considerably higher intermediate value.

The values of the intensity of the direct-current lamp are lower than those found by some earlier observers. In fact, the inclosed arc has been reported in some instances as quite equal to the average open arc. It is difficult to see how these results can be accurate for a lamp fitted with an opalescent globe. The results of a test recently reported by Nichols agree closely with those given for the direct-current lamp in this paper.

Comparison of the Rheostat and the Series-Parallel Controller for Street Electric-Car Service.*

BY PROF. THOMAS GRAY.

In the spring of 1896, a number of experiments were made at Louisville, Ky., by members of the senior class of the Rose Polytechnic Institute on the relative efficiency of the above methods of controlling the current flowing through the motors of an electric car. In the rheostat method the motors were in parallel, and the total current was passed through a rheostat having a maximum resistance of 4.2 ohms. In the series-parallel method the rheostat was first used with the motors in series, and after the resistance had been cut out the next step of the controller lever threw the motors in parallel and at the same time put each in series with half the rheostat. After this the resistance was cut out, and the two motors left in parallel. The final conditions were thus the same in both cases.

The tests included the measurement by means of an integrating wattmeter of the watt hours required to make a round trip of 5.5 miles, the car being stopped forty times during the trip. An autographic record was taken of the variation of current strength during the start. The rheostat method takes maximum current at the initial contact, after which there is gradual diminution as the car attains speed, combined with temporary sudden increments as the successive coils of the rheostat are cut out. The series-parallel method gives the maximum current when the motors are first put in parallel, which is after the car has attained a speed of four or five miles per hour. The consequence is that more of the power is used for propelling the car, and less for overcoming ohmic resistance. There resulted thus a comparative economy of from 10 to 15 per cent. under the conditions of the test. The ratio of the electric power used in starting the car in the two cases, as indicated by the record, was approximately four to five. The total weight of the car used was about 15,300 pounds; the watt hours per car mile averaged about 900, and the maximum speed between stops about 12 miles per hour.

New Train-Lighting Equipment.

The Canadian Pacific Railroad has just equipped one of its transcontinental trains with an experimental lighting equipment consisting [illegible] a storage battery for maintaining the lights when the train is at standstill, with suitable automatic cut-out and regulating mechanism. If successful, all of its through trains will be similarly equipped.

Inventiveness of the Americans.

[illegible] 1897. According to this there have been over 1,720,000 patents issued, of which 666,423 were granted in the United States, showing [illegible]

The Paralleling of Alternators.

BY EDWARD P. BURCH.

It is often noticed that station attendants are bothered and made very nervous whenever they have to throw large multiphase alternators in parallel.

The operation seems quite simple. The engines or turbines are first started and brought to approximately the same speed. Then the switchboard electrician excites the alternators, gets them at about the same voltage, and notes the difference between the speeds of the two alternators, as shown by the phase lamps.

In a great many cases the governors are too sensitive or hunt more or less at no load. After waiting impatiently for a few minutes, the electrician guesses which one of the machines is a little too fast, and signals to have it throttled some, or has the oiler try to steady it by hand or by some simple adjustment. Finally, if the lamps do not yet have any regularity in their flickering, he gets nervous or tired of waiting and, watching his opportunity, closes his switch and, in more ways than one, "throws" the units in parallel.

If the first generator is carrying lights, motor or rotary converter load, there is at the moment the switch was closed a flickering of the lights, a lunge, or the opening of a circuit breaker.

Often damage is done to apparatus by poor work in synchronizing and paralleling machines. In addition to the strain on the machinery and annoyance to the sub-stations there is a risk taken at the station, especially with generators of 3500, 6600, 10,000 and 12,000 volts, which are now being built in quite large numbers.

Such high voltage machines of 1000, 2000 and 3000-hp capacity generally have a porcelain chamber switch which makes and breaks the circuit. If the machines are not quite in synchronism when thrown in parallel there is a heavy wattless or synchronizing current. This in many cases destroys the switch contacts, burns up the switch and takes a generator out of service.

In synchronizing, the potential across the open switch is, at the maximum, twice the generator potential. Since the porcelain chamber switches made by the larger electric companies are not designed so that the contacts and tubes can be cleaned and inspected this potential often jumps across these switches and burns them out.

Again, the lagging current at the instant the switch is closed is often twice the full load current and the contacts are frequently pitted. They stick or work hard and break the porcelain work.

These troubles have suggested two excellent ways of connecting alternators in parallel which are simple.

Suppose several large alternators are to be started at about the same time each day (either after cleaning or before the peak of the load comes on, or before the cars start). The method of getting them in parallel is as follows: Start them, get them at approximately the same speed, and connect the unexcited alternators in parallel by means of the usual switches. After this, close the field switches of the alternators and then excite all the alternators simultaneously by closing the exciter switch. The alternators will buck for a minute and then settle down. (If the governors are throttled the bucking will be easier, since the hunting does not tend to pull them apart.) There are no dangers, no broken switches and much time is saved. The plan is especially useful in water-power plants which are operating electric railway systems.

Again, suppose four units are already in parallel and that after a time a fifth is to be thrown in parallel. Instead of watching the flickering of the phase lamps the following plan has been found convenient and safe with ironclad generators having a high or moderate armature reaction: Get the fifth machine up to speed and then throw in the paralleling switch, without exciting the machine.

The armature instantly takes a lagging current, which acts like a transformer with an open circuited secondary. The field current may then be thrown on without any delay and the lagging current is eliminated. A high voltage may be developed in the field coils, but since they are closed on themselves through the kicking rheostat this is avoided. There is a mechanical strain on the armature but experience shows that they are ordinarily put up solidly. In this plan the armature lagging current comes from four machines and does not produce more than a wink in the light. Moreover, the lagging current is generally not as heavy as in the case of paralleling by the use of phase lamps.

[illegible]

DIGEST
OF
CURRENT ELECTRICAL LITERATURE
AMERICAN AND FOREIGN

By Carl Hering.

Dynamos, Motors and Transformers.

TRANSFORMING MULTIPHASE INTO CONTINUOUS CURRENTS. Sahulka. "Zeit. fuer Elek.," Aug. 28 and Sept. 11.—An article on such transformers without motor generators. Two such methods were proposed some time ago, the second one of which can be appreciably simplified; these two he proceeds to describe. In the first portion he gives a long, illustrated description of the Hutin and Leblanc systems, the principle of which is as follows: The secondary windings of the static transformer for converting the high-tension current are made in the form of two sets of coils, whose windings are in opposite directions, and these are connected together and with the segments of a collector on which there are two brushes, the collector being driven by a small synchronous motor; from these brushes a continuous current is obtained. It can also be used for the reverse process of changing continuous into multiphase currents. In the second portion he describes the other method. In the usual rotary transformer for multiphase currents a field, which tends to revolve, is produced and the armature rotates in the opposite direction with the same speed, so that the poles of the rotary field remain stationary. The idea, therefore, suggested itself to keep the armature stationary and utilize the field, which will then revolve, and continuous currents will then be reproduced; such a transformer was suggested by Zipernowski and Deri, and is described and illustrated. There are separate windings for each of the multiphase currents and for the continuous current; the armature is of the Gramme ring or drum type, and is provided with the usual commutator on which there are brushes which are revolved synchronously with the revolving field by means of a small synchronous motor. As the speed would be too rapid with the ordinary frequency, the machine must be made multipolar, and it therefore becomes as expensive as a motor generator. The author, several years ago, endeavored to simplify this arrangement, but has not tried it in practice; he illustrates and describes his suggestions. The revolving part is not on the transformer itself, but in a separate apparatus; the transformer need, therefore, be only bi-polar, the small synchronous motor alone being multipolar; as the transformer itself contains no rotating parts, a very simple form of framework can be used, similar to that of the ordinary static transformer, and by this means the magnetic resistance of the circuits can be greatly reduced. There is an ordinary framework in the form of a square, which has a series of coils wound on it, and connected to the commutator as in the usual armature; inside of this square there is a cross of iron containing the coils of the two-phase current which produces the revolving field. In the coils, which are short-circuited by the brushes, there is no induction, and there will therefore be some sparking, to diminish which the number of coils should be made as great as possible. A similar device is shown for three-phase currents.

TRANSFORMING CONTINUOUS INTO ALTERNATING CURRENTS. Meyer. "Elek. Anz.," Aug. 4 and 7.—An article describing various methods in which the direct current is made to pulsate and is then passed through a transformer. It is claimed that there are advantages gained in doing this, as the same station can be used for direct or alternating currents.

CRITICAL STARTING RESISTANCE FOR NON-SYNCHRONOUS MOTORS. Arno. "L'Elettricista," June 1; abstracted briefly in "L'Eclairage Elec.," Aug. 20.—In a previous paper he showed how to determine theoretically the resistance which the circuit should have in order to enable the motor to be started by giving it a slight turn. The present article is supplementary to this, and shows how this resistance may be determined rapidly. This critical resistance has a value such that a current of a frequency equal to that of the magnetizing current lags by 68° behind the voltage at the terminals of the elementary circuit. The determination of this resistance may be made experimentally even before the conductors have been wound by means of a tangent phase meter.

POLYPHASE MOTORS. Hanappe. "L'Eclairage Elec.," Sept. 10.—The beginning of what promises to be a very long article, which seems to be of the nature of a treatise on this subject, with special reference to the graphical theory of alternating currents; the method of treatment appears to involve relatively simple mathematics, and is accompanied by numerous diagrams. In the present portion he describes the production and properties of revolving magnetic fields.

LEAKAGE IN CONTINUOUS-CURRENT MACHINES. Hoenig. "Zeit. fuer Elek.," Sept. 4.—A short article in which he describes a method of determining the magnetic leakage; the description is not quite clear; the following is a translation in abstract. The dynamo is run as a motor and the no load curve is determined for a constant speed; the consumption in watts in the magnet windings is then determined and both these curves are drawn; the friction losses at the constant speed, which are equal, are first deducted from the consumption of energy at no load, leaving the consumption for hysteresis and Foucault currents. If for a certain magnetizing current the watt losses in the armature are known the question might be asked, What current would be necessary if the magnetic frame is considered as a closed ring around which an alternating current flows, in order to obtain, as a component of this current, the real magnetizing and watt current? The product of the watt current and the voltage, and that of the current in the circuit and the same voltage, will be two amounts of energy, of which one is a function of the useful lines of force, while the other is a function of the total flux. If there were no hysteresis and Foucault current losses the total current in the circuit would be consumed for the magnetization of the ring; but as the latter represents the resultant of two currents, the relation of the supposed current in the circuit to the watt current will be a direct measurement of the leakage. In an accompanying diagram he gives the curve obtained for a certain machine. The effect of the armature reaction on the leakage is not considered.

UNIPOLAR MACHINES.—Lond. "Elec. Eng.," Sept. 9.—Answers to the question whether a unipolar machine can be made to give a voltage as high as 200, and if not, why not? The principles are pointed out, showing why loops of wires or windings cannot be used, owing to the counter e. m. f. induced in the return portion of the winding.

MULTIPHASE INDUCTION MOTORS. Baxter. "Power," Sept.—In this series of articles on the care of electrical machinery he discusses, in an elementary way, multiphase induction motors.

Lights and Lighting.

TESTING ARC LIGHT CIRCUITS. Markland. "Elec. Eng.," Sept. 22.—The conclusion of the article noticed in the "Digest" Sept. 24. After showing that the cost of the apparatus is very slight, he describes in detail the method of testing with a voltmeter, showing that the ordinary employee can carry out the test and make the calculations.

Power.

TRANSMISSION OF POWER. Janet. "Rev. Gen. des Sciences," Aug. 30.—An article of a general character on the electric transmission of power as distinguished from the distribution, in which he endeavors to show the limits of the electric transmission of power, and how this is determined for the specific cases.

ELECTRIC TRANSMISSION. Hartmann. "Elek. Anz.," Aug. 21 and 25, and "Elec. Tech.," Aug. 31.—An article comparing the application of electric power in single units and in subdivided units, in order to show which system is best to use. He determined some mathematical expressions which he claims show that there are definite mathematical limits; it is claimed that it can be readily determined by means of these equations which system is best for any particular case. The expressions are not in such form that they can be reproduced here.

MOTORS IN GERMANY.—"Elek. Anz.," Aug. 25.—Some statistics giving the number of all the various forms of generators and motors used in Germany in June, 1895, including wind, water, steam, gas, etc.; the number of electric motors is quite small in comparison with steam and water, which two together form over half of the total.

STEERING SHIPS ELECTRICALLY. Gentsch. "Elek. Anz.," Aug. 28, Sept. 1, 4 and 11.—The first part of a long article, in which he gives illustrated descriptions of various electrical methods of signaling from the bridge and operating the steering gear.

LANCEY.—"L'Energie Elec.," Sept. 1.—A long, illustrated description of this hydraulic transmission plant in the mountainous district of Grenoble in the French Alps. There are two turbines of 90 horse-power each, and the transmission appears to be to a distance of 1.8 miles; the simple alternating current is used, the line voltage being 12,000; it is used for lighting only.

COMBINED STEAM AND WATER-POWER PLANT.—Lond. "Elec.," Sept. 9.—A brief, illustrated description of a small plant at Bray, in Ireland. An alternator is coupled through coil clutches to a steam engine, and there are provisions to drive it by means of a belt when water power is used; the dynamo has a capacity of 75 kw.

TROLLEY SYSTEMS IN FOUNDRY WORK. Ramp. "Sc. Am. Sup.," Sept. 17.—A reprint of a paper read before the Foundrymen's Association pointing out the great advantages of the trolley systems for foundries, in place of the usual cranes.

Traction.

ALEXANDRIA. Dieudonne. "L'Eclairage Elec.," Aug. 20.—A long, illustrated description of the first railway in that city, which was constructed by the French. It embraces 7.8 miles of lines; it is stated that for the greater part of the circuit the trolley wire is double; it is also stated that the return wire is overhead on poles, having connection with the tracks at every pole. There is a drawbridge on which there are special arrangements, which are described, with illustrations; there are two contact devices on that portion.

BAHIA. Braun. "Elek. Zeit.," Sept. 8.—An illustrated description of the trolley line in this city in Brazil, which is the first electric street railway in South America, constructed by the Germans. The sliding contact bar is used in place of the trolley.

MOUNTAIN RAILWAY. Wietz. "Elec. Tech.," July 31 and Aug. 15.—An illustrated description of the electric railway from Urfahr to Poetslingberg, which is an adhesion line 1.8 miles long, rising 254 metres; the maximum grade is 10.5 per cent., and the gauge is 1 metre.

SURFACE CONTACT SYSTEM. Stendebach. "Elek. Anz.," Aug. 21.—An illustrated description, with a double-page plate, of his system. Contact is made with contact blocks between the tracks, and these are put into circuit by the car by means of mechanical devices operated in a shallow conduit under one of the tracks, the operation, therefore, being purely mechanical.

ELECTRIC RAILWAY COMPANIES IN GERMANY.—"Elek. Anz.," Aug. 25.—A table giving the capital and dividends of the German electric railways for July of this year; the total capital is 169 million marks.

ELECTRIC RAILWAYS.—"Elek. Aug.," Aug. 28.—A double-page table giving information on each of the fifty-five overhead trolley lines constructed and in course of construction by the German General Electric Company.

ELECTRIC AUTOMOBILE. Reyval. "L'Eclairage Elec.," Sept. 10.—An illustrated description of the Bouquet, Garcin and Shivre system. The carriages weigh from 2000 to 2200 pounds, while the battery weighs only 770 pounds, and is sufficient for running 60 to 90 miles, according to the type of carriage and the nature of the road. The motor has two independent armature windings, each with its own commutator; but these are made unequal, in the ratio of 5 to 3, which is done to enable different speeds to be produced. The controller, a diagram of which is given, enables seven different speeds to be produced (three of these, however, are produced with different dead resistances in the circuit), two of which are produced by cutting out completely one or the other of the windings of the armature; there is only one field, which is always in circuit.

AUTOMOBILES. Hospitalier. "Bul. Soc. Int. des Elec.," July.—The whole of this large issue is devoted to the reprint of his recent paper before that society. Other references to abstracts have already been given. The present reprint contains many illustrations and much data with references to the recent competitive tests in Paris.

SUBMARINE BOAT.—"Elek. Anz.," Aug. 18.—A brief description of the Sandor Bak submarine boat.

Installations, Systems and Appliances.

CHARGING BY CONTRACT.—"L'Energie Elec.," Sept. 1.—A short article giving the results in a Swiss station where both the meter and the contract system were used. In 1896 there were 750 customers using meters and 108 paying by the contract system; the next year the figures were 648 and 471 respectively; the records show that the expenses had greatly increased, while the receipts had diminished.

COST OF ELECTRICAL ENERGY. Haslam. Lond. "El'ty," Sept. 2.—The beginning of an article, giving tables and diagrams, which he has compiled largely from the weekly publications in Lond. "Lightning;" they refer to the year 1897 and to English stations.

COMMERCIAL AND BUSINESS ASPECTS OF MUNICIPAL SUPPLY. Gibbings. Lond. "Elec.," Sept. 9.—In this continuation of his long serial he mentions briefly other methods of charging, and begins the discussion of electric motors, their application, effect on the day load, etc., referring only to continuous-current motors. He gives a long list of approximate horse-powers required for various classes of machinery (they appear to be only rough approximations).

ELECTRIC LIGHTING AND POWER IN VIENNA.—"Zeit. fuer Elek.," Aug. 28.—Some statistics and descriptions of the state [illegible] 1897. It is followed by a short article on the present state and the prospects of the electro-[illegible]

AUTOMATIC [illegible] [illegible] "Elec. Tech.," June 30.—An article in which, after a long introduction, he [illegible] in order to bring them to [illegible]

[illegible]

flows through the magnet which moves this lever, thus breaking the arc; the magnet coil is shunted by a saw-tooth arrester. It is self-adjusting.

CHRISTIANIA.—"Elek. Zeit.," Sept. 8.—Tabular reports of the operation of this central station for last year.

THE MULTIPHASE SYSTEM FOR CENTRAL STATIONS. Kelley. "Elec. Eng.," Sept. 22.—An article discussing the requirements of a single system, which is of universal application for central station service for supplying both light and power, and he endeavors to show that the multi-phase system is the only one which fills these requirements. He also shows the now well recognized advantages gained by the use of a few large transformers instead of numerous small ones. Among the multiphase systems he shows that the three-phase system has decided advantages over the two-phase; he claims that the interlinked two-phase, three-wire system has proved to be exceedingly unsatisfactory in practice, and it is not recommended. The three-phase system requires but little attention to keep it balanced.

Wires, Wiring and Conduits.

GLASS OR PORCELAIN INSULATORS.—"Jour. of El'ty," Aug.—A discussion forming part of the proceedings of the second annual convention of the Pacific Coast Electric Transmission Association. Eastwood explained why he had substituted glass for porcelain insulators on the Folsom and Sacramento lines, after having used porcelain for some time. Everything went well during the dry weather, but trouble began with the fogs and storms during the winter, when much difficulty was encountered in the burning off of the pins; a pin almost invariably burnt off at the point where the lower petticoat came into contact with it, and in nearly every case the insulator was found to have been cracked or defective in the outer petticoat; these were replaced by carefully selected ones, the pins having been painted with P. and B. paint, after they were thoroughly boiled in paraffin. He came to the conclusion that the one main point is to have a dry place between the line and the pin, and for this reason he chose a glass insulator; on the new line, on which 10,000 volts are used, with glass insulators, not a single pin has burnt off. The glass insulators were not only cheaper than porcelain but were better in every way; they are sufficiently strong for any strains that will ever come upon them. While porcelain insulators give no trouble in dry weather, they were not safe in wet weather with 19,000 volts. Ensign tested insulators for a 30,000-volt line and he thought the trouble with the porcelain insulators was due to their porosity; he could not find one of glass large enough to stand the potential without the tie-wire being too near the pin, and he was therefore forced to use the porcelain insulators; these measure 6.5 inches across the bottom by about 4 inches from the tie-wire across to the bottom; they are guaranteed not to penetrate with 70,000 volts; he describes a method of testing them by inverting them in a trough containing a liquid connected to one pole and then applying the other pole to a liquid in the interior; 66,000 volts between the tie-wire and the pin in ordinary dry weather does not show the slightest tendency to jump, and this is four times the strain they will receive. The same insulators tested for rain effects showed a peculiar phenomenon, as the current seems to follow the path of the drop to the cross arms rather than to jump across the shorter path to the pin; with 45,000 volts and the insulator 4 inches above the arm, he could detect absolutely no leakage. In the laboratory test above described, in which the insulators were tested inverted in the liquid, each circuit had a spark gap of one-sixteenth of an inch in circuit; when an insulator broke down a red, flaming arc was produced; some 15 to 17 per cent. of those delivered were thus punctured. He found there was no use in testing insulators in this way without having a transformer of suitable capacity; moreover the voltage must be raised gradually. While he is satisfied with the insulator which he uses, he would prefer glass if he could get good ones large enough and free from cracks. At Telluride it was found that if the plant was shut down during a rain storm it would not start up again.

SHIP WIRING.—Lond. "Elec. Eng.," Sept. 9.—Answers to a request to describe the single-wire system, with its advantages and disadvantages. All three of the answers agree that it is the negative pole which should be connected to the framework of the ship.

Electro-Physics and Magnetism.

REGENERATION OF FLUORESCENT SCREENS. Villard. "L'Eclairage Elec.," Aug. 20.—An abstract of a French A. A. S. paper. When the platinocyanide of barium screen is subjected to the action of Röntgen rays, its fluorescence diminishes by degrees, while the salt becomes porous; by exposing it for a quarter or a half hour to the direct sunlight its properties will be restored. He endeavored to find what radiations this regeneration is due to. He exposed a screen to a spectrum and found that the ultra-violet radiations, the violet and nearly all of the blue, have little or no action; the band of the spectrum which contains the most active rays are those between 510 and 480, expressed in millionths of a millimeter; it is therefore not the rays which are most effective from a chemical standpoint which are the best to regenerate the screens. In the discussion Broca stated that the first band of rays, namely, the violet, blue, etc., are the very ones which Becquerel found were so important in the phenomenon of fluorescence.

[illegible] RAYS. Remond and Noe. "L'Eclairage Elec.," Aug. 20.—A brief abstract of a French A. A. S. paper. It appears that they found that the static machine is best and especially the [illegible] machine, which is a modification of the Carre. It seems that the maximum output is obtained when the positive pole is connected to earth. They claim that the positive pole of the source, the subject, the operator, the instruments, etc., should all be connected to the earth with the greatest care, and in that case the subject will not feel any ill effects.

CATHODE RAYS AS CURRENT PATHS. Wiedemann and Wehnelt. "Mitt. Phys. Inst. Erlangen," March; abstracted in Lond. "Elec.," Sept. 9.—They appear to have established the fact that the great resistance opposed to the discharge by the dark cathode space is greatly diminished as soon as the cathode rays unite the cathode and the anode; cathode rays, in fact, form a sort of conductor, penetrating the dark space. They also used Röntgen and ultra violet rays, but could obtain no diminution in the resistance. They conclude that it is only the paths of the cathode rays which are concerned in the discharge through the cathode space; it does not follow, however, that the cathode rays perform the same function outside of the dark space.

MUTUAL REPULSION OF CATHODE BEAMS. Wiedemann and Wehnelt. "Mitt. Phys. Inst. Erlangen," March; abstracted briefly in Lond. "Elec.," Sept. 9.—Crookes, in his earlier work, believed that two parallel cathode beams were bent aside by mutual repulsion; the present authors repeated an experiment made by Weber, which the latter claims confirms this repulsion, but they obtained the opposite result; under favorable circumstances the rays can be distinctly seen cutting each other in straight lines without a trace of mutual repulsion.

CROOKES' CROSS. Villard. "L'Eclairage Elec.," Aug. 20.—An abstract of the French A. A. S. paper. In one of the well-known Crookes experiments a metallic cross is placed in a beam of cathode rays and a shadow is formed on the end of the tube; when the cross is then removed a brilliant cross will appear on a darker background, where the former shadow was. Villard explains this by assuming an increase of temperature of the glass, and describes experiments to show this.

TRANSFORMATION OF X-RAYS BY DIFFERENT BODIES. Hurmuzescu. "L'Eclairage Elec.," Aug. 20.—An abstract of a French A. A. S. paper. He describes experiments which show that the effect of the discharge of an electroscope by transformed rays has no relation whatever with the opacity of the bodies to X-rays.

CATHODE RAYS. Geitler. "Wied. Ann.," April; abstracted in "L'Eclairage Elec.," Sept. 3.—An article on the electric and magnetic dispersion of cathode rays.

SIMPLE CATHODE RAYS. Goldstein. "L'Eclairage Elec.," Sept. 3.—An Academy paper replying to a recent one by Deslandres.

DIFFUSION OF CATHODE RAYS. Villard. "L'Eclairage Elec.," Aug. 27.—An Academy paper.

CATHODE RAYS AND CELESTIAL PHENOMENA. Deslandres. "L'Eclairage Elec.," Sept. 3.—An Academy paper on a simple explanation of some celestial phenomena by cathode rays.

ELECTRIC DISCHARGE IN RAREFIED GASES. Wien. "Wied. Ann.," 65, p. 440; abstracted in the "Elek. Zeit.," Aug. 18.—Descriptions of experiments.

VELOCITY OF ELECTRIFIED PARTICLES. Buisson. "L'Eclairage Elec.," Aug. 27.—An Academy paper on the measurement of the velocity of electrified particles in the discharge by ultra violet light.

RATIO OF CHARGE TO MASS OF ION. Schuster. "Wied. Ann.," No. 8; abstracted in the Lond. "Elec.," Sept. 9.—In 1884 he showed that the ratio of the charge carried by the ion to its mass may be deduced from the curvature of the cathode rays in a magnetic field; in a subsequent reconsideration the results revealed several sources of error. If the ions or electrodes concerned in luminous radiations and in cathode rays are identical in mass, such a result as he points out would have a profound effect on the progress of physical science.

EXPERIMENTAL STUDY OF THE ELECTRIC SPARK. Leduc. "L'Eclairage Elec.," Aug. 20.—An abstract of a French A. A. S. paper. He used the photographic process; on the reverse side of the plate was placed an electrode of tin-foil, while the other pole was connected with the sphere placed on the sensitive side; the photographic registering was very fine in all the details.

EFFECT OF SILENT DISCHARGE ON AIR. Shenstone and Evans. Lond. "Elec. Rev.," Sept. 9.—An abstract of the Chemical Society paper concerning the production of ozone and nitrogen compounds in air, an abstract of which was noticed in the "Digest" March 26 (see also April 16).

ELECTROMOTIVE BEHAVIOR OF CHROMIUM. Hittorf. Lond. "Elec. Rev.," Sept. 9.—An abstract of the article noticed in the "Digest" May 20.

FLUORESCENCE AND PHOTO-ELECTRIC PROPERTIES. Schmidt. "Wied. Ann.," April; abstracted in "L'Eclairage Elec.," Sept. 3.—An article on the relation between fluorescence and photo-electric properties.

LIGHT EMISSION OF ELECTRODES IN ELECTROLYTES. Braun. "Wied. Ann.," 65, p. 361; abstracted in the "Elek. Zeit.," Aug. 18.—In experimenting with the transformation of alternating into continuous currents by means of aluminum electrodes, he found that, in the dark, the active surfaces of the electrodes developed a yellowish red light, covering the whole plate; when the current was greater blue sparks were seen at various points. With a small piece of foil or wire the rotating mirror showed a succession of bright images, the light being produced with that impulse which leads hydrogen to that plate; similar effects may be produced with magnesium and zinc, the zinc being the anode; but the latter will only convert 0.1 ampere out of 3 amperes into continuous current.

ORIGIN OF ELECTRICITY OF CONTACT. Christiansen. "Wied. Ann.," 62, p. 545; abstracted at some length, with illustrations, in "L'Eclairage Elec.," Aug. 20.—He describes researches made to determine the origin of electricity of contact.

ELECTRIC ENDOSMOSE.—"Wied. Ann.," 63, p. 324; abstracted in "L'Eclairage Elec.," Sept. 10.—Descriptions of experiments.

ELECTRIC WAVES. Latrille. "Wied. Ann.," 65, p. 408; abstracted in the "Elek. Zeit.," Aug. 18.—He describes experiments made with electric waves, passing through adjustable slots. He found that a slot produced a polarizing action on electric waves, so that it is chiefly the component perpendicular to it which is allowed to pass through; the amount of energy transmitted increases irregularly with the size of the slit; when a coherer is used in these experiments it will act more energetically when it is parallel to the waves than when perpendicular to it.

ELECTRIC WAVES. Barton. "Phil. Mag.," Sept.—An article on the attenuation of electric waves along a line of negligible leakage.

ELECTROMAGNETIC WAVES. Gutton. "L'Eclairage Elec.," Aug. 27.—An Academy paper on the passage of electromagnetic waves from a primary to a secondary wire which is parallel to it.

PRODUCTION OF HIGH-FREQUENCY CURRENTS. Meyer. "Elec. Tech.," July 31.—A suggested method for avoiding the necessity of a spark gap in the usual form of apparatus like that of Tesla; this spark gap represents a great loss of energy and diminishes the efficiency. Instead of the spark gap he uses resistances of bismuth, which are inserted in the circuit parallel to a condenser, and are placed in the air gap of an oscillating magnetic field, which varies the resistance of the bismuth, thus producing variations in the current; this magnet is either excited from a separate source or from the same source as that of the original alternating current; in order to increase the frequency of the variations of the bismuth a condenser is placed in the circuit of the magnet. A selenium cell under the action of light might also be used in place of the bismuth.

REDRESSERS. Janet. "L'Eclairage Elec.," Aug. 27, and "L'Elec.," Sept. 10.—An abstract of an Academy paper. In a previous note (see "Digest" Aug. 6, under Electro-physics) he discussed the action of a redresser; in the present note he gives the experimental results to which he arrived. His conclusion is that in monophase redressers it is essential to specify the nature of the voltmeter used to measure the voltage, as the current may be undulating; in polyphase redressers this is not necessary.

GRAPHICAL CALCULATION OF ALTERNATING CURRENTS. Guye. "L'Eclairage Elec.," Sept. 3.—The continuation of his long article (see "Digest" June 18). The article is in the nature of a treatise on the subject.

CLARIFYING TURBID SOLUTIONS. Spring. "Zeit. f. Elektrochemie," Aug. 25; abstracted briefly from the "Chem. Zeit." --If a current is passed through pure water in which are suspended very fine particles of materials which are not electrolytes the solution will become clear; the current may be quite weak provided the voltage is sufficiently high. He explains this by assuming that the particles suspended in the liquid are in a certain electrical condition, which prevents them from uniting altogether and falling to the bottom; a current disturbs this condition, discharges them, causing them to collect together in large masses and sink to the bottom.

THERMOPHONY. Braun. "Wied. Ann.," 65, p. 358; abstracted in the "Elek. Zeit.," Aug. 18.—If acoustic vibrations are to be produced by periodic changes of temperature which produce oscillating currents as in the thermophone of Preece, or in the Simon arc, the present author states that it is necessary to superpose a continuous current on to the oscillating current. He describes an experiment made to prove this; the sound was greater when this continuous current was increased.

LAW OF INDUCTION. Westberg. "Elek. Zeit.," Aug. 18.—A long communication in reply to the recent suggestion by Breslauer (see "Digest" Aug. 20). He claims that this new law is easily reducible to the old, which latter, furthermore, is better, as it gives quantitative results and is of general application. He shows that the two older laws are not fundamentally different, as they are really identical, being merely different statements of the same law; both must always lead to the same results, and are applicable in all cases. The case pointed out by Breslauer, in which he claims they have failed, are due to his error in applying them; this is further explained and other illustrations are given.

THE THEORIES OF LORENTZ AND LARMOR. Lienard. "L'Eclairage Elec.," Aug. 20 and 27.—A long mathematical article on these two theories.

LIGHT AND MAGNETIC FIELDS. Righi. "L'Eclairage Elec.," Aug. 27.—An Academy paper on the absorption of light by a body placed in a magnetic field.

ACTION OF MAGNETISM ON THE SPECTRUM. Van Aubel. "L'Eclairage Elec.," Sept. 3; abstracted from "Jour. de

"Physique," July.—An article on the action of magnetism on the spectra of gas.

ZEEMAN PHENOMENON. Becquerel and Deslanders. "L'Eclairage Elec.," Aug. 20.—An Academy paper on some new observations.

MAGNETO STRICTION. Nagaoka and Honda. "Phil. Mag.," Sept.—A long article describing an investigation to determine the effect of hydrostatic pressure on the magnetization of iron and nickel and to find whether there exist reciprocal relations between the effects of compression and the volume-change by magnetization; also to examine Kirchhoff's theory of magneto-striction. They found that magnetization produced a minute increase of volume in iron and a diminutive in nickel; also that a diminution of volume by hydrostatic pressure produces a minute decrease of magnetization in iron and an increase in nickel. They also find that there are no serious discrepancies between theory and experiment in connection with Kirchhoff's theory.

ELECTROMAGNETS. Fery. "L'Eclairage Elec.," Aug. 20. An abstract of a French A. A. S. paper. He made experiments in order to find what dimensions should be given to the pole pieces in order that the tractive force should vary little with the distance, or on the contrary, vary rapidly. The armature was suspended from the arms of a balance and separated from the magnet by pieces of glass of known thickness, and in this way the tractive force at different distances was measured. The results are given in a table, and his conclusions are that narrow poles should be used when it is desired to obtain great tractive force or a great power for a small displacement of the armature; if, on the contrary, it is desired to move the armature through a great distance it is best to make the pole pieces very wide.

CHANGE OF LENGTH ACCOMPANYING MAGNETIZATION. Rhoads. "Phys. Rev.," Aug.—An article on the effect of the fibrous structure of sheet iron on the changes in length accompanying magnetization, and describing an extended series of experiments. From the results he finds that changes of volume which take place in iron wire, sheet iron, etc., when magnetized, may be due to the fibrous structure of the iron.

MOTION OF A STEEL BALL AROUND A MAGNETIC POLE. Wood. "Phys. Rev.," Aug.—An experimental study of the orbit of a ball moving in different planes over a magnet pole.

Electro-Chemistry and Batteries.

CALCIDUM IN LECLANCHE CELLS.—"Elek. Anz.," Sept. 11.—The results of tests made by Dettmar, of the material called "salmiakcalcidum," made by Busse in Hanover, as a substitute for the usual sal ammoniac in the Leclanché cells. Two identical cells were used, one containing the usual and the other the new solution, and they were discharged in series for forty-five days. On open circuit they had practically the same voltage; they were discharged through a resistance of 10 ohms. Some of the ten daily readings on closed circuits are given in a table, and they show that the voltage of the cell with the new solution was appreciably higher; the watt hours at different periods are also given and show that in the first fifteen days the number was 25 per cent. higher for the cell with the new solution, in thirty days 30 per cent., and in forty-five days over 33 per cent. A note by Busse states that on taking these two cells apart after the test the zinc which was in the sal ammoniac solution had a hard crust of oxide and was eaten with holes, while that in the other cell was bright and smooth. (The composition of this new compound is not given, nor was it stated in previous notices that have been published. Its composition seems to be kept secret.)

NEW TRANSITION CELL. Cohen. "Elec. Rev.," Sept. 9.—Abstracts of three of his papers from the "Zeit. Phys. Chem.," Vol. [illegible] trical method for the determination of transition points; in the second, together with Bredig, he introduces a slight alteration in the apparatus, using only one saturated solution; in the third he discusses the results given by another class of cells.

ELECTROLYTIC OXYGEN AND HYDROGEN.—"L'Energie Elec.," Sept. 1.—A few figures concerning the plant at Oloron, where both gases are produced electrolytically, the source of power being a waterfall. At first the attempt was made to generate the [illegible] in the gas under pressure; they are now generated at low pressure. [illegible]

[illegible]

DESILVERIZING LEAD.—"Cosmos," Sept. 3.—An illustrated description of the Tommasi process; references to other descriptions have already been given.

CYANIDE PROCESS. Pauli. "Zeit. f. Elektrochemie," Sept. 1.—A short article showing the increasing application of the Siemens and Halske process in South Africa.

ELECTROLYTIC PRODUCTION OF PERCHLORATES.—"Elek. Anz.," Sept. 1.—A brief discussion of the recent researches of Foerster and Winteler, in which they determined the conditions for the production of potassium and sodium perchlorate.

PURIFYING WATER WITH OZONE.—"L'Elec.," Sept. 10.—A note stating that the town of Blankenberghe, in Belgium, is to have its drinking water purified by ozone generated electrically. After being "disinfected" and filtered it is treated in the ozone sterilizers. The quantity treated is to be 1000 cu. m. per day, and this is said to require 55 horse-power; the Tyndal system is to be used; the plant is to cost about $66,000.

ACTION OF ELECTROLYTIC ZINC ON DYES. Binz. "Zeit. fuer Elek.," Sept. 1.—An article on the action of electrolytically prepared zinc on dye stuffs, more particularly on indigo.

ELECTROLYTIC REDUCTION OF AROMATIC BODIES. Elbs and Kopp. "Zeit. f. Elektrochemie," Sept. 1.—Descriptions of experiments.

REDUCTION OF NITRO-TOLUIDINS. Elbs and Schwarz. "Zeit. f. Elektrochemie," Sept. 1.—An article describing researches.

SYNTHESIS OF SUGAR. Slosse. "Zeit. f. Elektrochemie," Aug. 25.—An abstract of a paper read before a Belgian Society of Chemists. By subjecting a mixture of dry carbonic oxide with double the volume of pure dry hydrogen, in a Berthelot ozonizer to a dark discharge, a crystallized body was formed, which had all the properties of sugar. In a similar way from carbonic oxide with a double volume of pure dry ammonia he obtained urea.

CALCIUM CARBIDE PLANT AT INGLETON. Matthews. Lond. "Elec.," Sept. 9.—A short, illustrated description of this plant, which has just been started. There are two furnaces and one dynamo of 120 kilowatts, driven by hydraulic power; the Pictet system is the one used; the chief feature of this is that the waste gases of the furnace and the heat obtained by the combination of the hydrogen and the oxygen with the carbon are made to do the work of raising the lime to a temperature of liquefaction and supplying the latent heat of liquefaction, thus requiring the arc to supply only the very high temperature heat required for the dissociation of the lime and the combination of the calcium and the carbon.

SOLUTIONS OF PLATINUM AND GOLD. Margules. "Wied. Ann.," June; abstracted in "L'Eclairage Elec.," Sept. 10.—He shows that these metals may be dissolved in liquids in which they are not ordinarily soluble by using the high-voltage current produced by breaking an induction circuit periodically.

ELECTROLYSIS OF PLATINUM CHLORIDE. Kohlrausch. "Wied. Ann.," 63, p. 423; abstracted in "L'Eclairage Elec.," Sept. 10.—A careful investigation of the electrolysis of this salt in connection with which hydrogen is produced.

CONDUCTIVITY OF ELECTROLYTES. Kohlrausch, Holborn and Diesselhorst. "Wied. Ann.," March; abstracted, with some of the data, in "L'Eclairage Elec.," Sept. 10.—They reduce the conductivity of electrolytes to uniform and standard terms. Other abstracts have already been referred to.

CONDUCTIVITY OF DILUTE SOLUTIONS. Schaller. "Zeit. f. Elektrochemie," Aug. 25; abstracted from the "Zeit. Phys. Chem.," 25, p. 497.—Determinations of the conductivity of a number of dilute solutions at temperatures up to 100° C.; a large number of the results are reproduced in the abstract.

POLARIZATION OF THIN MEMBRANES. Nernst and Scott. "Wied. Ann.," 63, p. 386; abstracted in "L'Eclairage Elec.," Sept. 10.—They discuss the action of such membranes.

FRACTIONAL DISSOCIATION OF ORGANIC ACIDS. Smith. "Zeit. Phys. Chem.," 25, p. 144 and 193; abstracted, with a full-page table, in the "Zeit. f. Elektrochemie," Sept. 1.—The results of extended researches on the fractional dissociation of bi-basic organic acids.

ELECTROLYTIC AND PHOTOLYTIC REDUCTION. Bach. "Jour. Russ. Phys. Chem. Ges.," 30, p. 297; abstracted in the "Zeit. f. Elektrochemie," Sept. 1.—Descriptions of researches on the connection between the usual electrolytic and the photolytic reduction of carbonic acid. He draws the conclusion that the reduction of carbonic acid in plants is probably caused by the electrolytic process produced by the rays of the sun.

DETERMINING THE COEFFICIENT OF DISSOCIATION. Loewenherz. "Zeit. Phys. Chem.," 25, p. 385; abstracted in the "Zeit. f. Elektrochemie," Sept. 1.—A description of a purely chemical method.

TRANSPORTATION OF IONS. Kummel. "Wied. Ann.," April; abstracted in "L'Eclairage Elec.," Sept. 10.—An article on the transportation of ions in very dilute solutions of zinc and cadmium salts.

ELECTROLYTIC PHENOMENON. Del Proposto. "Zeit. f. Elektrochemie," Aug. 25.—Descriptions of some experiments in which he electrolyzed a concentrated solution of potash between iron electrodes, when an isolated plate of iron or glass fitting the sides of the vessel closely was gradually immersed into liquid from the top between the electrodes, thus compelling the current to pass underneath the edge of it. The results showed that the voltage in creased as the plate was depressed, and if the current was sufficiently great gas was formed on the isolated diaphragm. No conclusions of importance seem to be drawn.

Units, Measurements and Instruments.

WESTON STANDARD CELL. Kohnstamm and Cohen. "Wied. Ann.," 65, p. 344; abstracted in the "Elek. Zeit.," Aug. 18.—At 20° C. this has an e. m. f. of 1.0190; the temperature coefficient is also given, but the cell behaves irregularly between zero and 15° C., and the formula is therefore limited to between 15° and 25°. They endeavored to show that these irregularities are due to the formation of crystals in the bottom of the cell. They conclude that the cell should only be used above this temperature of 15° C.; if it is cooler than this the cell should first be warmed for several hours; if this precaution is used the Weston cell is a standard which in every respect is to be preferred to the Clark cell.

NEW SECONDARY STANDARD OF LIGHT. Blondel. "L'Eclairage Elec.," Aug. 20.—A brief abstract of a French A. A. S. paper. There are two objections to the use of the amyl acetate standard in France; one is that the liquid must be bought in Germany, and the other is the difficulty in making measurements when there is the slightest current of air in circulation. He therefore suggests as a modification to use a chimney and to burn a mixture of absolute alcohol and crystallizable benzine, which are easy to prepare from commercial products; these two liquids have the same density and boiling point, and are equivalent in their light-producing properties to amyl acetate. The chimney is made of a blackened cylinder of metal, having two small windows with oblique panes of glass, so that there shall be no internal reflections, as there are in glass chimneys.

STANDARD OHMS OF THE REICHSANSTALT. Jaeger and Kahle. "Wied. Ann.," March; abstracted in "L'Eclairage Elec.," Sept. 10.—An abstract of their report, which has already been noticed.

POTENTIOMETERS. Gosselin. "Bull. Soc. Int. des Elec.," June.—A reprint of a long, illustrated paper before that society, describing the principles and application of the potentiometer, and giving illustrated descriptions of various forms of commercial instruments, especially those made in England, where they are used so largely.

OSCILLOGRAPHS. Blondel. "L'Eclairage Elec.," Aug. 20.—A brief mention of a French A. A. S. paper. The word oscillographs was given by him to galvanometers for very rapid oscillations. In the present paper he completes the theory of these apparatus and describes recent perfected forms. The double form, the natural period of oscillations of which exceeds 5000 per second, may be used to see directly and to register photographically the instantaneous voltage and current curves of alternating currents: the synchronous motor requires only 0.5 ampere. A complete description is promised in that journal.

MEASURING OSCILLATIONS OF A LONG PERIOD. Birdman. Wied. Ann., April; abstracted, with illustrations, in "L'Eclairage Elec.," Sept. 10.—He describes a method of measuring them.

MEASURING MAGNETIC INCLINATION AND INTENSITY. Meyer. "Wied. Ann.," April; abstracted, with illustrations, in "L'Eclairage Elec.," Aug. 20.—He describes a new method of measuring the magnetic inclination and the intensity of the horizontal component.

APPARATUS FOR MEASURING VARIATIONS IN EARTH'S MAGNETISM. Heydweiller. "Wied. Ann.," April; abstracted in "L'Eclairage Elec.," Aug. 20.—He describes some new apparatus for studying the different variations of the field of the earth's magnetism.

MERCURY INTERRUPTER. Hauswaldt. "Wied. Ann.," p. 479; abstracted, with the illustration, in "Elek. Zeit.," Aug. 18.—He suggested an improvement in which the radial arms are not made straight, but are bent near the end to nearly a right angle; moreover, they are of silver, instead of platinum, and are sharpened on both edges; the ends must be broad and not pointed. Water should in no case be used over the mercury, but it should be replaced with pure, white, paraffin oil.

NEUTRALIZING FRICTION IN ALTERNATING CURRENT MOTOR METERS.—"Zeit. fuer Elek.," Sept. 11.—An illustrated description of the device used by the Siemens & Halske Company. The object is to give the revolving drum a slight torque when there is no current in the series coil. Besides the series and shunt coils there is a third symmetrical coil around the iron of the field of the motor, and this is short-circuited; with a resistance in this circuit the current can be so adjusted that with the shunt winding alone a torque is produced just sufficient to overcome the friction. Under certain circumstances, however, this will cause a tendency to rotate in the opposite direction and to overcome this the additional coil is connected as a shunt to the main circuit.

RECORDING CURRENT CURVES. Switzer. "Phys. Rev.," Aug.—An account of an investigation to improve the method of Crehore, in which he utilizes the property of certain substances, of rotating the plane of polarization of polarized light when placed in a magnetic field. Some of the photographic records obtained are reproduced. He calls this a reliable method, but concludes that its limitations are necessarily so great that it is not likely to find practical application.

Telegraphy, Telephony and Signals.

TELEPHONING ON TELEGRAPH LINES.—"Elek. Zeit.," Sept. 8.—A brief description, accompanied by good diagrammatic illustrations, of the Bechtold system, which is used on the Austrian railroad lines for telephonic communication between the block stations by connecting the telephones with the existing telegraph lines without interfering with their use for telegraphy (it seems to be the same system as was referred to in the "Digest" Sept. 17); only two stations can communicate with each other telephonically.

R. R. TELEPHONE AND BELL SIGNALS.—"Zeit. fuer Elek.," Sept. 4.—A brief description of the system used on the Austrian Government railroads. The telephones have no circuits of their own, being connected to already existing lines whose original purpose must not be interfered with by the telephones.

DISTURBANCES IN TELEPHONE LINES.—"Elek. Anz.," Aug. 14.—A short article on the changes which are to be made on the German long-distance lines, in order to aid in reducing the disturbances. The number of poles per mile is to be increased, the least distance being made 60 metres (about 200 feet); the lines are to be inspected more frequently and more regularly, for which purpose the bicycle is to be used, the inspectors traveling toward each other; the inspection of each line is to be made every four weeks. Testing stations are to be provided at every 15 to 20 km, consisting of a box into which the two lines go and with which telephonic communication can be had toward either side; these also contain an earth connection and a lightning arrester; an illustration is given.

PRINTING TELEGRAPH.—"Elek. Anz.," Aug. 7.—An illustrated description of the Kuebler system, for which great simplification is claimed, as well as great reliability and speed; it is claimed that 45 per cent. of the time can be saved as compared with other type-printing systems. It is a step-by-step instrument.

WIRELESS TELEGRAPHY. Ducretet. "Bull. Soc. Int. des Elec."—The reprint in full, with numerous illustrations, of his paper before the International Society, describing his form of the apparatus used.

PROGRESS IN TELEGRAPHY AND TELEPHONY.—"Elek. Anz.," Aug. 18, and "Elec. Tech.," Aug. 31.—A review of progress made in the second quarter of this year.

LIGHTNING ARRESTER.—"L'Eclairage Elec.," Aug. 27.—A brief, illustrated description of the Gattinger forms; they are intended for small currents. One form is composed of a pile of carbon plates, the alternate ones being connected to the line and the others to earth; between them are thin plates of mica; the action is said to be very energetic on account of the large surfaces. A vacuum arrester is also shown; in this there are carbon plates in a vacuum tube slightly separated from each other.

CO-OPERATIVE TELEPHONE SYSTEM. Manner. "Elec. Eng.," Sept. 22.—A short description of a projected system for connecting together the farmers of some nine or ten counties around Mansfield, Ohio.

Miscellaneous.

HEATING APPARATUS. Ritter. "L'Eclairage Elec.," Sept. 10.—A brief, illustrated description of the Alioth heating apparatus, which is adapted to be used with alternating currents only. The principle of these is the production of Foucault currents by an alternating magnetic field, these currents being produced in the massive metallic parts in which the heat is to be utilized; as the heat is not produced in the conducting wires, the efficiency is claimed to be high; the conducting wire, being an intermediate organ, can be properly proportioned for strength and efficiency, and, moreover, ordinary insulation is sufficient, as it is not subjected to the excessive heat. The cost of the apparatus is therefore considerably less; the massive pieces in which the Foucault currents are produced are made those in which the heat is wanted, the other parts being made thin or laminated; the efficiency is said to be very good. Several forms of apparatus are illustrated.

NEW INSULATING MATERIAL.—"Elec. Tech.," July 31.—A note on the new material called Marloid. It is made of rawhide, which is boiled in oil; it may be polished on either side, and after it is hardened it may be softened again by immersion in a salt or alum solution, so that it can be bent into any desired shape; it may also be formed before it is hardened originally. From one to ten minutes are required for the boiling; after being polished the material is nearly transparent, and can be given any degree of hardness. It can be milled, turned, drilled, etc.

VACUUM DRYING APPARATUS.—Lond. "Elec.," Sept. 9.—A brief, illustrated description of one made in Germany intended especially for the drying of cables. The great advantage claimed is that the hot air is forced to pass through every layer of the cable while it is on the drum.

ELECTRICAL FACTORY.—Lond. "Elec. Rev.," Sept. 9.—A long, illustrated description of the works of Brown, Boveri & Co. at Baden, Switzerland.

PARIS EXPOSITION.—"L'Elec.," Sept. 10.—A reprint of the rules concerning the electrical exhibits.

ELECTRIC HEATING.—"Sc. Am. Sup.," Sept. 17.—An abstract of an article from "La Nature" on Le Roy's system. He uses what he calls an electric "log," of which he can put any desired number in multiple, thus getting any desired quantity of heat. It consists of a piece of graphitoid for crystallized silicon about 4 inches [illegible] width and thickness, which is placed in a glass [illegible] is connected with copper mountings, a vacuum being formed in the tube. The material, "graphitoid silicium," was selected on account of its high specific resistance: a bar 4 inches long, "1.75-inch square section," has a resistance of 200 ohms, while carbon has 0.15 and german silver 0.00085. At 800° the resistance decreases from 35 to 40 per cent. Some comparisons are made of the cost of heating electrically and with [illegible]

PROFESSIONAL SCHOOLS. Thurston. "Elec. Eng.," Sept. 22.—A brief abstract of a recent paper on the correct theory and method of organization and conduct of professional schools, read before the Society for the Promotion of Engineering Education.

Book Reviews.

ELECTRICAL TESTING FOR TELEGRAPH ENGINEERS. By J. Elton Young. London: The Electrician Printing & Publishing Company. Imported by D. Van Nostrand Company, New York. 264 pages, illustrated. Price, $4.

This work discusses thoroughly the theory and practice of the testing of overhead, subterranean and submarine cables. The work is particularly devoted to the needs of the telegraph engineer, but should prove of service to those who have charge of cables for the transmission of currents for light and power where such cables require careful testing for faults.

THE INDICATOR HANDBOOK. By C. N. Pickworth. New York: D. Van Nostrand Company. 130 pages, illustrated. Price, $1.50.

This work is intended, according to the author's preface, as a practical handbook for engineers, describing the modern indicator and its application and discussing in detail the errors of the instrument and of its attachments and the errors likely to be introduced through faulty manipulation. For those who wish to make a study of the indicator and for those who wish to make more accurate determinations of the quantities measured by an indicator than can be obtained by following the directions given with the instruments by manufacturers, this book would be a valuable aid. For college instructors and indicator designers the book should also prove of value, and for a text book on this particular subject it is admirably suited; but for engineers who wish only to know how most simply and reasonably to obtain accurate results with the one type of indicator in their possession its complete discussion of the subject is hardly necessary.

"COMMERCIAL CUBA" is the title of a book about to be issued by Messrs. Charles Scribner's Sons, New York, the author being Mr. W. J. Clark, of the General Electric Company. The book deals with social and hygienic questions, legal procedure, political matters, public improvements, railways, both steam and electric, telegraph, cable and telephone lines, contract labor, mining and manufacturing in all of their branches and a multitude of other subjects of interest to business men who are looking to Cuba as a field for investment or as a market for goods. The book contains eight maps, seven plans of cities and forty full-page illustrations. The price of the one volume, which is large octavo, is $4.

THE DISCHARGE OF ELECTRICITY THROUGH GASES. By J. J. Thomson, professor in the University of Cambridge. New York, Charles [illegible] pages, illustrated. Price, $1.

This work is an amplification of four lectures on the subject given at Princeton University in 1896, with some results which have been made public since. The author's name is a sufficient guarantee of the reliability of the statements. The work treats of the electrification of gases by various means, photo-electric effects, conductivity of gases and flames, electrolysis in gases, sparks and the various phenomena of cathode rays. The ideas are expressed in as simple a [illegible] complexity, the use of the higher mathematics being limited.

A New Flush Plug Receptacle.

Messrs. Zimdars & Hunt, 127 Fifth Avenue, New York City, have just placed [illegible] able features that it will not fail to be appreciated in the trade. The device is [illegible]

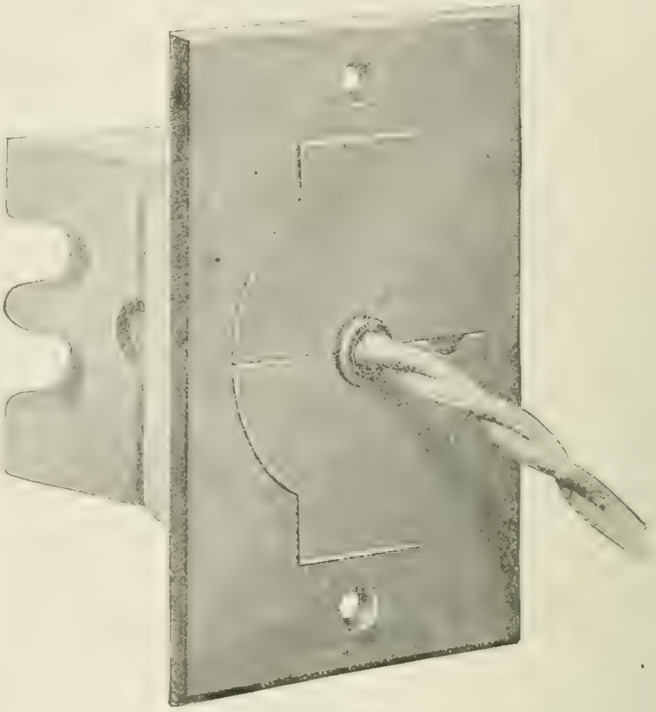
[illegible] tically the same appearance when the plug is in or out. An extension of the [illegible]

[illegible]

Improved Brush Arc Lamp.

[illegible]

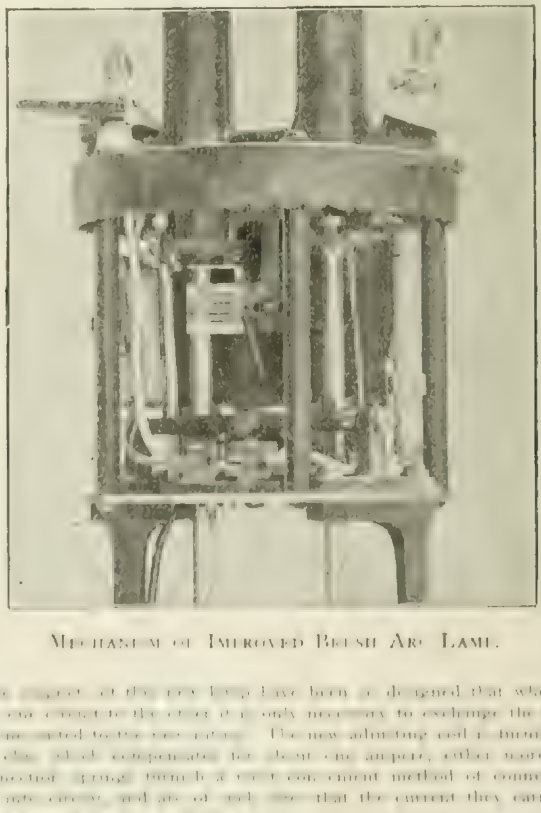
[illegible] as when first installed. It regulates so closely that the voltmeter on a circuit of lamps shows no appreciable variation. These lamps do not require hoods when hung outside, as all parts are thoroughly protected from the weather. All parts are made by special machinery, and are interchangeable. There are no springs to adjust or replace. The various contact surfaces are ample, and the insulation is so distributed that the danger of short circuits is eliminated. The use of one large insulating strip diminishes the number of insulation pieces required to secure the lower frame in position. All brass parts, except the carbon rods, are finished in nickel plate, adding to their durability as well as to the appearance of the lamp.



Improved Plug Receptacle.

The mechanism frame has been so modified that the armature lever is now supported by a base separate from the frame and mounted on a plate which insulates it entirely from the frame and zinc bottom of the lamp box. The armature lever has been slightly changed on account of changes in other parts and also to so support the balance wire in the double lamps that the second carbon feeds at practically the same voltage as the first carbon. This improvement makes a marked saving during the entire second half of the night's run, often amounting to from 30 to 50 watts.

Realizing the advantage of using a lamp on circuits of either 6.6 or 9.6 amperes, the magnets of the new lamp have been so designed that when changing from one circuit to the other it is only necessary to exchange the adjusting coil for one suited to the new rating. The new adjusting coil is furnished with a screw clip which compensates for about one ampere, either more or less. The connector springs furnish a very convenient method of connecting the magnets into circuit, and are of such size that the current they carry cannot heat them enough to change their temper.

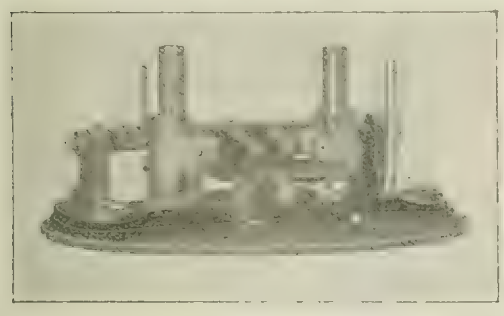


Mechanism of Improved Brush Arc Lamp.

In this lamp the contact between the rod and the inside terminal is necessarily a sliding contact, and the brush [illegible] keep the surface bright and clean.

The new brush is 1 inch wide, punched out of phosphor bronze and so slotted as to present five narrow fingers crosswise to the rod. The same punching is used on both single and double lamps, the double lamp requiring two strips and the single lamp one strip bent double. When worn out the contact brush may be quickly replaced without disturbing any other parts of the lamp. The improved contact is interchangeable with the old if the new contact support bracket is used.

The new form of clutch makes the feeding of the lamp independent of changes in the diameter of the rod. The wear caused by scouring is on the lower half—the part that rests in the bushings when new carbons are in the holder—and the best alignment is necessary. To overcome trouble due to excessive wear a reversible rod is introduced, which may be quickly removed, turned end for end and put back into the lamp while the lamp is hanging in position.



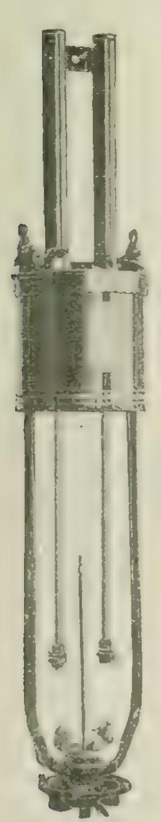
Support for Armature Lever.

Clutch with Rod Released.

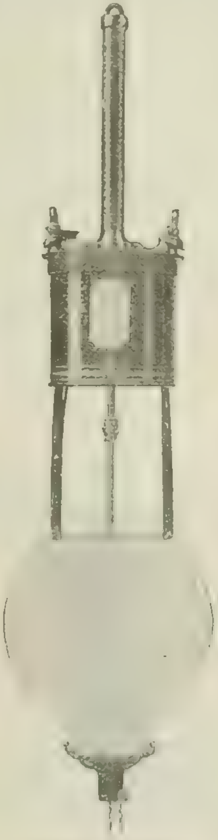
The two things necessary in a satisfactory carbon rod clutch—absolute uniformity of grip irrespective of the condition of the rod, and a means of accurate adjustment for wear of the rod or clutch—are found in the improved clutch. The surfaces bearing on the rod are so long ($1\frac{1}{4}$ inches) that the grip is not affected by roughness, dirt or even dents in the rod.

The shoe is of peculiar construction, being pivoted above its centre to a lever, which itself is so pivoted to the clutch body as to give a motion to the shoe perpendicular to the rod when the lever moves vertically. In action this clutch is positive, releasing the rod at a given point and instantly gripping it again when the lever is raised. The rod is always either firmly clutched or entirely free to fall. The clutch comprises but four parts beside the screw and rivets, and the same clutch is used on both single and double lamps.

The carbon holders have a V grip on the carbon. The upper holder is made in two sizes, taking seven-sixteenths inch or one-half inch carbons and nine-sixteenths inch or five-eighths inch carbons, respectively. It may be supplied with a flange to prevent injury to the rod in case of a flaming carbon. The lower carbon holder takes any size of carbon from seven-sixteenths inch to five-eighths inch inclusive. Its position is adjustable. To enable them to resist corrosion the holders are nickel plated.



Double Carbon Lamp.



Single Carbon Lamp.

The starting resistance is wound on a separate frame, which may be quickly removed, as only one screw, with a metal clamp, secures it to the side frame of the lamp mechanism. The cut-out is operated by the mechanical movement of the armature. When the current is too weak to energize the magnets the armature falls by force of gravity, throwing the cut-out into circuit.

In cases of accident to the main circuit of the lamp, such as breaking the carbons, the whole current of the lamp would tend to flow through the fine wire of the magnets before the armature would have time to drop and throw in the cut-out. To prevent any possible damage during this brief interval, an auxiliary cut-out is inserted, which at such a time opens a path for the total current around the magnets until the main cut-out can operate, when the auxiliary cut-out is itself thrown out of the circuit. On the double lamp the globe holder is secured by a thumb screw, the loosening of which permits the globe to be lowered until stopped by the nut on the centre support rod. The globe holder on the single lamp is also secured by a thumb screw, and when lowered is supported by a chain attached to the lower frame of the lamp. If desired the double lamp is supplied with drop tubes for the lower carbons. The globe holder of the single lamp for indoor use is fitted with a dust pan to prevent sparks and dust dropping through the globe holder.

When lamps are to be used indoors or in protected positions sheet-iron casings are furnished, but if they are to be exposed to the weather, especially near salt water or in a location where corrosion of the iron is likely to take place, the use of a copper casing is recommended. By simply pressing a spring clip on the upper side with one hand the casing may be removed. All casings are finished in black enamel.

Stokers at the Brooklyn Edison Company's Union Station.

Among mechanical stokers and patent furnaces the American stoker, introduced by the American Stoker Company, New York City, is claimed to stand alone as the only practical exponent of the principle of underfeeding of coal. That it is built upon correct lines is evident from its wide and rapidly extending adoption in power plants of prominence and magnitude in all parts of the country.

The principle upon which the American stoker operates practically reduces the coal to gas and coke, thus insuring complete combustion, and guarantees entire freedom from smoke and soot. The stoker will burn any grade of coal from the finest slack to lump of any size that can be put into the hopper, the constant feeding doing all the stoking necessary.

A good example of the use of the American stocker is found at the plant of the Edison Electric Illuminating Company of Brooklyn, N. Y., which will have an ultimate capacity of 60,000-hp station. About one-fourth of the plant has already been completed. The boiler room, 198x46 feet, is equipped with boilers of the Cahall water tube type, each with a nominal capacity of 500 horse-power. The boilers are furnished with the American under-feed stokers, three stokers independently driven being installed for each furnace. Slack coal for the furnaces is received upon boats at the foot of a dock and carried by cars to storage bins. From these bins it is elevated to smaller bins just above the boiler floor, and from these distributed through chutes to the several conveyors carrying it to the stokers. Chutes leading from the boiler house bins terminate in a weighing apparatus, which automatically registers the amount of coal passing through. The illustration herewith showing the boilers and stoker arrangement was secured before this coal conveying apparatus was installed.

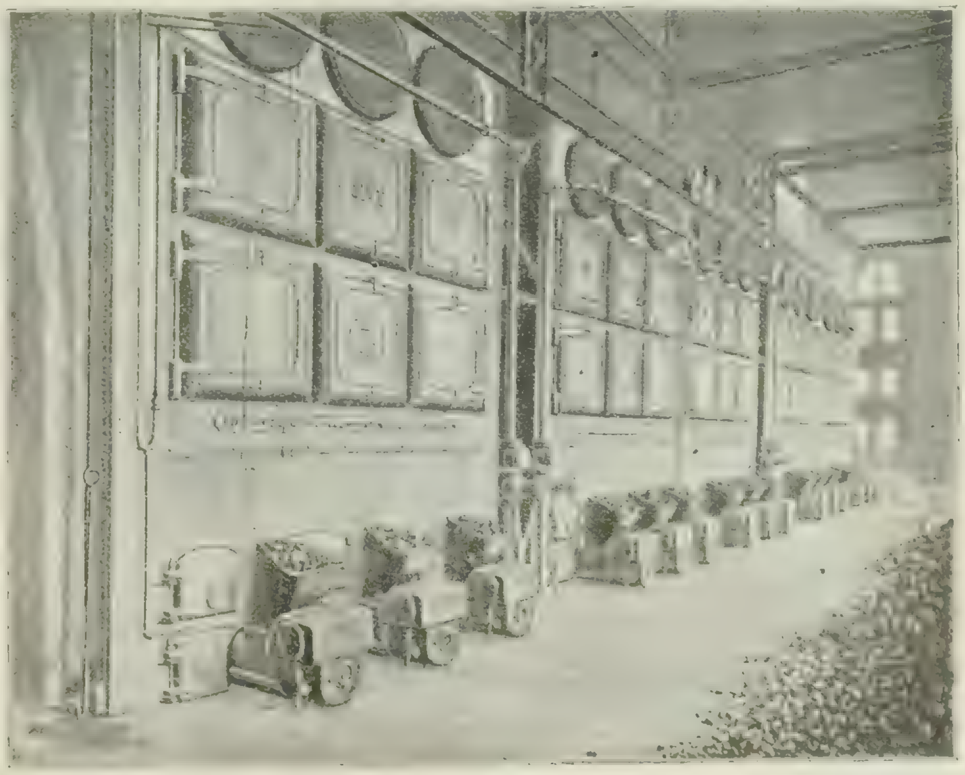


Fig. 1.—Stokers in the Brooklyn Edison Union Station.

Passing through the weighing apparatus the coal is distributed by two conveyors to three mechanical stokers on each side. These conveyors are driven by an electric motor located on the upper front edge of the boiler front. (Fig. 2.) Beneath the coal hopper of the stoker is a conveyor pipe, which communicates with the coal magazine placed in the furnace of the boiler. A screw conveyor, or worm (Fig. 3), is located in the conveyor pipe, and extends the entire length of this magazine. Immediately beneath the conveyor pipe is located the wind box, having an opening beneath the hopper, and through which the air supply for the furnace is forced. The other end of this wind box opens into the air space between the magazine and the other casing. The upper edge of the magazine is surrounded by tuyeres, or air blocks, which are provided with openings for the discharge of air inwardly and outwardly. Each stoker is driven independently by a small steam motor attached to and located in front and beneath the hopper. The motor has a simple reciprocating piston, which is so connected as to turn the conveyor shaft, which forces the coal into and up through the magazine.

The stoker is entirely self-contained and complete in itself. The rate of feeding the coal is controlled by the speed of the motor, this being effected by the simple means of throttling the steam in the supply pipe. The coal fed into the hopper is carried by the conveyor into the magazine, which overflows on both sides and spreads upon the sides of the grates. It is fed slowly and continuously, and as it approaches the fire in its upward course it is slowly roasted and coked. The released gases are taken up by the fresh air entering through the tuyeres, which consumes these gases and delivers the coal as coke on the grates above. Every pound of coal fed into the hoppers is subjected to this gas-making process, and there is no loss of coal through grates by reason of the use of dead grates in the furnaces in place of open grate bars. The fact that no smoke is discharged from the stack is evidence of the complete combustion of the coal.

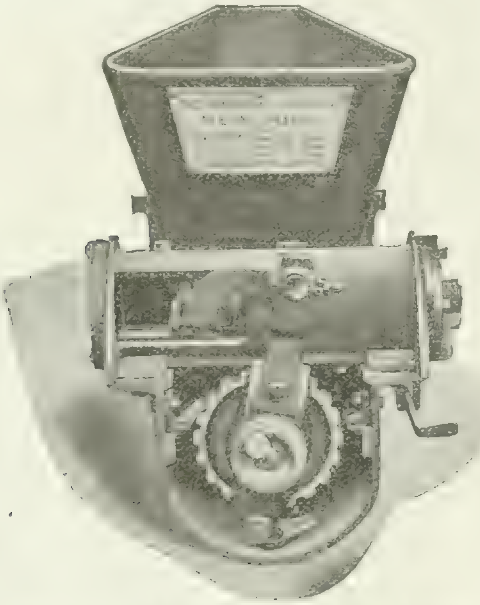
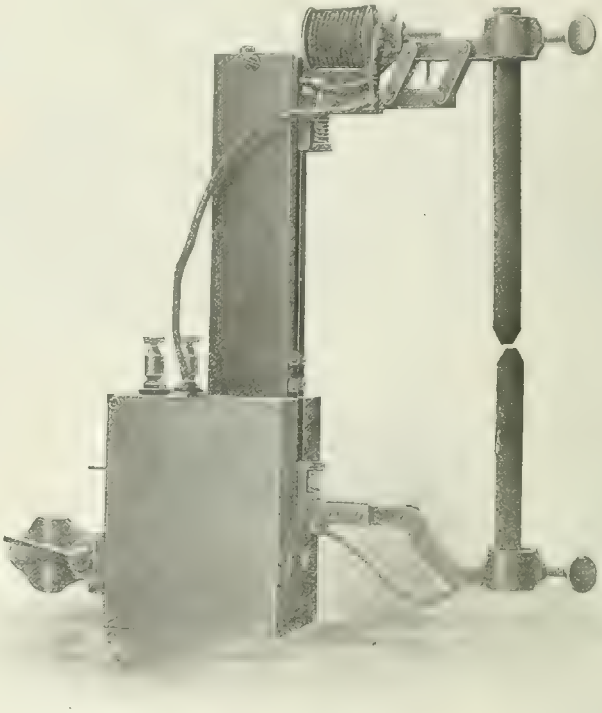


Fig. 2.—The Steam Motor of the Stoker.

An Improved Focusing Arc Lamp.

The automatic arc lamp described and illustrated herewith is designed for direct or alternating current, and will operate in any position. The carbons are fed by a new and patented mechanical movement which is said to be practically noiseless in action. The vertical screw rod is a right-and-left screw, [illegible] and is bevel geared to a clock movement contained in the case. At the back of the lower carbon [illegible] wheel, which engages in the lower [illegible] ing both carbons parallel. This action is effected by the plunger of the magnet, which is connected in series with the upper carbon.

The case contains, besides the clock movement, a pair of shunt magnets for automatically controlling the feed mechanism. The cores of these magnets are laminated for alternating current work, and they are wound with high resistance wire of low temperature coefficient. The armature is suspended on springs to eliminate as much friction as possible. The moment the arc becomes slightly enlarged the shunt magnet becomes more strongly energized, and the consequent attraction of the armature releases a small friction brake, which controls the clock mechanism. Thus released the clock movement turns the screw rod and moves the carbons toward each other. When the proper length of the arc has been established the armature drops and sets the brake, thus stopping the clock. The size of the arc is regulated by increasing the tension on the armature spring. As the tension is increased it requires more power, of course, to move the armature, thus giving a longer arc.



Automatic Lamp.

These lamps only require differences of from 0.2 to 0.5 ampere in the main circuit to cause the carbons to feed. This difference is so small that the arc does not enlarge to an extent sufficient to induce sputtering or unsteadiness.

A spring catch on the top and bottom carbon holders releases the worm or wheel from the screw shaft, enabling the operator to run the carbon holders back by hand before renewing the carbons.

The hand-feed lamp is provided with differential or equal feed, as desired, which is operated by means of a hand-feed screw. Like the automatic lamp it has a vertical screw rod, which, of course, is turned by the hand screw. The carbons are adjustable to any height independent of each other and of the feed rod, and the holders can be instantly returned to the starting position by disengaging them from the screw rod at the back by pressure of the thumb and finger on the [illegible] of the carbon holders. Only a very slight movement of the feed [illegible] is required in feeding, the carbon [illegible] one revolution [illegible].

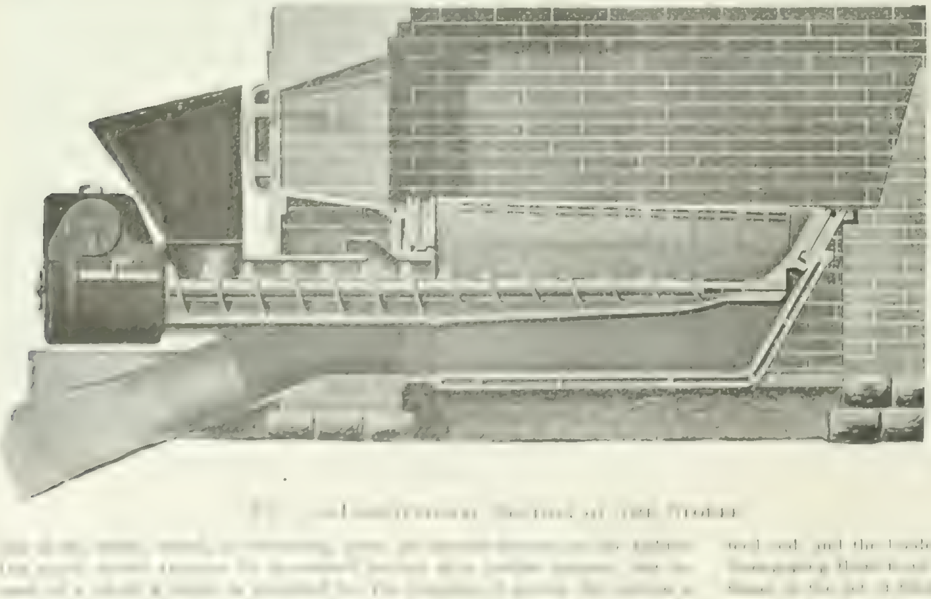
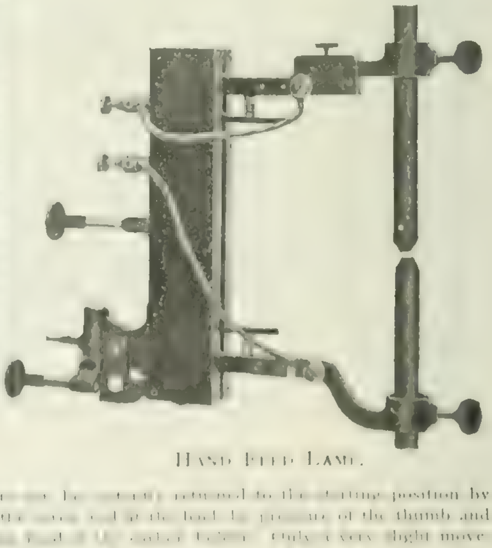


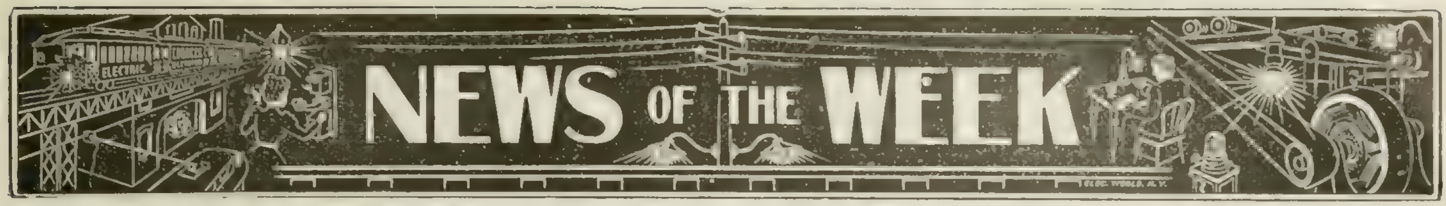
Fig. 3.—Longitudinal Section of the Stoker.



Hand Feed Lamp.

[illegible]

These lamps are adapted [illegible] stereopticon work and photo-engraving. In their construction great care is taken, and all the parts are made interchangeable. In view of [illegible] simplicity, [illegible] and convenience were the [illegible], and the manufacturers, [illegible] Baker & [illegible], 84 Schermerhorn Street, Brooklyn, N. Y., seem to have attained these to a high degree.



NEWS OF THE WEEK

Financial Intelligence.

THE MEXICAN TELEGRAPH COMPANY has declared a quarterly dividend of 2½ per cent., payable October 15.

THE GOVERNING COMMITTEE OF THE NEW YORK STOCK EXCHANGE on September 28 listed $575,000 additional issue of assenting stock of the Westinghouse Electric & Manufacturing Company, making the total amount listed $8,813,000. This stock is issued in part payment for the securities of the Walker Company.

THE EDISON ELECTRIC ILLUMINATING COMPANY, Brooklyn, has declared an extra dividend of the entire amount standing to the credit of profit and loss on June 30, 1898, together with the insurance reserve, and deducting therefrom expenses incurred through the proposed issue of $10,000,000 first consolidated bonds and its purchase of the stock of the Municipal Company. Holders of the stock of September 30, 1898, and the new stock of the company will participate in this dividend, which will be paid as soon as the accounts of the company are made up.

THE THIRD AVENUE RAILROAD COMPANY, New York, has notified its stockholders of an increase of its capital stock from $10,000,000 to $12,000,000, the additional capital being required to equip its lines with electricity. The Dry Dock, East Broadway and Battery line, the Union Railway Company ("Huckleberry" road), and the Forty-second Street, Manhattanville and St. Nicholas Avenue Railway Company, it is reported, have adopted resolutions providing for a consolidation with the Third Avenue road, with a capital stock of $53,000,000, of which $35,000,000 will be a new issue.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
9 Murray St., NEW YORK October 3, 1898.

THE BRIDGE RAILWAY SERVICE.—On Tuesday of last week a change was made in the schedule of the Brooklyn Elevated Railroad affecting the bridge service. Hereafter no through cars to and from New York will be in service on the bridge during the rush hours, from 6 to 10 o'clock in the morning and from 4 to 8 in the evening. During these periods the regular bridge cars will cross under one minute headway, and passengers will transfer to any elevated roads on one fare. It is believed that under this new arrangement a larger number of people can be moved during the rush hours than was possible under the old arrangement. It is estimated that 25,000 persons can be carried across each hour under the new order of things.

THE SIXTH AVENUE UNDERGROUND CONDUIT ROAD OPENED.—On Saturday morning, October 1, the new underground conduit road, running from 125th Street and Amsterdam Avenue, through parts of the Boulevard, Columbus Avenue, Fifty-ninth Street and down Sixth Avenue, was opened for traffic as far as Fourth Street. The cars were liberally patronized from the start, and the business men along Sixth Avenue, with an eye to an increase of trade, are naturally delighted over the new order of things. The portion of the line below Fourth Street is not quite ready for operation, but work on it is being pushed with the same vigor that has given a reputation to the Metropolitan Street Railway Company for rapid street railway construction.

THE SECOND ANNIVERSARY ENTERTAINMENT of the Metropolitan Street Railway Association was held at Carnegie Hall on last Saturday evening. A special feature was the presence of about thirty of the Metropolitan Street Railway Company's employees who served in Cuba and Porto Rico during the war. The railway company will restore them to their vacated positions as soon as they are able to perform their duties. They are yet too ill to return to work. The association has accumulated a fund of $5,000, which is invested in Metropolitan Street Railway securities. Thus the interests of capital and labor in this particular instance are brought into harmonious relations. The company encourages and aids the organization, which is of a benevolent character.

A CORPORATION WITH A SOUL.—The popular belief that corporations lack souls is not substantiated in one prominent case. The memory of the enthusiastic reception given to the famous Seventy-first Regiment on its return to New York is still fresh in the minds of New Yorkers. As usual on occasions of great popular demonstrations Broadway is the centre of activity and attraction, and necessarily the car service on that thoroughfare is then suspended, sometimes for several hours at a stretch. The loss to the railway company in consequence of the suspension of car service must be large, even if the stoppage is only for an hour. But how many people ever consider the company's loss? On the occasion of the return of the remnant of the Seventy-first Regiment regular car traffic was suspended when the troops marched up Broadway. The Metropolitan Street Railway Company rendered a graceful and patriotic service on that day. Many of the heroes were too ill to march, but the company provided cars, so that they could ride and be seen by the thousands of people who lined Broadway to welcome them. The generosity of the railway company on this occasion has been formally acknowledged by Lieut.-Col. Charles F. Homer, chairman of the Relief Committee of the Seventy-first Regiment Veteran Association, in a letter addressed to President H. H. Vreeland, of the Metropolitan Street Railway Company. The letter conveys the heartfelt thanks of the association for the service rendered to the sick and enfeebled soldiers by the officers and men of the street railway company. A number of the men, the letter states, have since died, but the assistance rendered by the company will long be remembered by the survivors.

REDUCING RATES FOR ELECTRIC LIGHT.—In accordance with its declared policy of reducing prices as fast as the extension of its business and its operating economies permit, the Edison Electric Illuminating Company of New York, is sending out to its customers a circular announcing a further reduction of rates on bills due after October 15. The new rates give customers the benefit of the fact that electricity for long-hour use can be produced and sold cheaper than any rival illuminant. The schedule is as follows: For retail use, 20 cents per kilowatt hour (equivalent to 1 cent per 16-cp 50-watt incandescent lamp hour, or 10 cents per standard arc-lamp hour), for the first hour's average daily use of the total lamp equivalent connected; 15 cents (three-quarters of a cent or 7½ cents) for the second hour; 10 cents (one-half cent or 5 cents) for the third and fourth hours, and 5 cents (one-quarter of a cent or 2½ cents) for all use above four hours. For wholesale use with a guarantee of 2000 kw hours' consumption each month and two hours' average daily use of installation, 10 cents per kilowatt hour for the first four hours' average daily use and 5 cents for all use above four hours; or, at the option of the consumer, the present wholesale or kilowatt hour rate of 10, 9, 8 and 7 cents per kilowatt hour for 2, 4, 6 and 8 hours' average daily use, with reductions for quantity, etc. These prices cover both incandescent and arc lighting, and include renewal of incandescent lamps (not exceeding one 16-cp lamp for each 20 kw hours), and the carbons and trimmings for arc lamps, but not first supply of lamps. Household elevators, pumps, etc., may be included at the retail rate without separate metering or separate minimum charge. To encourage cooking, heating, etc., by electricity, household apparatus for cooking, heating and ventilating will, until further notice, be excluded in reckoning installation. Thus the cost of lighting will be relatively diminished by the use of current for these purposes. These prices are made for the period of October-December, 1898, with the intention, should results justify, of making them permanent and possibly of still further reducing the rates for long-hour use or making a maximum rate equivalent to three-fourths of a cent per 16-cp incandescent lamp hour. The circular calls the customers' attention to the fact that to obtain their illuminant most cheaply and to the best advantage they will find it to their interest to use electricity for all their lighting, in place of other illuminants.

NEW ENGLAND NOTES.

Branch Office of THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., October 1, 1898.

THE ANCHOR ELECTRIC COMPANY, Boston, Mass., is about to open an office in New York City under the charge of a wide-awake representative, who will keep in close touch with the trade and electrical visitors to the metropolis. Mr. Marshall, treasurer and general manager of the company, has recently made several visits to New York to make the necessary arrangements.

THE OLD MECHANICS FAIR.—The twentieth triennial exhibition of the Massachusetts Charitable Mechanic Association will be formally opened at 8:30 o'clock in the evening of Saturday, October 8, by the Governor of Massachusetts. The machinery will be started by that official in the manner which has become customary on such occasions, namely, by closing an electrical circuit. Among the attractions of electrical interest at the fair will be the wireless telegraph system of the United States Electrical Supply Company, of New York, which will be in charge of Mr. W. J. Clarke, who has become widely known through his connection with this interesting phase of electrical development. Signals will be transmitted about the hall by the wireless system, and it is proposed to explode submarine mines in the artificial lake in the same manner. A modern parlor has been constructed and furnished in the basement of the grand hall for the purpose of exhibiting the Moore vacuum tube light. No expense has been spared to make this parlor elegant and attractive. The Edison Electric Illuminating Company of Boston will make a comprehensive and elaborate exhibit, showing the application of electricity to illumination and to domestic appliances. An extensive display of motor carriages, including electric, will also be made. A speed contest of these vehicles will take place in Charles River Park in order to afford an opportunity to bring to public attention the good points of each make. The conditions of the contest are: 1, speed at level grade; 2, speed at greatest elevated grade; 3, turning round in smallest space; 4, stopping at unexpected signal in shortest space; 5, economy of fuel; 6, efficiency of brake; 7, durability of machine; 8, cost of machine; 9, quickness of preparation for use. A series of eight historical wax tableaux, designed to mark some of the various stages of electrical development, will be shown, and no doubt will form an interesting feature of the show. Since no exhibition is complete without an X-ray demonstration the Mechanics Fair will not be an exception in this respect. The Diesel motor, which is attracting a great deal of attention in the mechanical world through the high economy realized in its operation, will be exhibited here for the first time in New England. Those interested in this machine may find a complete description of it in THE ELECTRICAL WORLD of February 19 and May 28, 1898. The exhibition will be opened to the public on Monday, October 10.

BUFFALO AND NIAGARA FALLS NOTES.

BUFFALO, N. Y., October 1, 1898.

PERSONAL.—Mr. R. A. [illegible], who has been the manager of the Buffalo office of the Walker Electric Company for two years, has resigned, and will return to New York City.

THE WALKER COMPANY has just [illegible] alternating current generator in the Niagara gorge power house of the Schoellkopf Company. It is to be used for street and hotel lights in the city. Current will be generated at 2000 volts, and in case the consumer desires to reduce the voltage he must set up transformers [illegible]

THE [illegible] & CONDUIT COMPANY has let the contract for 30,000 feet of cable to be laid in Niagara Street to the India Rubber & Gutta Percha Insulating Company, of Yonkers, N. Y., and the construction of the cable has already begun. The cable will carry a three-phase, 20,000-volt current. It will be a part of the regular line to Niagara Falls. Besides this a large amount of cable will go into new subways in the city yet this fall.

THE NEW TROLLEY LINE connecting the villages of Lima and Honeoye Falls, a distance of 6 miles, is finished and in operation. The cars are equipped with four 50-hp motors, this large power being requisite on account of the freight to be handled. The line is changed from a steam road, and will do all the work done by the latter. In fact, the handling of freight is to be the chief business during a part of the year at least. The power is to be furnished [illegible]

THE SEVENTY-FIFTH MEETING of the American Institute of Mining Engineers will be held in Buffalo, October 18-20. The final meeting will be held at the International Hotel at Niagara Falls, when a paper will be read on the power development at that place. It is expected that from 100 to 200 delegates will be present. The institute is twenty-seven years old, and as the membership includes many of the finest engineers in the country the proceedings cannot fail to be interesting and valuable.

CHICAGO NOTES.

Branch Office of THE ELECTRICAL WORLD,
936 Monadnock Building,
CHICAGO, Ill., October 1, 1898.

MR. GERALD MAHONY, electrician for the LaKon Company, Elkhart, Ind., was a visitor in Chicago during the past week.

CONSIDERING THE FACT that the Chicago Rheostat Company has but recently entered the electrical field it is encouraging to the company to note that orders have been received during the past two weeks for rheostats aggregating 464 horse-power. The company is under the general management of Mr. E. W. Hammer, whose efforts in the rheostat line in the past have brought successful results. In addition to a full line of standard motor-starting and controlling rheostats the Chicago Rheostat Company will furnish a complete line of special pump and elevator controllers made under the Whittingham patents, also a full line of dynamo field rheostats using the new enameled resistance unit system patented by the American Electric Heating Corporation. The superintendent of the company is Mr. J. D. Claghorn, who occupied a similar position with Mr. Hammer's old company from its inception until a very recent date. He has been intimately connected with electrical manufacturing for the past fifteen years. The designing department will be under the charge of Mr. F. S. Hurst, who was formerly chief of the draughting department of the Cutler-Hammer Manufacturing Company.

MILWAUKEE NOTES.

MILWAUKEE, Wis., October 1, 1898.

THE WISCONSIN TELEPHONE COMPANY has completed its long-distance circuit from Janesville to Monroe, and the line is being extended to Dubuque.

THE WAUPACA ELECTRIC LIGHT & RAILWAY COMPANY is contemplating the building of a line from the Wisconsin Central Railroad station to the Chain-of-Lakes.

ST. LOUIS NOTES.

ST. LOUIS, Mo., September 28, 1898.

STRIKE ENDED.—The strike of the linemen of the Missouri-Edison Electric Company, which was started August 1 for a raise in salary, has been ended. The men gave in, and the company is re-engaging the best of the workmen.

A SPECIAL ELECTION for a franchise to be granted to certain persons at Nevada, Mo., to build an electric street railway in that city, was held this week. The proposition was carried by a two-thirds vote. The company agrees [illegible] to the city.

NEW TAX ON TELEPHONE MESSAGES.—The Bell Telephone Company has undertaken the introduction of an innovation to which it is believed the public will not take kindly. It is the adoption of the pay system for sending telephone messages from public stations. A separate telephone with an attendant is placed in the public places, and a fee of 10 cents is charged for every [illegible]

THE CIRCUIT COURT in a decision this week sustained the motion of the railroad's attorney to set aside the decree in the People's Railway case, which subordinated the personal taxes against the road, amounting to about $12,000, to the claims of the first mortgage bondholders. The judge held that the personal taxes of the road were in reality a part of its running expenses, and that [illegible]

PACIFIC COAST NOTES.

[illegible]

[illegible]

PROF. [illegible]

THE [illegible] TELEPHONE & TELEGRAPH COMPANY [illegible] in length, which gives Eureka, Humboldt County, [illegible]

THE [illegible] ELECTRIC COMPANY [illegible]

THE [illegible] COMPANY has [illegible] with a capital stock of $100,000, of which amount $12,000 has been subscribed. It was organized to buy, sell, operate and conduct the business of electrical, gas, steam or water plants. Los Angeles, Cal., is to be the principal place of business. The directors of the company are Lewis Thorne, E. D. Silent, Ferdinand Wheeler and Harry V. Carter.

THE MT. OLIVET ELECTRIC RAILWAY line, which is about to be opened to travel, is said to be the shortest independent line in America. Starting from the San José road, in San Mateo County, Cal., it follows Mt. Olivet Avenue to the cemetery of the same name, the distance being 2528 feet. The line was built by the directors of the cemetery association, and it will connect with the San Mateo Electric Railroad Company's line from San Francisco.

CANADIAN NOTES.

TORONTO, Ont., September 29, 1898.

THE METROPOLITAN STREET RAILWAY COMPANY, of Toronto, is now extending its line north to Newmarket, a distance of 34 miles.

THE RATEPAYERS of Barrie have sanctioned a by-law to raise $35,000 to purchase and install a new municipal lighting and power plant.

A RUMOR is current that the Ottawa Street Railway Company has purchased the Ottawa & Gatineau Railway, and will convert it into an electric road.

A COMPANY of American capitalists is endeavoring to arrange for the development of the water power on the Jacques Cartier River for electrical transmission.

MR. S. C. DRUMMOND, representing the British Electric Traction Company, of London, England, has applied to the Nelson, B. C., Municipal Council for a charter for an electric street railway.

A PROJECT to convert the Niagara Central Railway, between Niagara Falls and St. Catharines, Ont., into an electric road is receiving favorable consideration. The extension of this road from St. Catharines to Port Dalhousie and Beamsville, Ont., is also being talked of.

THE CITY COUNCIL of Hamilton, Ont., has passed the third reading of the by-law authorizing the extension of the franchise of the Street Railway Company, and the agreement has been signed, thus placing that company in possession of its privileges for the next thirty years.

THE LINDSAY-FENELON FALLS TRANSMISSION SCHEME.—The Municipal Council of Lindsay, Ont., has granted an extension of two weeks to Messrs. Alex. Culverwell and George White-Fraser in which to complete arrangements for the carrying out of their 16-mile power transmission scheme between Lindsay and Fenelon Falls. The promoters state that the necessary capital has all been subscribed. The next move will likely be toward receiving tenders for the electrical and hydraulic plants.

OTTAWA, Ont., September 29, 1898.

THE ELECTRIC LIGHT & POWER COMPANY, of Quebec, is building a large power house at St. Gabriel Falls. It is proposed to establish three pulp mills at this point.

APPLICATION has been made to the Ontario Legislature for an act to incorporate the Toronto Elevated Railway Company, such act to provide that the company may, subject to the consent of the municipalities affected and subject to all other existing rights, construct and operate a system of elevated electric railways in Toronto and adjoining municipalities, and also in conjunction therewith a system of surface railways in Toronto and other municipalities within a radius of 50 miles.

THE ANNUAL MEETING of the Standard Light & Power Company was held this week at the office of the company in Montreal. A contract has been entered into with the Lachine Rapids Hydraulic Company for supplying current to run its plant from the Lachine Rapids by electric power in place of steam. It was decided to largely improve the station by purchasing rotary converters, fireproofing the building and making the station the most complete direct current station in the Dominion. In addition to receiving power from the Lachine Rapids there is also a magnificent steam plant in reserve, so that its customers are doubly protected.

A PRACTICAL TEST of the Canadian Pacific's new copper wire was made on Wednesday last, between Montreal and Vancouver, and the time consumed in sending a message to Montreal and transmitting reply to Vancouver was about a minute. The wire was duplexed. The actual distance covered by this new wire is about 2900 miles, constituting probably the largest direct line circuit for daily work in the world. The line will enable Montreal, Vancouver, Winnipeg, Rossland, Nelson and other far western points to transact speculative business between these points almost as quickly as between Montreal and Chicago. [illegible] to the Kootenay, via the Crow's Nest Pass line, will [illegible] be completed [illegible]

FRENCH NOTES.

(From Our Special Correspondent.)

PARIS, September 29, 1898.

BROWN, BOVERI & CO., BADEN.—[illegible] Zurich that [illegible] Brown, Boveri & Co., Baden (Canton [illegible] in that city, with [illegible] in France, which will [illegible]

AN ELECTRICAL THRESHING MACHINE.—A portable threshing machine [illegible] has recently been [illegible] The use of [illegible] is very general, and the price extremely low. It is not uncommon to find small cabins and even stables lighted by this beautiful illuminant.

GENERAL ELECTRIC COMPANY.—The company bearing this name was organized last April, with the following objects in view: 1. To produce and furnish electrical energy for public and private use in France and other countries; to undertake enterprises and install machinery for and to manufacture every kind of article connected with the use of electricity as a source of light, heat and power; to solicit, obtain or take over all kinds of concessions, charters and permits connected with such enterprises. 2. The manufacture and sale of all forms of accumulator batteries. 3. The manufacture and sale of all forms of electric lamps, incandescent or otherwise. 4. The installation and operation of all kinds of metallurgical establishments, paying especial attention to such industrial and commercial operations as are allied with the metallurgy and production of copper and its alloys, whether intended for electrical or for other uses. Also the exploitation of the arts relating to the pulverization of metals and their applications. The capital stock is 10,000,000 francs in 20,000 shares of 500 francs each, and is composed of cash and property valuations; 7480 shares have been apportioned on the property as follows: 4000 to the Société Normande d'Electricité, this company receiving in addition to this stock a cash payment of 1,032,500 francs; 280 to F. Gabriel and H. Augenault, lamp manufacturers, with a cash payment of 760,000 francs; 2000 to the Société Anonyme de Monchel, with a cash payment of 440,000 francs. M. Azaria, in return for his contribution in kind and for the time and study and management laid out by him on the foundation of this company, receives 1200 shares at 500 francs each. The 12,520 shares forming the remainder of the capital are subscribed for in both cash and property to the extent of about one-quarter.

THE ELECTRIC RAILWAY BETWEEN OLORON (FRANCE) AND JACA (SPAIN), ACROSS THE PYRENEES.—The Oloron-Jaca line of railway will have an annual traffic of some 60,000 tons and 35,000 passengers. It should be possible to collect 8 francs per ton for through freight, which is a trifle less than 10 centimes per ton kilometre. At this price the railway ought to secure the wine which is sent from Huesca to Paris, and with still greater reason that which goes to intermediate points like Orléans, Bourges, etc., which have the same rates as Paris from Oloron. These towns are getting Huesca wine from Paris, and they are paying in addition to 55 francs 31 centimes per ton an extra sum for freight from Paris, which gives the advantage to the route via Oloron. The fare of 6 francs for passenger traffic from one terminus to the other is not exorbitant considering the altitude which is attained. With the passenger rates in France, as in Spain, strictly proportional to the distance traveled, this line can offer advantages not only to travelers from France to Jaca, Huesca, Saragossa and Aragon, or those traveling between Madrid and Pau, but even to those traveling between Madrid and Lyons, Valence or Bordeaux. The cost of building this line is estimated, from special surveys, to be as follows: Roadbed, with track, one metre gauge, stations, depots, tools, operating machinery, rolling stock, interest on capital during the construction period and land damages, 40,000 francs per kilometre. This is the contract price for the portion in the lower Pyrenees, and it includes all the expenses mentioned above, and is high enough to have enabled the contractor to sublet parts of his contract with profit to himself. For the whole 85 kilometres this would be a cost of 3,400,000 francs. There will be extra expenses to be added to this for special constructions and apparatus for reaching the peak of the mountain range. Either rack or cable railway will be used. These types of traction make such progress each day that it is impossible to state now which of the two will be better adapted to this purpose two years from now. At 5000 francs per kilometre this would add to the cost of the 85 kilometres 425,000 francs. Snowsheds will be used, a method of protection from snow which makes it possible to cross the highest ranges without the necessity of piercing them with a tunnel. This method has been much used in America in the Rocky Mountains and in Europe; also at a few points, notably on the Mont Cenis route, while awaiting the completion of the tunnel. In Spain also it is used in a few places on the Northern road, where the sides of the sheds are made of wire cloth, with a mesh sufficiently small to keep out the snow in winter, but permitting a free passage of air in summer, which is frequently extremely hot. These sheds will add 750,000 francs per kilometre for 7 kilometres, or a total of 525,000 francs. Conduit laying for wire will cost 15,000 francs per kilometre, or 1,275,000 francs additional. The power stations will be built to furnish 2500 horse-power. This is based on an estimate allowing two five-car trains, carrying 8000 kilogrammes load on the ascent between Oloron and Somport at a rate of 30 kilometres per hour, also a train similarly loaded coming from Jaca at the same rate of speed. No account has been taken of the possibility of making the trains on a down grade furnish power to the line which would diminish the installation needed. Moreover, it is quite unnecessary to have more than a third of the transportation facilities figured on the ascent at any one time. Hence the figure 2500 horse-power, given for the motive power, is greatly in excess of all needs. Twenty-five hundred horse-power at 400 francs per horse-power would require 1,000,000 francs. The sum total of first cost comes up to 6,625,000 francs.

General News.

NEW INCORPORATIONS.

THE REX INCANDESCENT LIGHT COMPANY, New York, N. Y., has been incorporated with a capital stock of $300,000.

THE OTTUMWA LONG-DISTANCE TELEPHONE COMPANY, Ottumwa, Ia., has been formed with a capital stock of $10,000. The incorporators are J. C. Goddard, P. E. Wilson and A. R. Cowdery.

THE ATLANTIC COUNTY TELEPHONE COMPANY has been incorporated at Trenton, N. J., with a capital stock of $100,000. Among the incorporators are Frederick L. Benson, Alfred Dingler, Jersey City; John J. McCloskey, Philadelphia, Pa.

THE AMERICAN AUTOMOBILE COMPANY has filed articles of incorporation at Elizabeth, N. J., with a capital stock of $500,000. The company [illegible] engage in the manufacture [illegible] other electric devices. Its chief office will be in Plainfield.

THE TELEGRAPH AND TELEPHONE.

ELYRIA, OHIO.—The Elyria Telephone Company has increased its capital stock from $20,000 to $50,000.

TOWSON, MD.—Articles for the incorporation of the new Baltimore & Harford County Telephone Company have been filed here. The capital stock is $30,000.

ABILENE, TEX.—Telephone connections between Merkel and Sweetwater have been established. This gives Abilene long distance connection with Roby, via these two places.

GREENVILLE, PA.—The Jefferson & Warren Telephone Company already has poles on the ground for a branch line from Cortland to Orangeville, Kinsman and Andover. It is quite likely that a connection will be made with the Mercer Company's lines.

ASBURY PARK, N. J.—The Monmouth County Telephone Company has applied to the Board of Commissioners for a franchise to erect its poles and run wires through the streets of Long Branch for the purpose of conducting a telephone business. The matter was laid over.

NEWARK, N. J.—Workmen are tearing down the old buildings at 158 and 160 Market Street to make room for the new edifice which the New York & New Jersey Telephone Company is going to put up there. The new building is to be six stories high, with terra cotta front of the Renaissance style. It will be fireproof throughout. The building will be ready for occupancy by May 1, 1899. Its cost will be about $90,000.

NEWARK, N. J.—A mortgage for $1,000,000 was recorded a few days ago in the office of the County Register at Newark by the State Telephone Company of Jersey City to the Fidelity Trust Company, of Newark. The mortgage is signed by W. I. Taylor, president, and W. C. Cox, secretary of the Telephone Company, and by Jerome Taylor, second vice-president, and Uzal McCarter, secretary of the Trust Company.

GREENFIELD, IND.—The New Long-Distance Telephone Company has obtained the right from the County Commissioners to construct its lines along the highways of Hancock County. There is a movement on foot now to organize a co-operative telephone company in Greenfield, with an invitation to the people in all parts of Hancock County to run their lines into its exchange and to connect with all subscribers in Greenfield without cost.

SANTIAGO DE CUBA.—Orders have been given to Captain Brady, of the United States Signal Service, to begin the construction of an overland telegraph line from Guantanamo via Santiago to Manzanillo. The principal use of the line will be for the transmission of government dispatches, the present cost of message transmission by telegraph from Guantanamo to Santiago being 20 cents per word up to thirty words, and 12 cents for each additional word..

MINNEAPOLIS, MINN.—Negotiations were closed a few days ago whereby the Northwestern Telephone Exchange Company, the Western Electric system, the Western Electric Telephone Company, the Minnesota Mutual Telephone & Telegraph Company, and all of the dependent and allied companies operating in between 500 and 600 towns, will pool issues. They will operate their lines in direct connection, which will enable Minneapolis to talk with all parts of Iowa, Nebraska, Missouri, Kansas and Illinois.

RICHMOND, VA.—That the city of Richmond intends to fight to the last ditch the Southern Bell Telephone Company, now doing business here without franchise, by grace of an injunction granted by Judge Nathan Goff, of the United States Circuit Court, was plainly shown by the action of the Board of Aldermen. That body suspended its rules and adopted unanimously a resolution providing for the employment of assistant counsel to the city attorney in the conduct of the case, which is now pending in the Supreme Court of the United States.

ELECTRIC LIGHT AND POWER.

THIBODEAUX, LA.—The question of establishing municipal lighting will be voted upon at the November election.

MONTICELLO, ILL.—It is proposed to increase the stock of the Monticello Electric Light Company to $20,000, and put in a large heating plant to heat the business houses.

GRAND RAPIDS, MICH.—A favorable report has been made upon the bid of the Chase Construction Company, of Detroit, for the proposed city electric light plant. The bid is $89,970.

EMMETSBURG, IA.—A special election will be held on Thursday, October 20, on the question of granting a twenty-year franchise for an electric light plant to John McNamara, of Fulton, Ill.

NAPA, CAL.—The Clear Lake Electric Power Company has nearly completed its preliminary work, which has extended over two years, and is expecting to develop between 3000 and 4000 horse-power.

CLEVELAND, OHIO.—R. P. Baldwin has been appointed by Judge Ong as receiver of the People's Light & Power Company, of Crestline. The application was made by A. R. Manning, assignee of the Cornman Electric Company.

STEVENS POINT, WIS.—The Stevens Point Lighting Company has been placed in the hands of Vice-President Atwell, of this city, as receiver, under $50,000 bonds. The capital stock is $50,000. This plant is bonded at $30,000 in Milwaukee.

TROY, N. Y.—Charles J. Cooper, of Brooklyn, who recently purchased the Hudson Street Railway, has just closed negotiations by which he also becomes sole owner of the plant and franchise of the Hudson Electric Light & Power Company. The consideration is $150,000.

WABASH, IND.—It is announced that the sale of the Indiana Electric Company's line in Elkhart and connecting Elkhart and Goshen has been effected to the owners of the South Bend system. The new owners will build a trolley line from South Bend to Goshen this fall.

LITTLE FALLS, N. Y.—The Cayadutta Generating Company has purchased the electric light plant of Streeter Brothers, of Fonda, which includes the franchise for the villages of Fonda and Fultonville. The transfer is to take place November 1. At that time the Cayadutta Generating Company will be in shape to operate its new plant, which is being equipped with the latest and best machinery.

ALBANY, N. Y.—Papers incorporating the Mill Point Power Company have been filed with the Secretary of State. The new concern is capitalized at $80,000. Its objects are stated to be to furnish electricity for Amsterdam and towns of Montgomery County, and Johnstown and Gloversville and towns in Fulton County. The directors for the first year are: John Marsh, San Francisco; John Begley, Gloversville, Hugh J. Brady, Cooperstown; Paul T. Brady, Robert E. Drake, Syracuse; Walter H. Bunn, New York; Charles M. Warner, Syracuse.

THE ELECTRIC RAILWAY.

GRAND RAPIDS, MICH.—Mr. C. B. Judd, of this city, is reported to be at the head of a project to build an electric railway between Grand Rapids and Belding, Mich.

FREMONT, OHIO.—The right of way for the Tiffin-Fremont-Port Clinton Electric Railway has been secured between this city and Tiffin, a distance of 18 miles. The right of way between Fremont and Port Clinton is now being secured.

MILLBURY, MASS.—Work has begun upon the construction of the new electric road from Grafton to Worcester. The line will pass through North Grafton and Millsbury Junction and connect with the Consolidated road's tracks in Worcester. The plan is to have the cars running by Nov. 1.

NEW YORK, N. Y.—Reports have been revived that there is a project on foot to combine all of the trolley roads between New York and Albany into one great system, and to build up a formidable competitor to the New York Central. This time the scheme is attributed to ex-Gov. Roswell P. Flower.

AUBURN, N. Y.—The City Railway Company is negotiating for the construction of a steamer to be run on Owasco Lake next season. It is proposed to build the boat this winter, and have it ready to launch next spring. The steamer is to be 120 feet long and to be fitted with every modern convenience. It will be run in connection with the trolley.

ALBANY, N. Y.—The Board of Railroad Commissioners has granted the application of the New York & North Shore Railway Company for permission to construct an electric road from the terminus of the New York & Queens County Railroad, at Middle Village, L. I., through Jamaica, Flushing, Whitestone, College Point and Bay Side to Manhasset.

CLEVELAND, OHIO.—Frank De Haas Robison, a well-known street railway man, announces that Cleveland will have a complete system of low fare street railways. In all 90 miles of double-track railway will be built, paralleling the present roads. Mr. Robison says consent of property owners for 42 miles of the road has already been secured, and the City Council will soon be asked for a franchise.

PHILADELPHIA, PA.—The Newtown Electric Street Railroad Company, which recently acquired control of the Langhorne and Bristol trolley road, has awarded the contract for the extension of this line from Newtown to Doylestown. This will make a continuous line of 26 miles from Bristol to the county seat. Thomas H. Connell, the contractor, promises to have the road completed about December 15.

SAN FRANCISCO, CAL.—A syndicate composed of San Francisco capitalists will soon be in control of the Los Angeles street railroad system. The deal has been in contemplation for some time, and will be consummated within a few days. The local financiers who are interested in this new enterprise are C. P. Huntington, Henry E. Huntington, I. W. Hellman, Christian de Guigne and H. Borel. The Los Angeles street railroads were recently consolidated and bonded. These bonds will be purchased by the new combination and another issue made.

PHILADELPHIA, PA.—At the annual meeting of the Union Traction Company on September 26 John Lowber Welsh, who withdrew from the presidency and accepted an election to the board of directors, presented his resig[illegible] Elkins, was chosen as his successor. The board then organized and elected John B. Parsons president and George D. Weidener vice-president. Mr. Parsons has been general manager of the company since 1896, coming here from [illegible]

[illegible] road to Wilmington. The line is now being built between that city and [illegible] one connecting Chester with Darby, and which has been in operation for several years. When the Wilmington link shall have been completed it will be [illegible]

[illegible] arranged that when the necessity arises they will be available for telephonic [illegible]

[illegible]

the year 1897 on the property of the surface railroad companies in Kings County. The DeKalb Avenue and Newtown track mileage is reduced from $320,000 to $215,000. The Nassau Electric Railroad Company's track valuation is proportionately reduced and the valuation is placed at $30,750 a mile of double track of girder construction, and $22,750 a mile of double track of stronger construction. The Brooklyn Heights Railroad Company's track valuation is reduced from $2,900,000 to about $2,000,000. The valuations of the Brooklyn, Queens County & Suburban, the Atlantic Avenue and the South Brooklyn Central Railroads are reduced proportionately. The reductions are about 25 per cent.

PITTSBURG, PA.—There has been some concern among local theatrical managers lest the free show scheme of the Consolidated Traction Company should encroach on the pay theatres to such an extent as to practically kill the legitimate show business of the city. Recognizing the fact that a free entertainment, such as was given in Schenley Park during the summer months, given through the regular theatrical season would, to say the least, make serious inroads on the regular theatres, men who have their money invested in these institutions have naturally felt that the time had arrived to call a halt. Their fears, however, have been allayed by a statement made by President C. L. Magee to the effect that there will be no free shows in the winter time and that the summer shows will not begin early enough to interfere with the regular theatrical season.

HAVERHILL, MASS.—The efforts of the Lowell, Lawrence & Haverhill Street Railway Company to secure bonds from its employees have met with determined opposition, and the men are now out on strike. They were ordered, under penalty of dismissal in case of refusal to comply, to furnish an indemnity bond in the sum of $300 to cover damages resulting from mishaps or accidents to property, arising from what is termed in the bond as the negligence or misconduct of the men. The latter endeavored to secure certain modifications in the requirements of the bond, but were unsuccessful and, it is reported, were denied employment for refusing to sign. According to the terms of the bond, it is said that the company could make the men pay for every accident from any cause whatever, and the old employees take the ground that the bond scheme is unjust, since none of them is in a position to defend his objection to paying damages when accidents did occur.

PLAINFIELD, N. J.—An interesting and important point has been raised in Somerville as to whether or not the Brunswick Traction Company has forfeited its right to operate the extension of the street railway through that place by not having the road completed over the whole route within the six months allowed for the work of construction by the Bridgewater Township Committee. It was this time limit that caused the company to make a hasty move to run cars through Dunellen recently, but in Somerville the possibility of the franchise becoming invalid was not recognized. The agreement between the township and the trolley capitalists was that the tracks should be laid from the eastern to the western limits of the town, but the tracks lack a considerable distance of covering the route on the western end. The time limit on the franchise expired on September 21. A number of Somerville residents are urging the officials to use the circumstance as a means of compelling the traction company to award the township a further bonus.

LEGAL NOTE.

THE SPRAGUE ELECTRIC RAILWAY & MOTOR COMPANY V. THE DETROIT CITIZENS' STREET RAILWAY COMPANY.—Another preliminary injunction in the infringement litigation which the General Electric Company has been bringing against the Walker Company on the Sprague patent No. [illegible], for the spring suspension of railway motors was filed in the United States Circuit Court, Eastern District of Michigan, September 19, 1898. The defendants are ordered to remove at least 250 of the equipments infringing this patent within thirty days from the date of filing, 250 more within sixty days and the balance within ninety days. Owing to the consolidation of the Westinghouse and Walker companies before the filing of this preliminary injunction, it is doubtful if its provisions will be enforced, but if so, the same course will undoubtedly be followed as previous injunctions have compelled, viz., the replacement of the springs supporting the motor at the end furthest from the wheel axle by links, leaving the springs at the other end to give proper flexibility.

PERSONAL NOTES.

MR. JAMES F. HOBART, electrical and mechanical engineer, has opened an office at 85 Times Building, New York.

PROF. WM. A. ANTHONY has been appointed lecturer in electrical engineering at Columbia University, New York.

Trade and Industrial Notes.

THE STURTEVANT patent steam hot-blast apparatus is clearly illustrated and fully described in a 24-page catalogue issued by the B. F. Sturtevant Company, Boston, Mass.

THE [illegible] COMPANY, [illegible], Ind., reports an excellent trade in [illegible] to work overtime to enable [illegible]

THE STRIKE [illegible] of the Bullock Electric Manufacturing Company, Cincinnati, Ohio, which began on March 18 last, has been declared [illegible] system of the factory, and, it is stated, was unsuccessful.

[illegible] IN LIGHTING AND POWER STATIONS.—Circular [illegible], just issued, describes and [illegible] in the station of the Barre Montpelier Traction Company, Montpelier, Vt.

[illegible] of the electric light business, [illegible] of trade. In order to meet this demand and give the customer just what he wants the Western Electric Company, Chicago, has put in a varied supply of these articles.

THE MICHIGAN ELECTRIC COMPANY'S place of business in Detroit was completely destroyed by fire September 24. The company has leased temporary quarters at 106 Woodward Avenue, where the business will be carried on as usual. In the meantime work on permanent quarters will proceed with all dispatch.

THE ELECTRIC APPLIANCE COMPANY, Chicago, has just placed in the printer's hands copy for its new telephone catalogue. It claims that this will be the best all-around telephone apparatus and supply catalogue that has so far been issued. It will be ready for distribution in the course of a few weeks. Copies will be sent on application.

THE "STANDARD" telegraph and telephone fuse links and bases, fusible cut-outs and lightning arresters are illustrated and described in an eight-page circular issued by the Harvard Electric Company, 52 Dearborn Street, Chicago, Ill. This company manufactures a complete line of these goods, which are notable for simplicity of construction and serviceability. The cut-outs and lightning arresters are effective devices.

WESTINGHOUSE CIRCULARS.—The Westinghouse Electric & Manufacturing Company has recently issued circulars 54-58, both inclusive, devoted, in their numerical order, to alternating current fan motors, generators and rotary transformers for electrolytic work, polyphase inductor generators, long burning arc lamps for direct and alternating current circuits, and street lamps for alternating current constant potential circuits.

THE CROUSE-HINDS ELECTRIC COMPANY, Syracuse, N. Y., is exceptionally well equipped for turning out the finest class of work on switches, switchboards and panel boards. This company makes a regular line of these goods, as shown by its catalogue, a copy of which will be sent to anyone upon request. The company has a large corps of engineers and draughtsmen, and is in a position to quote prices on all kinds of special work of this class.

THE KOKOMO TELEPHONE & ELECTRIC MANUFACTURING COMPANY, Kokomo, Ind., has issued a neat little catalogue of its extensive line of telephone apparatus. The salient features of the Kokomo microphone transmitter, the regular exchange 'phone-standard pattern, combination set, long-distance 'phone, desk sets, switchboard, lightning arrester and cross connecting board, magneto bells, bridging bells, etc., are briefly described. The catalogue is completely illustrated.

IN ORDER to meet the demand from bicycle dealers for a good side line the Julius Andrae & Sons Company, Milwaukee, Wis., has offered its representatives the agency for Andrae telephones and electrical supplies. The Andrae Company has just finished the work of installing a complete electric light system in the Racine (Wis.) post office. The company has also equipped the Fish Brothers' Wagon Works, of the same city, with a complete telephone system, and placed a programme clock system in the Wisconsin State Normal School.

THE VALUE of a good name in a manufacturing establishment is exemplified by the success with which the Roebling rubber insulating wire is meeting at the very outset, so to speak, of its career. In the comparatively small period that the new rubber insulating plant of the John A. Roebling's Sons Company, of Trenton, N. J., has been in existence it has made a very creditable record of production, having been running to its full capacity on general orders from the start. The business prospects are so bright that it will undoubtedly be necessary to increase the installation in the near future.

THE GLASS MANUFACTORY of Messrs. James J. Murray & Co., Philadelphia—who make everything in glass required for electrical purposes—has been in full operation for several weeks for the blast of 1898-99. The firm employs 275 hands in its various departments, and its pay roll is about $2500 per week. Every conceivable size, shape and color of globes and shades for electrical purposes are made, and there is not a prominent plant in the United States or Canada or South America that does not use this firm's goods. The outlook is very promising for a large output during the coming fall and winter.

"DRAFT WITHOUT A CHIMNEY" is the title of a small, finely illustrated pocket folder of eight pages issued by the B. F. Sturtevant Company, Boston, Mass., manufacturer of fan blowers for every conceivable purpose. The folder presents a description of an enlargement of the company's works, the old boiler plant having been replaced by a new one in which mechanical draft was substituted in place of a chimney. It is pointed out that the latter feature of a boiler plant has outlived its usefulness, and in support of the statement the advantages of mechanical draft are presented in concise, compact form.

"MACHINISTS' AND DRAUGHTSMEN'S DATA SHEET."—Mr. George Kirkegaard, 28 State Street, New York City, has compiled and published a data sheet for machinists and draughtsmen. It is designed to go directly into the hands of workmen at the bench and into the draughting room, to be tacked up for ready reference. It contains tables of taps and tap drills, speeds of machines and tools, horse-power of battery, standard dimensions of steam, gas and water pipes, etc. This data sheet will no doubt save both time and money to those having use for such information. It is mounted on heavy paper and on cardboard, and is sold for a small sum.

CAR LIGHTING.—The National Electric Car Lighting Company, New York City, has closed a contract with the Pullman Car Company to light all the Pullman cars which run on the Santa Fé limited between Chicago and Los Angeles. There are four trains in this service. The electrical equipment of each train will aggregate 4928 candle power, divided as follows: One observation compartment car, 1056 candle power; three sleeping cars, each of 1056 candle power; one dining car, 352 candle power, and one library car, 352 candle power. Total, 4928 candle power. All berths will be provided with lights, and it is the intention to light the locomotive headlight with the same current.

VALVES.—The economy effected in buying cheap valves is more than offset in the long run by repairs and renewals that would ordinarily not be necessary if good valves had been put in in the first place. The Scott gate, globe angle and safety valves, manufactured by the Roe Stephens Manufacturing Company, Detroit, Mich., are said to be becoming very popular abroad, where they have been tested in some of the more important government work. During the past month the company reports having made large shipments to London, Hamburg and Christiania, and is making the second shipment of six 30-inch gate valves to Honolulu, Hawaii, our newly acquired territory.

RESISTANCE WIRE.—Messrs. Wilbur B. Driver & Co. have established an office at 126 Liberty Street, New York City, where they will carry a full stock of Climax resistance wire in all sizes, from No. 5 to 36 B. & S. gauge. Since the introduction of this wire about a year ago it has steadily grown in favor, and is now regarded as a standard for resistance work. It is recommended as the most reliable resistance wire on the market for the majority of applications. The firm can furnish Climax wire in ribbon form and insulated. This wire has a high specific resistance and possesses extraordinary strength and toughness. It has nearly fifty times the resistance of copper, and has a low temperature coefficient.

CATALOGUE NO. 6 of the Farr Telephone & Construction Supply Company, 357 Dearborn Street, Chicago, which has just been issued, points out the principal features of the various telephone outfits manufactured by this company. The catalogue will be of interest to telephone people. The apparatus manufactured by this company possess certain features which commend the instruments to the trade. The portable telephone and switch is an ingenious device. It is adapted for mines, vessels, docks and yards, warehouses, elevators, offices, hotels, stores, etc. The features of construction are novel and simple. The line of apparatus manufactured by the Farr Company is a complete one, and the various types of instruments are very clearly illustrated.

THE CARLISLE & FINCH COMPANY, Cincinnati, Ohio, is distributing its 1898 catalogue of electrical novelties and toys. This catalogue contains a great many things of interest to young electricians. Electric railways, with large double-truck cars, steel tracks, switches, bridges, stations with automatic signals are among some of the best articles represented. Besides these dynamos to be operated by water power or hand power are shown. The water-power dynamos are of such a size that they may be run by the water furnished from an ordinary house hydrant. The hydro-electric fan apparatus is also described, the current being supplied by means of a water-driven dynamo. This company has placed upon the market three sizes of small dynamos, the smallest giving an output of 20 watts, the next size 75 watts and the largest 300 watts. These dynamos are fully described in the new catalogue, a copy of which may be obtained on application to the company, whose address is 830 West Sixth Street, Cincinnati.

MR. H. BEVIS, manager of the General Electric Company, Limited, London, England, who is on a visit to this country, has with him some samples of apparatus which ought to prove interesting to the American electrical trade. The Hunnings Cone Deckert telephone transmitter is one of these. The fault with some Hunnings transmitters, as is well known, is the liability of the carbon to pack, resulting in the loss of efficiency. In the Deckert cone, however, this defect has been overcome in a simple and ingenious manner. Mr. Bevis says the General Electric Company's transmitter has been adopted in competition with all other types by the National Telephone Company, of England, which has already over 100,000 of them in use. He adds that it has also been adopted by the English Government Post Office in all departments, and that altogether there are at least 600,000 of these transmitters in use for long and short distance work. Another interesting piece of apparatus over which Mr. Bevis is enthusiastic is a new Aron meter. It will be remembered that the old pattern of the Aron meter had the serious drawback of requiring to be wound up every month, as well as of requiring the accurate synchronism of two pendulums, and that it could not be sent out sealed from either the manufactory or central stations. In the new instrument, however, these difficulties are said to be entirely obviated. In size it is about the same as that of other meters, and it is sent out sealed from the makers and requires no winding up or other attention whatever. The manufacturers of this meter guarantee that a 500-ampere meter will register with a single 16-cp lamp. It is stated to be a true watt-hour meter, and it registers directly in units. Mr. Bevis states that the English Board of Trade has approved of it as a standard meter, after a series of tests lasting over two years. A new company has been formed in England to exploit the device, and it is the intention of the parent company to dispose of its American rights and to form a separate company here for the manufacture and sale of the meter. The English company has a subscribed capital of £250,000, and among its directors are Mr. R. E. Crompton, Sir James Pender, Mr. R. Wallace, Mr. R. Binswanger Byng and Dr. Aron.

Directory of Scientific Societies, Associations, Etc., and Meetings of the Same.

HENRY ELECTRICAL SOCIETY meets every other Friday evening between October and May. Headquarters, 115 West Twenty-eighth Street, New York City.

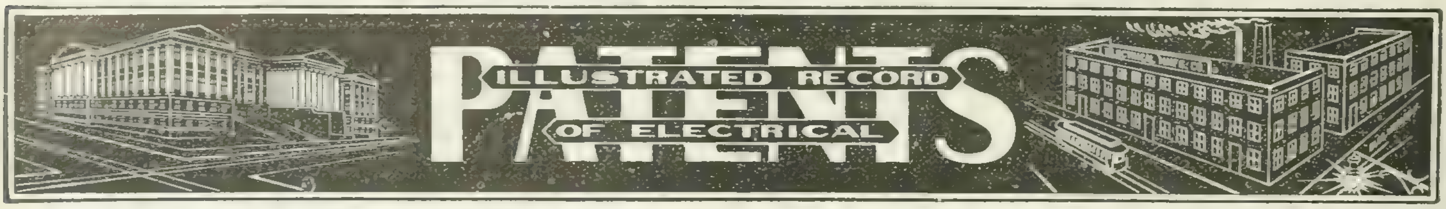
CHICAGO ELECTRICAL ASSOCIATION.—Meetings, first and third Friday of each month, from October 1 to June 1; J. R. Cravath, secretary, Monadnock Block, Chicago, Ill. Meetings and papers for the season of 1898-99: October 7, "Electrical Features of the Late Spanish-American War," by Thomas G. Grier; October 21, "Practical Points on Electrical Measurement," by W. B. Hale; November 4, "The Electrical Equipment of a Model Printing Establishment," by George A. Damon; November 18, "The Development of the Motorcycle," by F. B. Rae; December 2, "Practical Points in Street Railway Engineering," by W. A. Harding; December 16, "Wireless Telegraphy," by Arthur V. Abbott; January 6, 1899, "Telephone Engineering—Some Problems Solved and Unsolved," by S. G. McMeen; January 20, "Observations on Ventilating Fans," Gerard Swope.

THE BROOKLYN INSTITUTE OF ARTS AND SCIENCES, Brooklyn, N. Y. Henry T. Weed, secretary. Meetings: October 7, lecture by A. L. Riker on "Electric Carriages," illustrated by lantern photographs; November 4, illustrated lecture by T. C. Martin; December 2, lecture by Prof. William E. Geyer, Stevens Institute; January 6, lecture on "The Electro-Metallurgy of Copper," by John B. F. Herreschoff; February 3, lecture and experimental demonstrations by Prof. M. I. Pupin; March 3, illustrated lecture on "Electricity in the Navy," by Captain Zalinski, U. S. N.; April 7, lecture on "Cable Telegraphy," by A. E. Kennelly; May 5, lecture by Prof. William A. Anthony

Business Notices.

THE ILLUSTRATIONS in this issue were made by the Photo-Engraving Company, 9-15 Murray Street, New York City.

THE WAR IS OVER, and now our thoughts are all of peace and home. There are, too often, people to be found who have no home, and it is to them these few words are addressed. If you really want a home you can easily get one, but you should act at once before the relapse from the war puts prices on the advance. In Marinette County, Wisconsin, the very finest farming land is to be had now at a most modest figure. Excellent home markets are at hand to take whatever the farmer raises, and good prices are given. These lands are on the Chicago, Milwaukee & St. Paul Railway, and full information concerning them will cheerfully be furnished by C. E. Rollins, Immigration Agent, 161 La Salle Street, Chicago.



ILLUSTRATED RECORD OF ELECTRICAL PATENTS

UNITED STATES PATENTS ISSUED SEPTEMBER 27, 1898.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

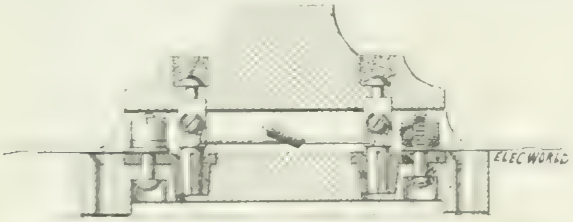
611,243. SAFETY FUSE FOR ELECTRIC CIRCUITS; G. W. Gardanier, of Nyack, N. Y. App. filed Dec. 16, 1897. The fuse holder comprising the portions forming an enclosed space between them, combined with the fuse in said space, and means connecting said fuse in the electric circuit, said fuse comprising the insulated resistance wire and soft wire connected with one another, and the wire forming the heat coil around said wire, substantially as described.

611,271. ELECTRIC RAILWAY; O. Preil, of Washington, D. C. App. filed Dec. 30, 1897. An electric railway system, comprising a feed-main, separate contact stations, an electromagnet at each station, switching devices operated by each magnet for controlling the circuits, a circuit for the working current at each station and shunt circuits at each station extending in either direction therefrom, and including coils of the electromagnets at the stations, both in advance and rear of the station where they are controlled, substantially as described.

611,367. TROLLEY POLE; A. M. Meredith, of Philadelphia, Pa. App. filed March 31, 1897. The combination of a trolley pole in sections, and a coil spring connecting said sections and allowing the end of one section to roll upon the adjacent section.

611,448. APPARATUS FOR PRINTING TELEGRAPHIC MESSAGES; G. M. Gibson, of Chumleigh, England. App. filed Nov. 10, 1896. The combination of a type-wheel tending constantly to revolve, rings of pins revolving with it and pins, one for each ring of pins operated by the signals and each engaging with the pins of one of the rings.

611,460. ELECTRIC ARC LAMP; T. H. Pettengill, of Amsterdam, N. Y. App. filed Sept. 4, 1897. In an arc lamp feed mechanism, the combination



No. 611,243.—Safety Fuse for Electric Circuits.

[illegible] above the latter, a catch screw threaded through said extended upper end in position to engage the stop when the carbon has been consumed, and a carbon carrier clutch carried by the lower end of the suspending rod.

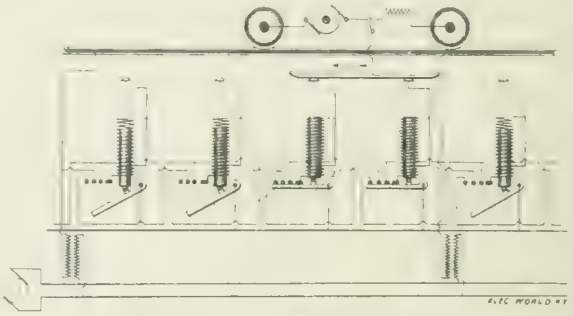
611,465. CONTROLLER FOR ELECTRIC MOTORS; H. P. Davis, of Pittsburg, Pa. App. filed April 18, 1898. A reversing switch for two electric motors, comprising two movable members, an actuating device therefor, [illegible] and for detaching the same therefrom at will and stationary contacts co- [illegible]

611,466. ALTERNATING CURRENT MEASURING INSTRUMENT; H. P. [illegible]

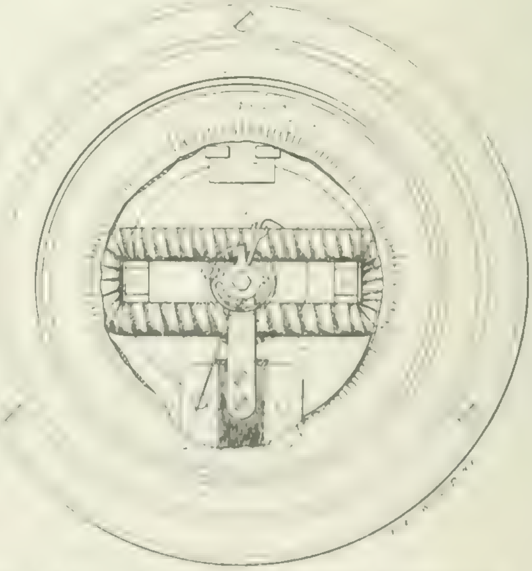
[illegible]

[illegible] traveling [illegible]

611,581. TELEPHONE SYSTEM; G. Ritter, of Stuttgart, Germany. App. filed Feb. 23, 1895. In a telephone system having a plurality of sub-stations, the combination, with a principal and subordinate line conductors between the central station and each sub-station, a call bell in each subordinate conductor at its respective sub-station, a branch circuit at each sub-station around its call bell and having one end connected to its subordinate line conductor, a contact device at each sub-station connected to the ground, a switch lever at each sub-station arranged when in one position to connect its respective principal and subordinate line conductors through the call bell; when in its other position, to connect said line conductors through the respective branch circuits, and when moving from one position to the other to ground its principal line conductor through the contact device, telephone apparatus in each branch circuit, annunciators at the central station, each annunciator being connected to its respective principal line conductor and a battery at the central station, having one end grounded and its other end connected to all the principal line conductors, of means at the central station for connecting the line conductors from one sub-station with the corresponding line conductors from any other sub-station, and simultaneously cutting out the battery and the respective annunciator.



No. 611,271.—Electric Railway.



No. 611,466.—Alternating Current Voltmeter.

[illegible]

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The Electrical World.

VOL. XXXII. NEW YORK, OCTOBER 15, 1898. No. 16

PUBLISHED EVERY SATURDAY BY

THE W. J. JOHNSTON COMPANY,

9 Murray Street, New York.

Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York.

New England Office, 620 Atlantic Ave., Boston.

Western Office, 936 Monadnock Block, Chicago.

Philadelphia Office, 929 Chestnut Street.

SUBSCRIPTION IN ADVANCE, ONE YEAR, $3.00,

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THE ELECTRICAL WORLD,

9 Murray Street, New York.

VOL. XXXII. NEW YORK, OCTOBER 15, 1893. No. 16.

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GERMAN CONDUIT ELECTRIC ROADS.

To those who have watched in this country the development of the electric-railway systems using open conduits, the description, on other pages of this paper, of the system which has found considerable use in Germany and Austria will be of great interest. This system differs essentially from American practice in the location of the conduit, which is immediately under one of the service rails, the rail being split, so to speak, into two slot rails between which run the plow and the flanges of the truck wheels. Compared with American systems with a centrally located conduit and yokes supporting the two service rails as well as the centrally located slot rails, the German construction is undoubtedly cheaper. About 100 pounds of steel per yard of single track is saved in the rails, and the yokes, as they need only embrace the conduit, are materially lighter. An incidental disadvantage of this, especially where the service is heavy, as it generally is where the open-slot system is used, is the fact that the track foundation is not as substantial, especially under the rail not over the conduit, as in the American construction, the solidity of the yokes of which, combined with the heavy concrete conduit and its extension under the service rails in the form of a foundation, make a track the depreciation and repair accounts of which are very low.

On a complicated system the use of a conduit offset to one side might give trouble, owing to the difficulty of always keeping the cars headed in the same direction. With many lines intermeshing in all directions and through routes over common tracks, some cars are bound to go around loops, bringing the contact plow on the wrong side. Of course, this can be remedied by crossing the conduit from one side of the track to the other at the proper switches, but this would require some very elaborate special track work and a special form of plow capable of traveling across the truck which does not seem to be provided in the German construction. With a central conduit cars can switch, back, turn around, go around loops or be manipulated in any way without losing their ability to take any track.

The most ingenious thing about the German roads is the self-folding plow, which can on occasion be forced up and out through the slot, narrow as it is, or lowered again into it, so that through service can be given by the same cars on lines with overhead and underground conductors, respectively. The narrow contact plates which thus fold up, of course, give a much smaller area of contact on the conductor rails than do the substantial flat cast-iron shoes used in this country, but even so, they probably give a contact of sufficiently low resistance for all practical purposes in street traction. The system is most completely worked out, the plow when it is ejected from the slot automatically cutting itself off from the car circuits and cutting in the overhead trolley, and vice versa when it again enters the conduit, the intent being that the car will not even have to stop, but may continue at practically full speed, while this change in the power-feeding mechanism is being effected. Whether the overhead system involves a double trolley or not does not appear. If not, and the two systems are supplied from the same bus bars, one pole of the underground conductors is necessarily grounded, thus losing one of the elements quite essential to continuous service with conduit roads, namely, the necessity of two grounds in one section for short circuit.

Another difference from practice in this country is the shorter interval without power on special work, especially switches. American practice in this regard is simpler, the conductor rails being simply discontinued at switches and crossings, the cars drifting through until, in the case of switches, the two branches of the conduit are sufficiently removed from each other for the insertion between them of conductor rails flared out to avoid carrying away the plow contacts. In the German system the conductor rails are provided with a switch tongue, as is the track rail above, the switch tongue having necessarily within it a section insulator, owing to the change of polarity of its tip every time it is thrown, but this section insulator gives the car lights at night but a brief wink compared with the period of darkness on American roads, especially when running slowly. The German construction of this detail is of necessity more complicated, but the results are undoubtedly more satisfactory.

INCREASING THE PRESSURE FOR ELECTRIC-RAILWAY DISTRIBUTION.

The available drop on electric railway systems is so large a percentage of the total voltage generated that only under exceptional circumstances is "boosting" allowable from the standpoint of economy. Without it systems can be worked with 100 to 150 volts drop in the feeders, and if a greater drop exists than this it would generally be good policy to put in either more copper, other generating stations or some system of high-voltage transmission. But in certain cases, particularly where the load factor is extremely low, as often occurs with excursion lines not used at all for many months of the year, and only occasionally crowded while in use, it does not pay to incur any high fixed charges, and extreme loss at these rare times of heavy load is justifiable. For such work the pressure at the power station of the feeders is generally raised by what are called boosters, sometimes by as much as 100 per cent.

The arrangements of these boosters are various. Where the service is only occasional it is best to arrange one of the regular 500-volt generators for such work. This can be done by means of ordinary throw-over switches, which in one position connect the generator in multiple with its fellows, and in the other in series between the main positive bus and the feeders supplying the districts where a high voltage is desired. In this way a compound-wound machine is obtained, and, as the desired increase in pressure is rarely 100 per cent. of the normal the shunt field can be made very weak, giving on no load a low voltage which rises rapidly with the load, owing to the action of the series coils. This rise in volts will be much more rapid per ampere than with the shunt fully energized, owing to the steeper inclination of the magnetization curve below than above full shunt excitation, and in this way the variations of the line-drop with varying current can be automatically compensated without complicated apparatus. Boosters built especially for such service are often series-wound to give added voltage above that of the bus bars very nearly proportional to the [illegible]

For use with storage batteries, however, the conditions are somewhat different. With the battery installed in the station itself, it is obvious that if simply connected across the line the over-compounding action of the generators would increase the voltage and [illegible] the battery with increased load and decrease it with decreased load, thus making the [illegible] diminish them. [illegible] booster. The former method is rarely used in traction work, as the [illegible]

[illegible]

feeder terminal in spite of the over-compounding action at the station, and in this case the battery would without any booster whatever give a steadying action to the load, taking current when the load is light and discharging it when the load is heavy. As a rule, however, battery sub-stations are installed at a distance from the main station so great that without excessive outlay for copper the bus-bar voltage would not be sufficient to maintain a proper line voltage at the battery sub-station even with the steadying action of the latter. In this case boosters are used to raise the pressure on the feeder supplying the battery. Here series machines or compound-wound machines with weak shunt fields are dangerous, owing to the risk of reversal of the current, in which case the machine voltage also reverses, tending to help the battery discharge. The danger only exists when the voltage generated by the shunt excitation of both main generators and boosters is less than that of the battery, the voltage due to the series excitation being at all times less than the feeder drop. For example, if the station generators build up at no load a pressure of 500 volts and at full load 600 volts, the storage battery should not have an open-circuit pressure above 500 volts. In case it does, it will sooner or later reverse the line current, build down the dynamo voltage by means of the series field and cause trouble.

ELECTRIC CANAL TOWAGE.

An English contemporary, "The Electrical Review," in discussing the decadence of canal traffic in Great Britain, describes conditions somewhat parallel with those that obtain in this country, where the same disuse of the once busy canals is noticeable. According to this authority the facts underlying this decadence are that at the time of the appearance of railways popular interest forsook the canal in favor of its rival, and that the canals in great measure passed into the hands of the railway companies; that there was never a systematic development of trunk-line canal systems, and hence never a fair competition between the water route and the land line. These all seem to apply as well to conditions here as there. Whether the remedy is to be found in electric towage remains to be seen, but the promise of success is at least sufficient to encourage far more comprehensive experiments than any that have yet been undertaken.

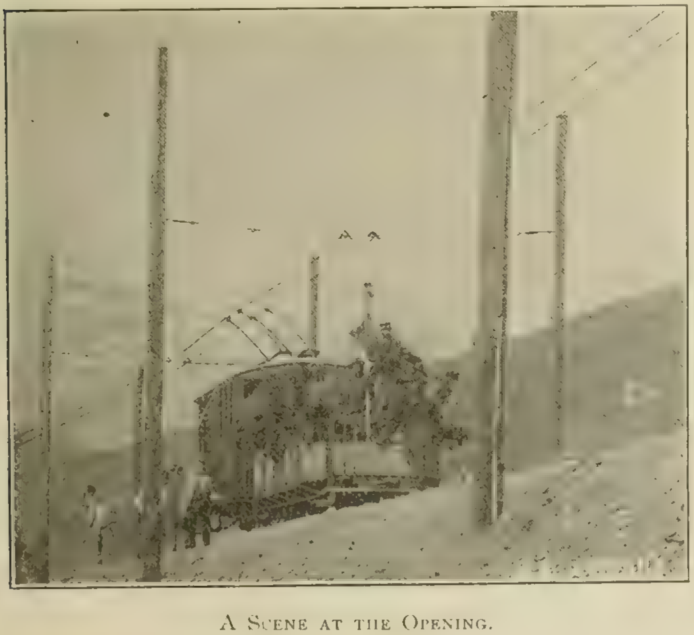
In brief the canal problem differs from that offered by the equipment of a railway by the total absence of grades on a canal, and the very small power required to move great burdens of freight at the low speeds made necessary by the limitations of this form of transit. The system of animal towing in vogue since canals were first dug is more suited to the days of the first navigators of these ditches than now. It has been proven that horse transportation is the most expensive kind when goods or passengers are moved on rails, and the growth of the automobile has already given data that go to show the same thing when it is a question of transit over roads. It is a fair presumption to assume that it is equally true of the moving of canal-boats.

Propeller boats raise destructive waves in the confined waters of a canal, and the trolley problem presented by them is more than discouraging. Perhaps the best approximate solution of the haulage problem yet tried is the bank-towage system in vogue in Belgium and elsewhere in Europe, where an electric truck on the bank takes the place of the horse. If this truck can be controlled from the boat, as it easily may be, thus eliminating the cost of attendance, the problem is largely solved. How long it will be before America sees its canals provided with electric tramways on the tow-path is hard to foretell, but the day that sees it an accomplished fact will probably also see the canal once more take its place as a factor of importance in our industrial life.

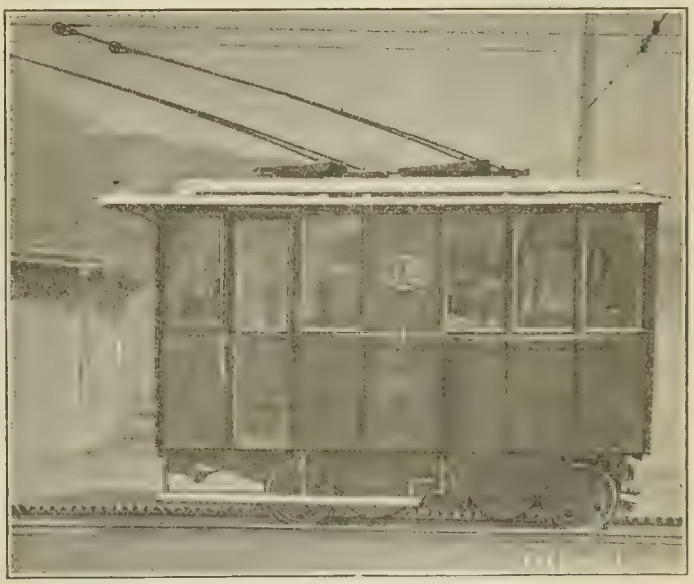
ROUTE OF THE JUNGFRAU ELECTRIC RAILWAY.

The Jungfrau Electric Railway.

PERHAPS the boldest electric railway undertaking yet projected is that now under construction in Switzerland, the upper terminal of which will be the summit of the Jungfrau, 13,670 feet above sea level. A short section of this road, 1.2 miles in length, has already been completed and was recently opened to the public, and from the account given by the special representative of the London "Electrician" the following information and illustrations have been in a large part taken. The road when completed will be 7.9 miles in length, with a maximum rise of 6900 feet, 240 feet of which is a vertical lift at the summit. The road starts from a station, known as the Little Scheidegg, of the Wengern Alp Railway, which is a rack and pinion road, with traction obtained by steam locomotives. The section already constructed is almost entirely on the surface, only 85 yards being in the tunnel, but the whole of the remaining 6.7 miles will be within the rock, under the Eiger, Mönch and Jungfrau Mountains, the line only touching the surface at the stations, which will be built within the rock and fitted with restaurants and other accommodations for the passengers. A view of these mountains and of the route is shown in the accompanying supplemental sheet. It is estimated that the railway will be completed by 1904. The whole line is on an upward gradient, varying in inclination from 6¼ to 25 per cent., so that should the power supply fail the trains can run down to the lower end of the line by gravity. Plans for the various parts of the work were obtained by an international competition, over $6000 being distributed in sixteen prizes.



A SCENE AT THE OPENING.



A VIEW OF THE LOCOMOTIVE.

The Jungfrau line is one of the most interesting applications of three-phase transmission and distribution yet made. Water power is made use of in the valley to generate three-phase alternating currents at 7000 volts, and these are transmitted by means of an overhead line to transformer stations at the Little Scheidegg and the Eiger Glacier, where they are transformed to 500 volts multiphase by means of stationary transformers. Not only is electrical energy employed for traction purposes, but also for lighting, heating and for working the rock drills used in the tunnels. When the railway reaches a high altitude the energy expended in heating the trains and stations will be an important part of the total demand.

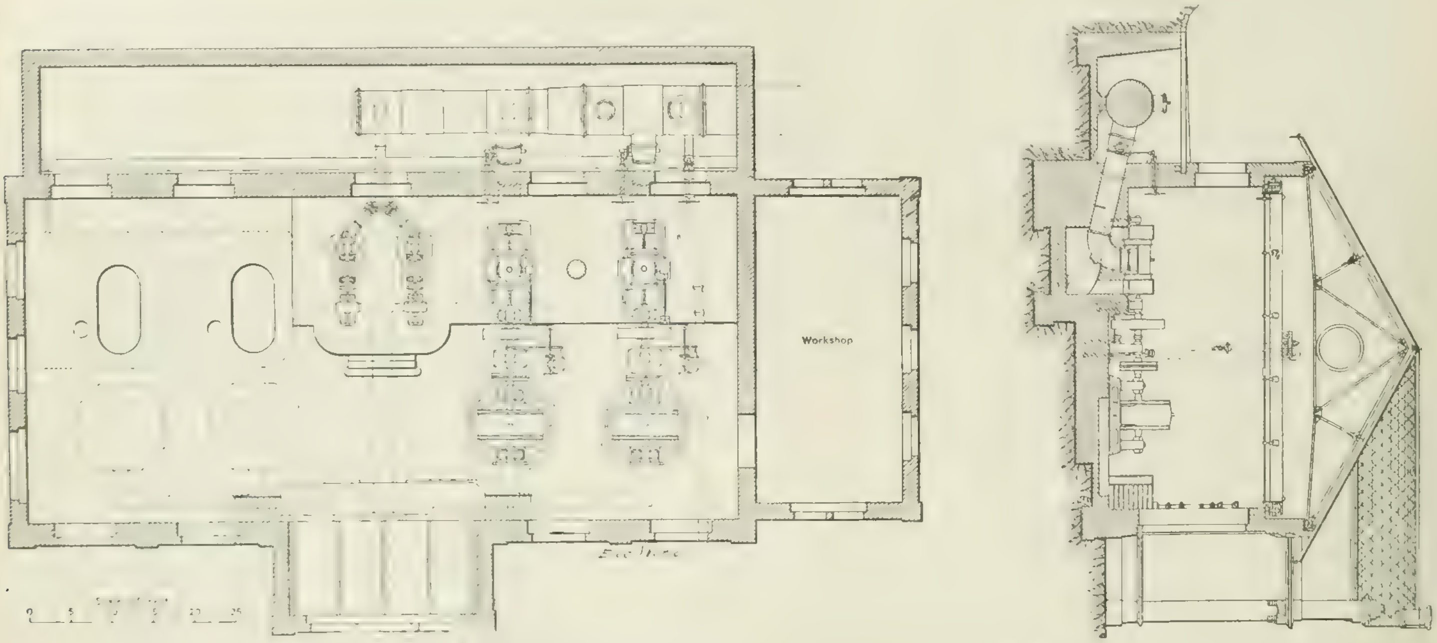
At present only one power house has been built, this one being situated on the White Lütschine, near Lauterbrunnen, down in the valley. The power-transmission line from Lauterbrunnen to the Little Scheidegg is about 4½ miles long. The three wires are of bare hard-drawn copper wire, 0.3 inches in diameter. They are supported on triple-petticoat insulators, about 4½ inches in diameter and 7 inches high. Stout wooden poles, about 33 feet long, are used, with galvanized iron brackets. Whenever the wires cross a footpath they are nearly surrounded by a circular guard-net of very wide mesh, intended to prevent a wire from falling to the ground in case of breakage. A metallic-circuit telephone line is fixed on the same poles, some distance below the three-phase wires, and the two telephone wires are transposed every 550 yards to avoid induction. Lightning protectors of the Siemens & Halske horn-shaped pattern are used on each of the power-transmission wires, as well as on the secondary trolley wires. The fall of potential in the transmission line will be about 10 per cent. at full load.

The transmission line is not duplicated, so that if it were interrupted all power would be cut off from the railway. A duplicate power station is projected, however, at Burglauenen, near Grindelwald, on the other side of the Wengernalp, capable of supplying some 2600 horse-power, which is to be furnished by the Black Lütschine. This will feed the Little Scheidegg transformer station through an independent transmission line of similar construction.

The sub-stations are substantial stone buildings, designed to withstand the action of the most inclement weather. They are each fitted with two 200-kw transformers, reducing the pressure to somewhat over 500 volts for the secondary feeders. The latter are of hard-drawn copper and are constructed in a similar manner to the transmission line. The transformers were built by the Oerlikon Company. The fuses are of copper wire outside the sub-stations. In addition there are rotary transformers at the Eiger Glacier station which supply continuous current for the rock drills and lighting. When more of the line is built transformers will be added every thousand yards.

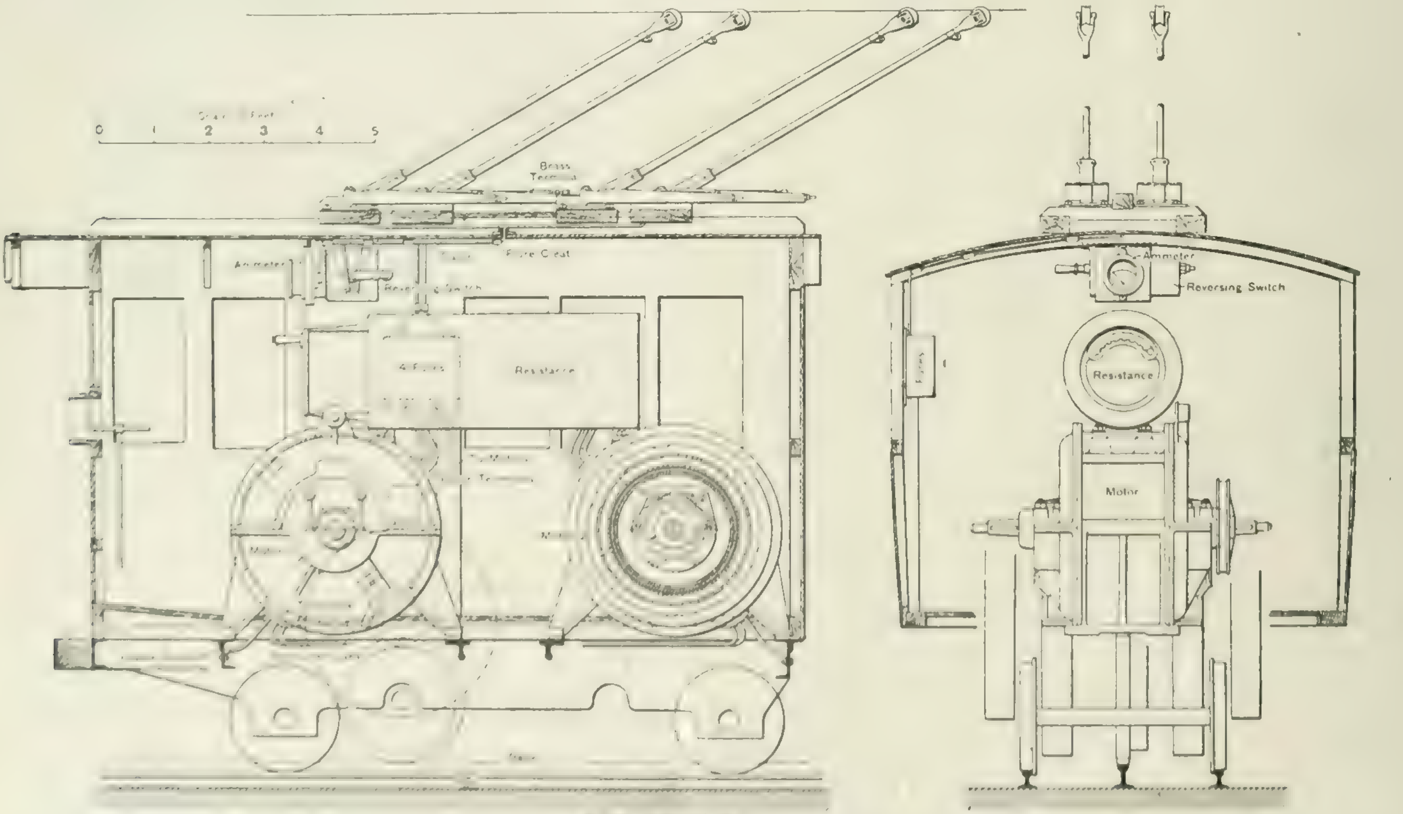
The permanent way is built on the Strub rack system. Metre gauge (3 feet 3⅜ inches) is employed, the rails being of the usual T pattern, about 4 inches high and weighing 40 pounds to the yard. Steel sleepers are used, their distance apart averaging about 3 feet 3 inches. The rack, which is, as usual, midway between the rails, is of steel, rolled solid with the teeth cut afterward in the cold bar. It is made in lengths of 11 feet 6 inches and weighs only 68½ pounds per yard. Its mean tensile strength is 28½ tons per square inch, with an elongation of 20 per cent. The inclined sides of the rail and teeth of the rack permit the use of an emergency brake which clutches them on both sides. As was mentioned above, one section of the projected line will have a gradient of only 6¼ per cent., and here it is anticipated that no rack will be needed. The sharpest curve of the section of the line now opened has a radius of 33 feet, and the sharpest curve in the tunnel will have a 66-foot radius. Two Chicago bonds of 0.28-inch diameter are used for each rail joint, and the rails are cross-bonded every 55 yards with 0.32 inch rods.

The locomotive has been built by the Société Suisse des Locomotives, with motors by Messrs. Brown, Boveri & Co. It contains two 125 to 150-hp induction motors driven directly at 760 revolutions per minute by the 500-volt three-phase current, with a frequency of 38 cycles per second. Each motor drives, through double-reduction gears, a cogwheel meshing in the rack. The weight of each motor is 2.6 tons and the locomotive complete weighs 13 tons.



Plan and Elevation of Power House, Jungfrau Electric Railway.

One advantage of the three-phase system on such a railway is the simple automatic braking action of the induction motors. When the locomotive is going down hill the motors act as generators when their speed exceeds synchronism. From the plan of the connections it is plain that the motors are merely controlled by a reversing switch (through which the stator or primary winding is connected) in one bank and one [illegible] the secondary, or rotor, winding [illegible] on a short circuit. The group of resistances is mounted [illegible] over the motors.



Elec. World N.Y.

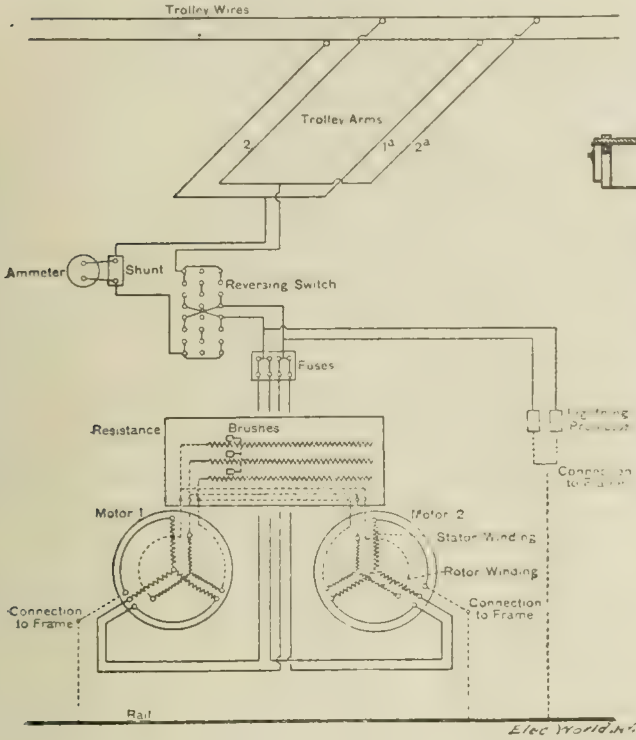
Sectional Elevation of Locomotive, Showing Electrical Equipment.

The locomotive is fitted with three absolutely independent brakes. The first is an automatic one, electrically controlled. By means of a centrifugal governor, when a speed greater than a certain maximum is reached, the current is automatically switched off from the motors, and at the same time a band-brake is set on each of the motor shafts. A dashpot prevents slight momentary increases in speed from putting the brake in action. This brake can also be applied by the guard in the passenger car, who is provided with a switch to cut off the current. The second is a hand-brake, which applies bronze shoes to grooved pulleys, one on the shaft of each of the two main gear wheels meshing in the rack, and the third, which has been already referred to, is an emergency brake which grips the rack. This brake is also lined with bronze and it can be applied either by the driver or the guard.

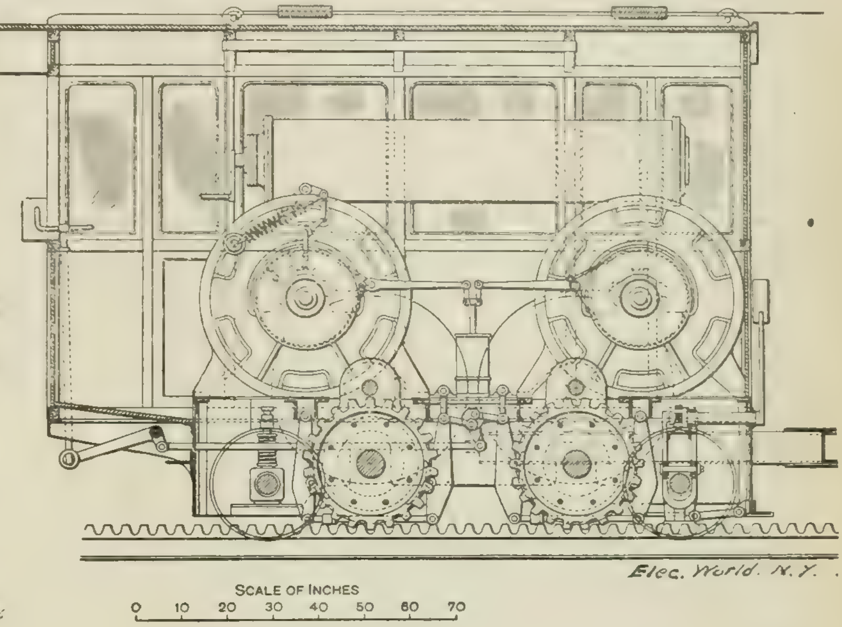
There are six incandescent lamps on the locomotive, two in series on each phase, and the passenger car will be lit with fifteen lamps, five between each pair of wires. Two trolleys are employed on each wire on account of the large currents which have to be transmitted to the locomotive.

The passenger cars, which cannot be called trailers, as they are pushed, not pulled, are built for forty passengers. Each train will usually consist of a locomotive and one car, but at times of exceptional traffic a second car will be added. At present only two trains will run, one up and the other down.

The turbines of the power plant at Lauterbrunnen work under a head of 115 feet, the water being delivered through a steel pipe line about 1500 yards in length and about 6 feet in diameter.

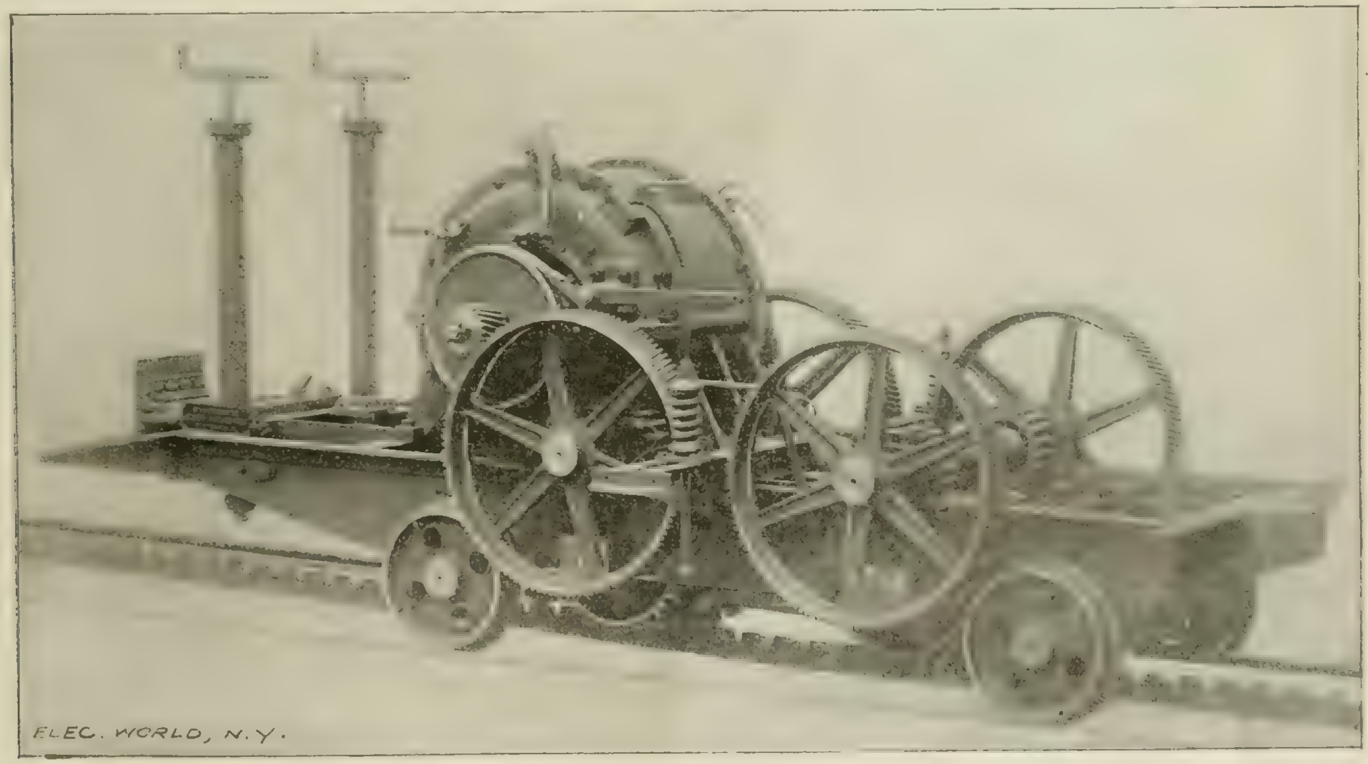


The Circuits of the Locomotive.



Sectional Elevation of Locomotive, Showing Gearing and Brake Mechanism.

The accompanying figure shows the power house in plan and elevation. It is planned to have four main generating sets, each of 500-hp capacity, but only two of these have as yet been installed. The turbines, made by the J. J. Rieter Company, are of the twin, axial-flow Girard type, with central admission and outside delivery. They stand over the tail-race and the water is delivered to them from below, thus clearing the dynamo room of all piping. They run at 380 r. p. m. and are direct-connected through flexible couplings to three-phase inductor generators of the Oerlikon make, delivering three-phase current at the full line pressure of 7000 volts and 38 cycles per second. Two exciters are installed coupled to independent turbines.



Locomotive Jungfrau Electric Railway, Showing One Motor in Place.

Telephonic Direction of Vehicles.

A unique feature of the Knights Templar conclave, which takes place in Pittsburg from October 11 to 15, will be the means adopted for handling the crowd at the reception to take place at the Duquesne Garden. Near the main exit there will be a booth having a telephone switchboard, from which eight lines will be carried out to as many booths, in different directions, three or four blocks distant. A man is to be stationed in each of the smaller booths, while just outside the door there will be a policeman with a large megaphone. When the ball closes and carriages are wanted the man at the switchboard in the ballroom will call out the vehicle number to each one of the stations.

The Use of Electricity in the Spanish-American War.*

By THOS. G. GRIER.

The application of electricity in the army and navy for their various and many purposes is recent, but its progress is rapid. The object of this paper is more to note the uses than to describe the details.

The fortification board established ten years ago by the United States Government has developed complete and elaborate plans for the equipment of coast fortifications. In these plans electricity plays a very important part. Submarine mines connected by cable with harbor forts have been planted, electric light and power stations have been installed, searchlights, motors, telephones, telegraph instruments and many other devices have been used in preparing for the defense of our harbors.

Range finders for determining distances were extensively used; these instruments may be dependent upon electricity for their operation, as in the case of the Fiske range finder, or may be operated mechanically. Just prior to our recent war with Spain 200 Lewis depression range finders were ordered by the United States Government to equip our various fortifications. While these instruments are operated mechanically their efficiency in action depends upon the application of electricity in communicating the distance observed to the gun captain or commander.

To condense as much as possible, a brief summary of the applications can be given by describing the methods employed at Fort Wadsworth, which lies just below New York City. In this fort the fire commander directs the attack from a sheltered station equipped with a Lewis range finder. There are also a position-finder station and four battery-commander stations. The fire commander is in direct communication with all by means of telephones.

In the position finder's station, together with numerous other instruments, are a dial telegraph, electric clock and telephone. One of the guns is equipped with a dial telegraph and another with a Sheehy teleotype, an instrument which indicates the azimuth or angle from a predetermined line and gives the range or distance in yards the observed vessel is from the fort. All of the commanders' stations are, however, connected with the guns both by speaking tubes and telephones.

Observations are signaled to the guns, and the course and speed of a ship are plotted upon a miniature representation of the harbor. By means of an electric clock placed at every station absolute uniformity of time is obtained, and the probable course and range of a vessel for several minutes can be plotted from these observations, and without even seeing the vessel the gun can be elevated for the range and trained for the proper angle, and by means of a stop watch the order to fire given so that the shot will fall upon the deck of a vessel whose course has been observed by men at a distance from the guns. The introduction of electricity for signaling has given this wonderful control to the fire commander over his batteries.

Sandy Hook, at the mouth of the harbor, is connected by cable with Fort Wadsworth, and the approach of hostile ships may be telegraphed to the fire commander so that their course may be [illegible] at the proper time to do justice to the work before them. Sandy Hook was also placed in telephone communication with Washington during the past summer, so that the Government was in position to receive or send messages to the fortifications.

[illegible]

[illegible]

[illegible]

[illegible]

so cut down that not more than 5 per cent. of the amount needed was carried on hand by the Government. There are two styles of cables of seven conductors which are used to connect the shore end to a junction box in the channel, and a single conductor cable which connects each conductor in the multiple cable to an independent mine, each conductor being numbered. Any mine may be exploded at will from the shore.

When war was declared each of the manufacturers of submarine cable in this country received orders for all they could make in thirty days, and some were kept busy for sixty days, producing, probably, 200 miles of multiple cable and 200 miles of the single conductor. This has been distributed from the Bay of Fundy to Florida. Some was sent to the gulf cities and some to California, Oregon and Washington. One hundred and fifty miles of each size was under contract in the early part of August. The cost of seven-conductor cable averages about $1000 per mile, and the single conductor about $450 per mile.

Headquarters for work on submarine mines are at "Torpedo Station," Willets Point, Long Island, with Major John D. Wright in charge.

SUBMARINE MINES.

There are three different kinds of mines used in our harbor defense.

First. Observation mines, which are fired from shore when a ship is judged, by observation, to be within effective range of the explosive.

Second. Automatic mines, which are self-firing on being struck by a vessel.

Third. Electrical contact mines, which, on being struck by a ship, give notice on shore, and the operator, by the throw of a switch, fires the mines.

The methods of firing observation mines and electrical contact mines are similar. Automatic mines may or may not be fired by electrical means.

Mines may be placed upon the bottom of the harbor, and in such cases are called ground mines, and if they are contact mines the contact mechanism is contained in small buoys anchored at a depth below low-water mark just sufficient for them to be an obstruction in the path of vessels. When the channel is deep, buoyant or floating mines are used. A buoyant mine is more effective, as it lies nearer the object of attack, and for an equal effect does not require as large a charge of explosive.

MINES IN BOSTON HARBOR.

The shape and material of mines or mine cases are various, and the kinds employed at different points not always identical. However, a general description of the mines employed in Boston harbor will give a good idea of the plan and design used in all other harbors.

There were about 1000 mines planted in Boston harbor, covering the main ship channel and ingress to the harbor where vessels of over 12-foot draft could go at low water. The regular Government mine consists of an upright iron case about the shape of a top, with a strap on the bottom for holding the cable. Galvanized steel rope secured by an anchorage of any kind, in many cases of old horse-car rails, maintained the mines in position. The cable containing the electric wires runs up separately from the cable holding down the mines.

As the demand was urgent and no mines of the Government pattern were to be had, the engineers in Boston used new ale barrels, a hole being bored in one end for the receipt of the contact mechanism and cable. The barrels were encircled with rope to make a sling to hold them down, a flat steel ring being put around the rope so the steel anchor cable attached to it would not cut through. These mines were of different sizes and held from 100 to 500 pounds of explosive gelatin. Ordinary dynamite was used in some mines where there was not enough gelatin to be obtained. This was put in through a small hole in the top where the electric contact mechanism is placed.

The contact mechanism is connected through high resistance and by a battery circuit using the cable and ground return for its conductor, to an indicating and circuit closing device located in the protected casement on shore. When a ship strikes a mine containing the device, deflecting the mine from its normal position, the battery circuit is closed, this operates an indicating mechanism which [illegible] in the dynamo circuit and notifies the operator. To throw in the circuit for exploding a mine it is necessary to throw in a switch or plug after the first break is closed by the indicating device. This circuit can be closed without any contact from the vessel at the will of the officer in the casement.

The firing switchboards at Boston contained an ordinary knife switch suitable for 500 volts, with springs which hold them open at all times except when held closed by the operator. These switches, one for each group of mines, were mounted on slate boards and plainly numbered with large letters. A dynamo developing one ampere at 500 volts, driven by an oil engine, furnished the exploding current.

The contact devices were made by the Anchor Electric Company and by the General Electric Company, the design being that of the Government, with several alterations made by Dr. Louis Bell, the engineer in charge for the Government, to shorten the time of manufacture. All of the parts of the contact mechanism were of platinum or gold-plated brass to prevent any possibility of corrosion. The exploder consisted of a thin strip of platinum wire which was laid in a case of fulminate, which in turn was put in a case of dry guncotton; the remainder of the explosive was wet.

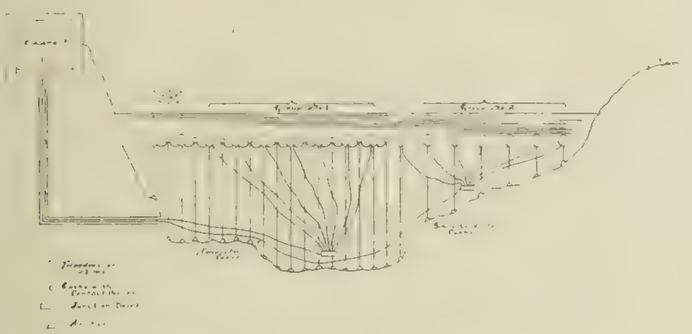


DIAGRAM OF MINES IN BOSTON HARBOR.

The mines were usually placed in groups of seven each, about 150 feet apart. These groups of mines in Boston harbor were strung clear across the channel and in the main channel there were three lines.

In this method, should a vessel be sunk by the first line of mines and the wreck not obstruct the passage for other vessels, the second line of mines would catch the next vessel and the third line the third vessel. Between the mines were small casks with contact devices connected to mines on either side. These were cheaper than mines, but were equally serviceable and made the line complete, so that no vessel could get through.

The submarine cables connecting the world's centres of population—a great system of electric nerves—had a most important influence in every feature of this war. Ships at distant points were enabled to advise and receive information, and movement of fleets could be directed from the seat of government. It is hard to conceive of this almost complete annihilation of time and space.

The Oregon, that speedy and modern man-of-war, equipped with powerful machinery, took eighty-one days to make the remarkable voyage from Puget Sound to Key West, a distance of about 18,000 statute miles, and of this time she was about fifty-nine days at sea. The distance by cable and telegraph from Chicago to Hong Kong is nearly as great, yet to send a message between these two points, including all the delays caused in the many transfers, requires less time in minutes than it took the Oregon days to make the trip.

Our army in the field has its cable tents completely equipped with telephones and telegraph instruments. The telephone at Santiago and adjacent points before and after the siege was of great service, and cable tents now have their names lengthened into the title of cable and telephone tents.

The Bishop Gutta-Percha Company, of New York, has furnished the Government with a special cable, which is used in the signal service by General Greely. It is very light and very strong, weighs about 60 pounds to the mile, and is furnished on reels in half-mile lengths—a two-conductor concentric cable. This outpost cable, as it is called, is carried by a scout on a reel fastened to his back like a knapsack. He carries a telephone, and one end of the cable being connected at headquarters enables him to communicate in whispers to his commander. An attendant accompanies the scout with extra reels, which are easily attached when the wire on the first reel has reached its limit. Telephones, in fact, are used everywhere—in forts, in camps, in the field, and on board vessels.

Among the most recent applications of electricity that found a place in the army and navy was the "X-ray" apparatus. It was used in the field, in the hospitals, and on the hospital ships. The Solace was equipped with the latest production of the Edison Manufacturing Company.

Notices were published in the papers of electric cooking outfits, which were going to be placed upon some of the hospital ships, and if it was done there is no doubt that much comfort and convenience resulted, especially when the vessels were in the warm climate of the West Indies.

Aboard modern men-of-war the electric light is found to be absolutely necessary for the efficiency of the ship. Searchlights are used to observe the movements of other vessels, to find buoys or landmarks on entering shallow channels, to pick up disabled boats or men overboard, to make landings, and for signaling. The incandescent lamps illuminate the entire ship, dispensing with oil lamps and candles; they are also used for night signaling.

Electric motors are used in hoisting boats and ammunition, for removing ashes, for steering, for training gun turrets and many other purposes. Steam whistles are opened and closed by electrically operated valves. The range for guns and the speed and direction of revolving shafts are indicated by the electric current, and guns are fired by an electric spark. Telephones and electric signaling devices aboard ship are extensively used.

This, in brief, covers the application of electricity ashore and afloat in the recent Spanish-American war.

A description of the principles governing some of the signaling devices on board ship will materially assist in showing to what a great extent modern vessels depend upon electricity.

The signaling and indicating devices used on vessels are: "helm indicators," "steering telegraphers," "speed indicator," "direction indicator," "range indicating system," "Fiske range finder," "azimuth telegraph" and "transmitter of orders." All of the devices consist of galvanometers, which indicate on their dials a difference of pressure, the dials being marked for the different offices the instruments perform, and with each instrument or system of instruments proper devices are used for altering resistances and consequently changing pressures to accomplish the ends in view. A description of the principle applied to the helm indicator will explain the operation in general of all the others.

The object of the helm indicator is to indicate, at different parts of the ship, the position of the helm. The principle of operation is shown in Fig. 1. Attached to the helm and insulated from it is a metallic contact, *A*, which presses continually on an arc of resistance wire, *C D*. At the centre of this resistance wire is a permanent contact, *B*, which is connected by a wire to one side of a number of galvanometers located at various stations. *E* and *F* are the negative and positive wires of the electric lighting system. Primary or storage batteries also could be used as the source of energy. A dead resistance is inserted in the circuit connected with the arc of resistance wire, *C D*, which reduces the current to about two amperes.

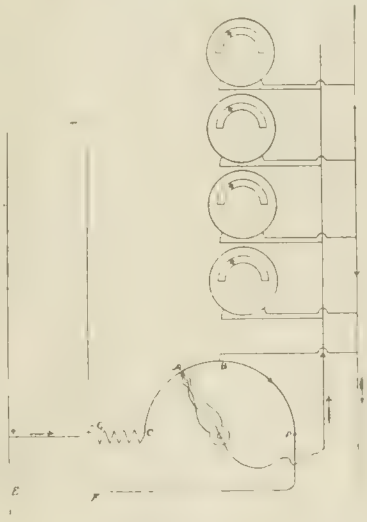


FIG. 1.

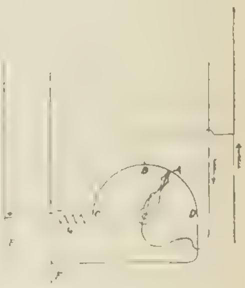


FIG. 2.

The current flows as indicated by the arrows. As the pointer, *A*, is moved toward the left, or toward *C*, the difference of pressure between *A* and *B* becomes greater and the flow of current through the galvanometer is greater. The galvanometers are adjusted so that they take the same angle as the helm, or pointer, *A*. In Fig. 1, when the pointer is on the left of *B*, its pressure, as compared with *B*, is positive. When *B* and *A* are both in the centre, or when the pointer, *A*, coincides with the fixed point of contact *B*, then the needles of the galvanometers come to rest at zero or the centre of the scale. When *A* is moved toward the right, or toward *D*, then the conditions are reversed (Fig. 2), *A* becomes negative compared with *B*, and the current flows in the opposite direction in the galvanometer, bringing the needle toward the right. One of the instruments can be on the bridge, one in the captain's cabin, one in the wheelhouse and one in the conning tower.

The steering telegraph is the same arrangement of galvanometers, with a device for altering the resistance by hand. The captain sets the resistance from his station, having an instrument before him. The same indication appears upon an instrument in the wheelhouse, and by noting the helm indicator the captain is advised when his order is obeyed. The same thing is true of the engine telegraph, the transmitter for orders and the azimuth telegraph.

In the Fiske range finder the general principle is the measurement of the resistance of a conductor in the form of a Wheatstone bridge, there being two arcs of wire at the ends of a base line, corresponding to two contiguous members of the bridge. Two telescopes are located at the ends of the base line and carry contacts which move over the resistance wire as the telescopes are turned to be pointed upon any object.

In Fig. 3, let the arms, *a b*, of a Wheatstone bridge be represented by arc *h*, while *c* and *d* are bent into arc *k*, both of these arcs being wires of conducting material. Let contacts, *e* and *f*, be attached to telescopes pivoted at *A* and *B*. When the telescopes are parallel and [illegible] to the base line the galvanometer will not deflect and its point of rest is marked infinity. Now, let the telescopes converge and the angle of convergence is *A T B*, and presuming the telescope at *B* is pointing at right angles to the base line the angle of convergence is measured by the arc, *C E*. The bridge is out of balance, that is, the needle deflects, and the amount which it is out of balance will vary with the difference of direction of the telescopes. The [illegible] of convergence [illegible] across the galvanometer, or reading instrument, and the [illegible] is marked in yards.

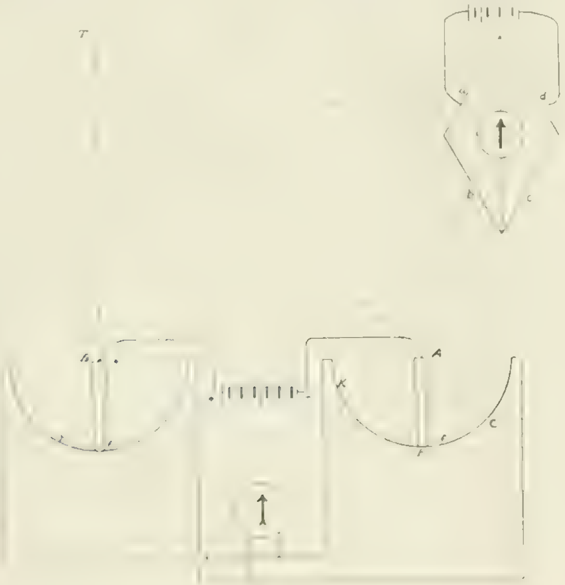


FIG. 3.

The speed indicator is, in reality, a small alternating-current dynamo, the current being great or small according to the speed of the armature. [illegible] alternating-current galvanometer graduated in revolutions per minute. [illegible]

[illegible]

The Siemens & Halske System of Underground Conduits for Electric Roads.*

BY GUSTAV BRAUN.

The first successful electric road with underground conduits was built by the Siemens & Halske Company, in Budapest. As early as 1886 this company made exhaustive experiments with underground conduits on the grounds around its works in Vienna, which led to the construction of an experimental road 2.52 kilometres long in Budapest in 1887. Here all the technical problems, under the existing local circumstances necessary for a perfectly safe operation of the underground conduit system, were carefully worked out, and such favorable results were obtained that the Siemens & Halske Company could at once start with the construction of the first electric line with underground conduits.

This first electric road with underground conduits, which, as may be here remarked, was the first electric street railway in any large city in Europe, was thrown open to the public on July 30, 1889, and was soon followed by three other lines with underground conduits in the same city. These, together with the Quai line, which was opened in 1897, are the property of the Budapest Electric Street Railroad Company, and have a track length of 30 kilometres.

In the "Budapest system," a name by which this underground-conduit plant, as it was first applied in Budapest, soon became generally known, there is a concrete conduit under one rail containing two angle-iron conducting rails, one at each side of the conduit and fastened to the yokes by means of insulators. The yokes are placed at a distance of 1.2 m., and support and maintain at the proper distance from each other the two halves of the tram rail which serves also as a slot rail.

The conduit presents in section an egg-shaped profile 0.28 m. wide and 0.33 m. high. At the top it is provided with a slot 33 mm. wide. From this it is obvious that the underground-conduit system in Budapest is distinguished from the American railways principally by the location of the slot, which is not midway between the rails—as is the case with cable roads—but coincides with the groove of one of the rails.

The two slot rails are subject to the same wear, since the flange of the carwheels is in the middle of the tire, an arrangement which, to my knowledge, is found nowhere else in Europe, but in Budapest it has proved very satisfactory.

The device for picking up the current employed in this system consists of two cast iron shoes, which are pressed outward laterally into the angle of the conducting rails by leaf springs and are attached to a thin plow passing through the slot and fastened to the truck of the car. Insulated cables through the plow conduct the current from the sliding shoes to the car controllers.

By the arrangement of two current-conducting rails, both insulated from the ground, a ground connection on both sides is necessary to cause a short circuit and all danger of electrolysis from stray return currents is eliminated.

The experience gained by the Siemens & Halske Company in Budapest in the course of several years was used to advantage in building the electric street railway in Berlin from Behren Street to Treptow in 1896, and in enlarging and improving the system of the Budapest Electric Street Railway Company in the years 1895-97.

These roads were constructed for through service with underground conduits and overhead trolleys. The conduit system was employed in Berlin for a track length of 4.5 kilometres, and in Budapest for 30 kilometres. The problem to be solved was to fit each car for use on both the conduit and the trolley systems, and in such a way that the change from the conduit system to the trolley system, and vice versa, should be effected with the least possible delay. For this purpose each motor car had to be provided with a trolley which could be easily pulled down, and with a contact plow which could be quickly removed from, or inserted into, the conduit. This problem was successfully solved by the Siemens & Halske Company, and at the same time other valuable improvements were made so that the system worked very successfully in Budapest as well as in Berlin, notwithstanding the exceptionally large masses of snow during the winter of 1896-97, when, from time to time all other means of traffic could not be kept in regular service in the streets of this large city.

The accompanying figures show the arrangement of this system as it is applied in Berlin. It differs but slightly from the similar system employed in the Budapest roads in the design of the sliding contacts of the underground plow. In this, as in the older system described above, one rail of the track, the common grooved girder rail, is placed on concrete or gravel in the usual manner. The other track rail is supported by the cast iron yokes 1.25 metres apart and consists of two like rails of peculiar section, having between them a slot 30 mm. wide, in which run the wheel flanges and the plow.

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*Abstract from the "Elektrotechnische Zeitschrift."

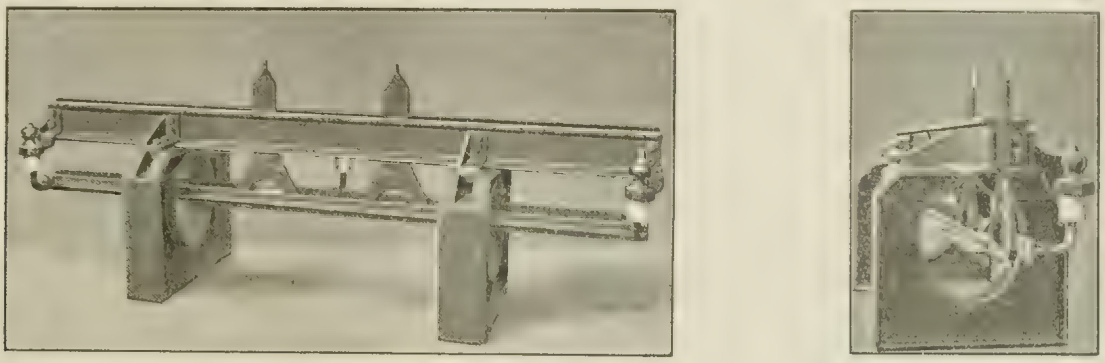


Fig. 1.—Two Views of the Metal Parts of the Conduit.

The fastening of the rails on the yokes is effected by wrought-iron bracket-joints, which press down the foot of the rail and secure its web by means of two screw bolts. In order to prevent a contraction of the slot by the slipping of the slot rails a projection is cast on the support against which rests the foot of the rail.

The yokes stand on a foundation of broken stone and serve as ribs for the conduit which, otherwise, is made of concrete. For drainage sump pits are provided at intervals of about 50 metres, and empty into the sewer system. The clearing of the shafts is easily effected by flat shifters having about the same shape as the profile of them.

The placing of the conduit on the same side of the two tracks greatly simplifies the construction at switches, since it is not necessary to switch the conduit across from one track rail to the other or to use two plows on the car.

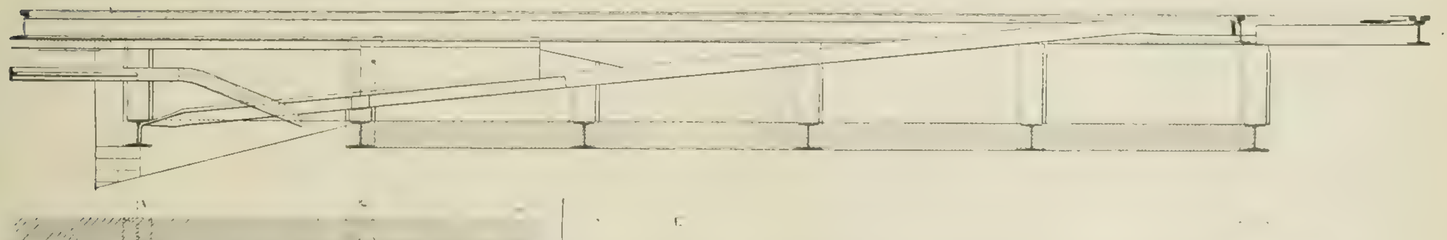


Fig. 3.—Sections of Switch Shown in Fig. 2.

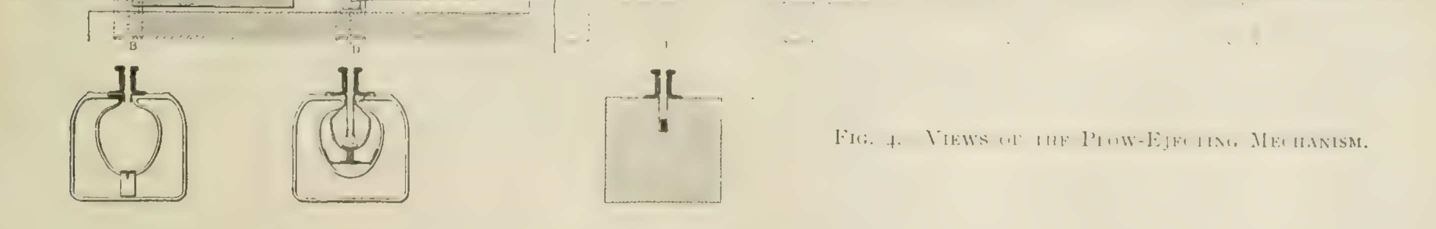


Fig. 4. Views of the Plow-Ejecting Mechanism.

In comparison with American roads, in which, probably for local reasons, the underground conduit is located in the centre of the track, the Budapest system presents the advantage that, first, iron covers for the hand holes are not needed, and consequently less iron is required on the surface of the street, and, second, there are only two rails in the street, as with a common railroad track.

The current-conveying rails of this system are somewhat different from the angle-iron rails employed in the first Budapest installation. They consist of T-shaped rails of 1000 sq. mm. cross section and 10 metres long. These rails are placed with their heads toward each other, and are bonded at their joints. They are about 0.12 metre apart, and are perfectly sheltered under the rails of the track, so that it is impossible to see them from above through the slot, or to touch them. Further, they are located at a height of 0.24 metre above the bottom of the channel, so that water which might occasionally collect in the channel can flow off below them. They are hung by means of insulators at intervals of from 2.5 to 4 metres from the flanges of the slot rails, the insulators being inserted between two yokes. The arrangement of these insulators is illustrated in the figures.

The horizontal flange of the current-conveying rail is fastened by a vertical pin in a fork, mounted on a bolt fastened in the insulator. The latter is supported in a shell which is fastened to the flange of the rail in such a manner that the insulator is offset from below the slot and out of the way of dripping water.

Each insulator is placed in a special recess in the walls of the conduit and is surrounded by a cast-iron box cemented into the wall. A cover, easy to remove, permits of ready inspection from above, and by removing the pin in the conducting rail by means of a special tool and unscrewing the shell from the track rail, an exchange of the insulator is easily accomplished.

In order to be able to renew the current-conveying rail, should this be necessary, it is arranged that the slot rail on the side toward the track centre can be removed at certain places, especially on curves.

The construction of the switches employed with the underground conduits is a difficult one, as it is necessary to provide a long narrow support or gusset plate for the tongue of the switch, since both conduits must retain their full sectional profile. This gusset plate consists of a strong iron casting, unsupported for a length of 1.8 metres, and carrying the movable switch tongue on its narrow end. switch tongue of the track rails, turning about pivot, *G*; *D* is the switch tongue of the current-conveying rail, having a turning point, *F*; and *E* is an insulated connecting rod between *C* and *D*. The switch tongue, *D*, consists of a pointed flexible front portion, connected to the rear part by an insulating piece, *H*. The parts are so arranged that the conductor-rail switch swings through a greater arc than the other, as it should to reach its positions. This secures a smooth passage of the plow contacts and reduces the portion of the rail which is without current to a minimum, corresponding to the length of the insulating piece, *H*. The length of the insulated sections, B_1, inserted in the current-conveying rails is made greater than that of the insulating piece, *H*, so that arcs occurring when a car passes over the switch are always formed on the current-conveying rails, *B*.

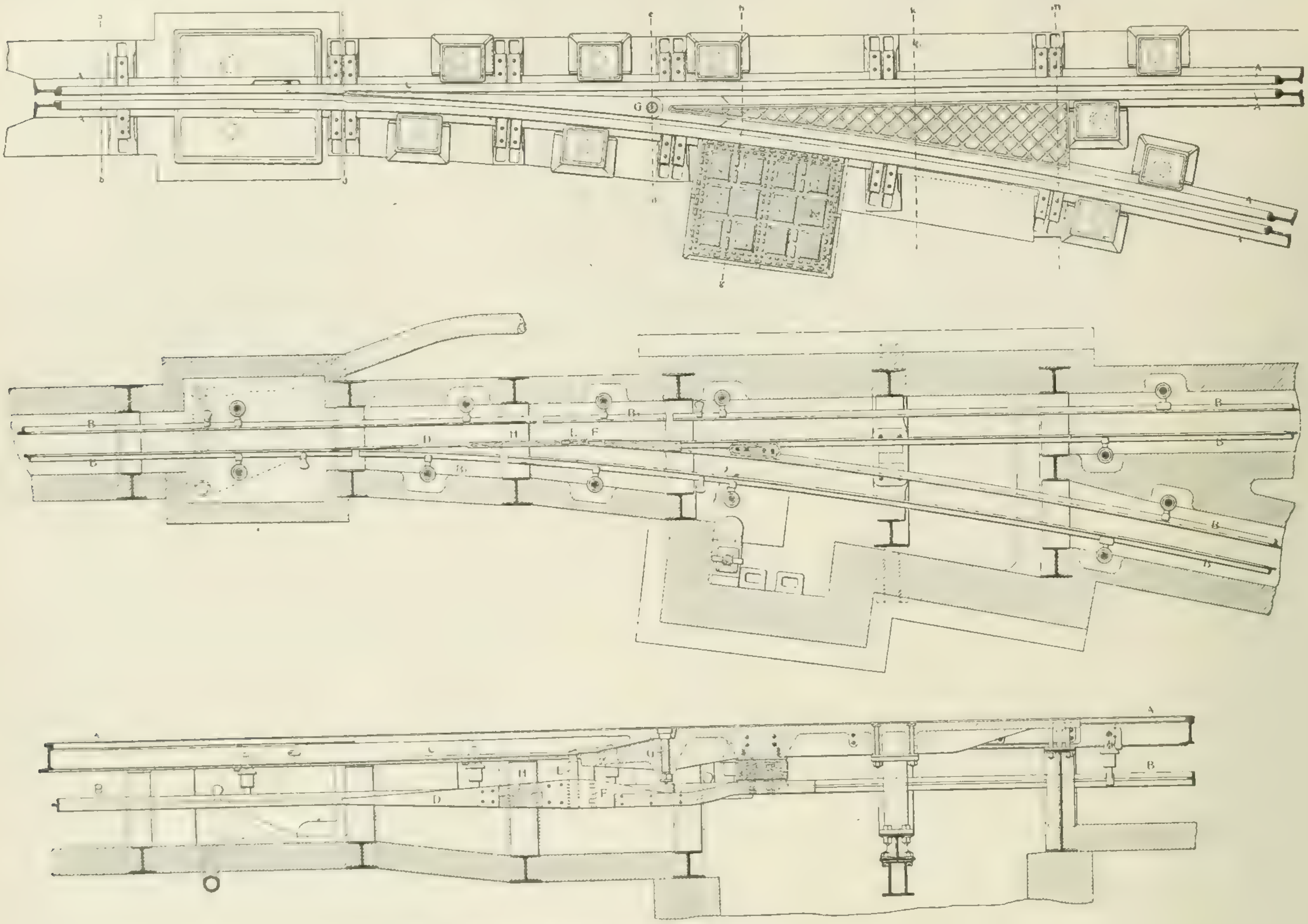


FIG. 2.—PLAN AND SECTIONS OF A CONDUIT SWITCH.

This tongue is so arranged that its point enters a recess in the track rail, giving it thus a support at both ends.

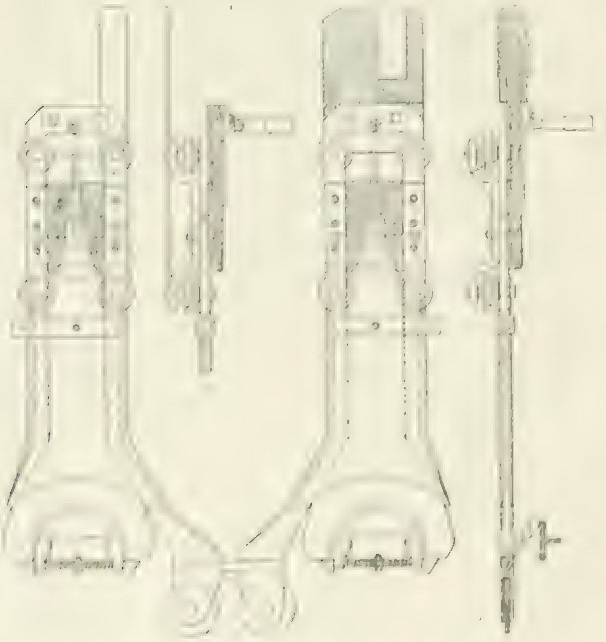


FIG. [illegible]—[illegible] OF THE PLOW.

The arrangement of the conductor switch is [illegible] in [illegible] (Fig. 2).

A represents the track rails; *B*, the current-conveying rails; *C*, the

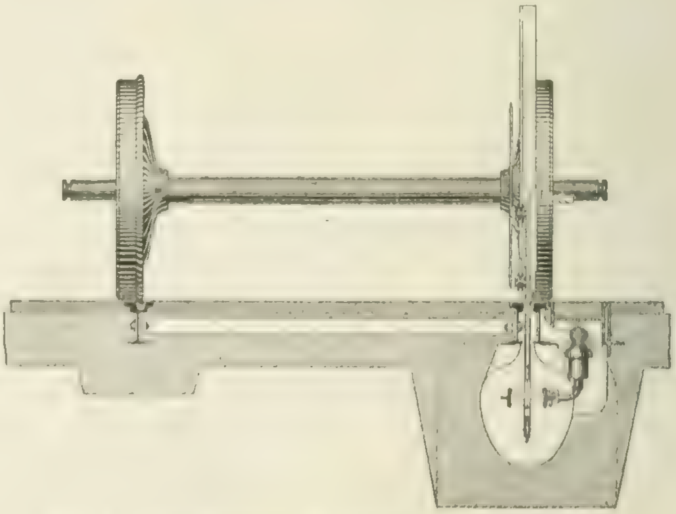


FIG. 6.—CROSS-SECTION OF CONDUIT, SHOWING PLOW.

The plow consists of a frame which is secured to the car in such a manner that it is capable of swinging freely in a horizontal direction, so that the contacts attached to it will easily follow when the car passes curves and switches.

As shown in the illustration each part of the double device consists essentially of a wrought-iron casing, in which is fastened a well insulated iron plate carrying pivoted on its lower end a metal leaf which rests against the current-conveying rail.

The contact leaf is rotated outwardly toward the rail by helical springs coiled on its pivot. These springs permit the leaf to be folded up or down into a vertical plane coincident with the plow. This makes it possible to introduce or remove the device through the slot, the leaves being sprung out against the two conducting rails respectively, as soon as they are clear of the slot. When the plow is raised its connection is also broken from the car circuits.

The plow carries four small wheels engaging with vertical T-iron guides fastened to the truck of the car. The raising or lowering of the plow may be effected by the motorman by means of a chain.

In order to effect a quick and safe change from the underground-conduit system to the overhead trolley, and vice versa, the company has at the proper points built an inclined conduit floor which effects the automatic insertion and removal of the plow and the proper change of connections.

As shown in the figures this is effected by providing in the conduit an inclined and gradually narrowing terminal which pushes the plow up and simultaneously folds the contacts in so that they may pass through the slot. From the surfaces of the rail up to a point 5 cm. higher the device has naturally to be raised by hand by the motorman.

In entering the conduit tract the action of the arrangement is reversed. The motorman releases a catch on a ratchet wheel which is mounted upon the drum holding the chain to the plow, and the latter slides, by virtue of its own weight, down the inclined plane through the slot and into the conduit.

This conduit system has proved to be a perfect success in every respect, and has worked well under the severest trials. For instance, in 1896 there were made in Budapest, on the lines operated by underground conduits, nearly four millions car kilometres, and about thirty millions of passengers were transported.

Because of the good results obtained in Budapest and Berlin with underground conduits, the system is now being introduced in other cities, such as Brussels and Paris. In Germany another line has been built by the Siemens & Halske Company, this system having a ground return so that but one conductor rail is necessary in the conduit. It is especially noticeable that the conduits are completely interrupted in this system at crossings and switches; while passing such places the plows are automatically lifted out of the channel and inserted again by means of an inclined plane.

An Opportunity for Engineers Experienced in Underground Work.

The "Cosmopolitan Magazine" offers a prize of $250 for the best essay on the arrangement and construction of subways for carrying the various pipes, tubes and conduits under the streets of large cities. Although it is not so stated definitely, the wording of the offer indicates that plans for a tunnel in which the services can be installed and repaired without disturbing the surface of the street are wanted in the competition.

Little Leaks.

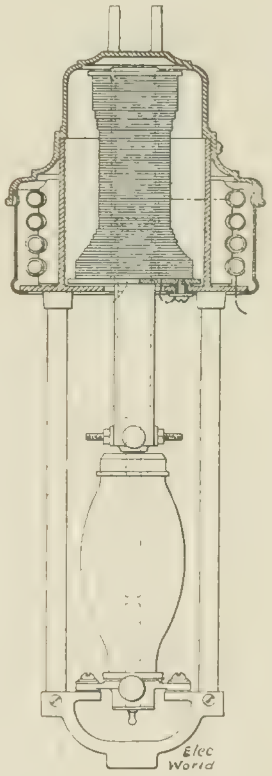
The surprisingly large aggregate to which apparently trivial but continuous leaks may amount is shown in a paper recently read by the chief of the Philadelphia Weather Bureau, in which it was stated that a leak of one drop per second amounts to five gallons per day. Central stations with leaky piping, paying for water by meter, may well remember this and also that apparently trivial steam leaks are a loss not only of water but of coal, and electrical leaks, of water, coal and labor.

Electric Power on the New Monitors.

The four new monitors for which bids were opened on October 1 will be quite fully equipped with auxiliary electrical apparatus, electric motors being installed for the turret-turning gear, ammunition hoists and ventilating apparatus.

An Arc Light Regulator Without a Clutch.

United States patent No. 611,601, issued October 4, 1898, to Mr. S. Bergmann, of the General Incandescent Arc Light Company, of New York, describes an arc light controlling mechanism, so simple in character that it seems as though the maximum obtainable reduction of parts was about obtained. As may be seen from the accompanying illustration, the armature or plunger of the controlling solenoid—which is in series with the arc—travels through the full range of carbon consumption, the plunger being rigidly attached to the carbon. To obtain a uniform vertical lift—equal to the weight of the holder and upper carbon—through the entire travel of the plunger, the solenoid is wound with an increasing number of layers toward its upper, and particularly toward its lower, end. As is well known, the pull of a uniformly wound solenoid on a core equal to or greater than the solenoid in length is a maximum when one end of the core is about in a mid-position within the solenoid. By increasing the number of turns toward the ends of the solenoid, the pull of the end of the core near either end of the coil is increased, and a practical uniformity of pull obtained over a considerable travel. As noted in the patent, a similar effect can be obtained by winding the solenoid with a uniform number of layers throughout its length and varying the cross section of the core, or the two methods may be combined. In the lamp described the upper end of the hollow spool on which the core is wound is sealed and the core, fitting tightly within the spool, acts as the plunger of its own dashpot. The spool is of metal, and the tightly fitting core also serves as a contact for the current. The series resistance is wound in a helical coil wrapped in an annular chamber around the controlling solenoid. The claims of the patent cover only the arrangement of this series resistance.



Electric Lighting Plant on a Sailing Vessel.

A sailing ship now being built at Camden, Me., is to be fitted with an isolated electric lighting plant. This ship is said to be the largest schooner ever built. She will be 282 feet long and will have a capacity of 4000 tons. She is intended to engage in the coal trade between Philadelphia and New England.

The Italian Electro-Technical Association.

The first number of the first volume of the annals of the Associazione Elettrotecnica Italiana, covering the papers and proceedings of this society from its founding in August, 1896, until April, 1898, has been issued. The volume has many valuable papers and indicates a lively interest in the welfare of the society on the part of the ablest electrical engineers in Italy.

DIGEST OF CURRENT ELECTRICAL LITERATURE AMERICAN AND FOREIGN

By Carl Hering.

Dynamos, Motors and Transformers.

THEORY OF THE ROTARY TRANSFORMER. Kapp. "Elek. Zeit.," Sept. 15 and 22.—The first parts of a long article. After referring briefly to the various possible methods of converting an alternating into a direct current by means of revolving machines, as distinguished from rectifiers, and their relative advantages, he discusses the properties of the rotary transformer (Gr. "Uniformer"), which has but a single armature winding in which the alternating current is transformed into a direct current. In such a machine the relation between the alternating and the continuous voltage can no longer be chosen, as it is given by the conditions; this he discusses theoretically and obtains the following results, which give the relation between the e. m. f. of the alternating current and that of the continuous current in percentage of the latter; when the width of the poles is two-thirds of the distance between the centres of the poles these values are as follows: For single-phase, 75 per cent.; two-phase, 75; three-phase, 65; four phase, 53; six-phase, 37; when the widths of the poles is one-half the distance between their centres, these figures are 82, 82, 71, 58 and 42, respectively; for the three, four and six-phase systems the triangle or delta system is assumed. These relations will be changed only slightly when it is loaded, as the armature reaction is very slight; the alternating voltage is therefore in all cases smaller than the continuous, and in most cases a static transformer will have to be used to lower the line voltage. He discusses whether it is better to use a motor generator—that is, a motor coupled to a dynamo—or to use a rotary transformer. He discusses the question of the material required and the efficiency: the amount of material required for the motor generator is practically the same as that for two machines, but the speed may be relatively high; the combined efficiency will average 85 per cent.; its efficiency would be about 92.5 per cent.; that of the static transformer being 97.5 per cent., the total will be about 90, which is better than for the motor generator. The question of the material required is then discussed at length; for equal phases and single-phase currents the armature will be somewhat larger, but with two and three-phase currents appreciably smaller than in the usual continuous current armature for the same load; with phase-shifting the armature becomes larger than for phase equality; in general for two or three-phase currents the material and cost will be less than that of the continuous-current machine in the motor generator combination; the static transformer will be somewhat cheaper than the alternating-current motor; the cost of the rotary transformer and its static transformer will therefore be less; this supposes that one is not limited in the choice of the frequency, for otherwise this relation can be reversed, for with low frequencies the transformer, and with high frequencies the rotary transformer, becomes expensive; there may even be an impossible case when the number of poles is great and the number of conductors small. The output of a continuous-current machine is limited by the armature reaction rather than the heating, while with a rotary transformer the armature reaction is small and the limit is therefore determined by the heating; this he then discusses at length, assuming that the same armature is first driven mechanically and then by means of an alternating current, delivering the same continuous current in each case; he assumes that the currents have the sine form. He discusses first the single-phase transformer with phase equality, and obtains a simple formula; for equal heating a machine in which the width [illegible] of the distance between the centres of the poles will, when used as a rotary transformer, yield 12 per cent. less than [illegible] continuous-current generator; when the pole [illegible] the output [illegible] per cent. less [illegible] phase lag between the current and the voltage it will be less favorable. In the [illegible] with phase shifting, and gives a table of results for various angles; these show [illegible] output than the theoretical, whose field follows exactly the sine law; it is there- [illegible]

[illegible] MOTORS WITH LARGE [illegible]

Lights and Lighting.

[illegible] OF POTENTIAL IN ARC. Mrs. Ayrton. Lond. [illegible] arcs varying from 1 to 7 mm, and with currents from 4 to 14 amperes. The drop of potential at the positive carbon is affected both by the length of the arc and by the current, and is given by the following formula:

$$V = 31.28 + \frac{9 + 3.1\,l}{A}$$

The drop between the arc and the negative carbon is affected by the current only, and not by the length of the arc; it is given by the following formula:

$$V = 7.6 + \frac{13.6}{A}$$

The drop of the negative carbon is therefore by no means insignificant, nor does its sign change; its value is about one-quarter of that at the positive carbon. From these equations the value of the whole fall from carbon to carbon, less that in the arc, is as follows:

$$V = 38.88 + \frac{22.6 + 3.1\,l}{A}$$

She gives the equation found from her former tests for the whole drop, including the arc, and this contains exactly the same constant —38.88—thus showing that this constant does not belong to the positive carbon alone, but to both the positive and negative. Observed and calculated values agree quite closely. The three straight line laws which were found may be expressed as follows: If W represents the watts expended in either of the carbons, and a, b, c, d, e and f be constants, then for the positive carbon: $W = a + b\,A$ with the constant length of arc; or $W = c + d\,l$ with constant current; for the negative carbon $W = e + f\,A$. Others who have experimented with this third carbon placed it in the arc, but this cannot give very accurate results; she approached it to the main carbon and measured the last voltage registered by the voltmeter before it fell to zero. The importance of insulating the exploring carbon is apparent, and she hopes soon to solve that difficult problem.

TESTING ARC LIGHT CIRCUITS. Stevens. "Elec. Eng.," Oct. 6.—A note indorsing the voltmeter method suggested by Markland (see "Digest" Sept. 27 and Oct. 8), which he has used for some time past, and calling attention to a practical form of instrument based on this method, which is now in the market. In using this no complicated calculations are required.

ECKMUEHL LIGHTHOUSE.—"West. Elec.," Sept. 24.—A translation in abstract of the article noticed in the "Digest" Sept. 24.

Power.

ELECTRIC TRANSMISSION OF POWER. A. Siemens. Lond. "Elec. Rev." and "Elec. Eng.," Sept. 16, and "Elec.," Sept. 23.—A reprint of his Brit. Assn. paper. The first part is general in character, and discusses the development; in this he favors continuous as distinguished from alternating currents. The latter part gives a detailed account of the operating costs of the continuous-current plant at the Siemens factory, in which currents at 2000 volts are used; this has been in operation for six years, and has shown itself to be perfectly reliable, the expected great saving in cost having been fully realized. The costs are analyzed, and it was found that during last year the total cost of motive power was 4 cents per hp hour or 3.42 per brake hp per hour exerted by the motors; in this analysis he shows that, roughly speaking, the standing charges account for half the expense, fuel for a quarter, labor for an eighth, repairs for a twentieth and stores for the rest; the distance of transmission is relatively short, and if it were greater the standing charges would be still greater. He also shows the importance of increasing the load factor, and concludes that if electric transmission is used it is necessary above all things to use the power as constantly as possible; if power is wanted only at intervals and at short periods, no economy can be effected by electrical transmission. Owing to the good efficiency of an electric motor at different loads it will in most cases be best to group machines together and drive them from one motor; the most useful field for electric motors is to drive movable machinery and drilling tools. He advocates erecting the generating plant near a coal mine and distributing the power; such an installation was erected at Brakpan, in the Transvaal, a brief description of which he gives; three-phase currents are delivered at 750 volts, which is raised to 10,000; the total power is 4000 horse-power. There is a similar plant near Waldenburg, in Silesia, which has been at work for two years; the total power is 1200 horse-power, half of which is distributed as three-phase currents, which, for great distances, are transformed up to 10,000 volts.

THREE PHASE POWER DISTRIBUTION PLANT. [illegible] Lond. "Elec. Rev." and "Elec. Eng.," Sept. 16.—A reprint of his Brit. Assn. paper on electric power and its application on the three-phase system to a carriage works. He assumes that 15,000,000 tons of coal are consumed annually in Great Britain for stationary engines, and he endeavors to localize the causes of the waste involved in connection with workshops and factories, and to show how this may be obviated by using electricity; he also endeavors to show how the maximum output of machine tools can be obtained, as also the greatest economy in labor. The well-known advantages of electric motors are discussed, after which follows a description of a plant in which electric driving superseded steam driving; the results of tests are given, an analysis showing a saving of approximately $5000 per year, besides other advantages. The reasons for adopting the three-phase system are given—namely, the absence of commutators, the better mechanical design and construction, the fact that such motors can run for long periods without attention, and the freedom from possibility of breakdown.

ELECTRIC MOTORS FOR SMALL INDUSTRIES. Gibbings. Lond. "Elec. Rev." and "Elec. Eng.," Sept. 16; reprinted in "El'ty" (N. Y.), Sept. 28.—A reprint of his Brit. Assn. paper on the application of the electric motor to small industrial purposes and its effects on trade and the community generally. He considers more especially the reasons why its application has been confined to a few special trades; (the paper has special reference to the conditions in England). He endeavors to show how large a sphere of influence the motor is destined to fill. He recommends as a solution of the problem that the central station should purchase good motors and hire them out, so as to diminish the cost to the small consumer; he shows the effect of this system in Bradford, where it has been in use for some time.

ELECTRICAL TRANSMISSION IN A JAPANESE IRON WORKS.—Lond. "Elec.," Sept. 16.—A note from the "Elek. Anz.," stating that in the iron and steel works in Yawatamura belonging to the Government electric power is used to drive the individual machines; the aggregate capacity is 1750 horse-power; current is supplied at 250 volts to several hundred motors, some of them of 100 horse-power.

MOTORS IN A TANNERY.—Lond. "Elec. Rev.," Sept. 11.—A brief, illustrated description of a new application in Cork in which electric motors are used to agitate the leather which is suspended in the tanning liquor; this agitation must be continued periodically, and in the present case it is accomplished by a collector, which switches the motor on and off at the desired intervals, the current being obtained from accumulators. The electric current is not used to accelerate the tanning process itself, as it is claimed to have been found that the resulting product is different from leather tanned in the usual way.

MINE DRAINAGE. Marten and Howl. Lond. "Elec. Eng.," Sept. 23.—A reprint of a short paper describing the scheme used at the South Staffordshire mines, in which electrically driven pumps are installed in the neighborhood of the mine to prevent the water from draining into the deep portion.

ELECTRICAL REFRIGERATION. Fay. "Elec. Eng.," Oct. 6.—The first part of an article describing his system, with the aid of illustrations. An electric motor operates, through double reduction gearing, two compressor pumps; the whole machinery, including the motors, is inclosed in an air-tight box, which is filled with the gas to be compressed; this is done in order to avoid the use of stuffing boxes, which consume much energy. Sulphur di-oxide is used as the gas to be compressed, as he claims this to have advantages over ammonia. The machine has been running for one summer, and the results of tests are given. The average horse-power of current was 3.08, while the power applied to the refrigerant was about 2 horse-power; this, in twenty-four hours, produced the equivalent of 2 tons of ice—that is, 1 ton is equivalent to 1 horse-power in twenty-four hours, delivered to the gas; water is supplied to lead off the heat.

DUMB WAITERS.—"Elec. Eng.," Oct. 6.—An illustrated description of those in the Chicago public library, which are operated by electric motors. Some move only in a vertical direction, while others move around angles. There are pointers on each floor, which are moved by hand, and if the elevator is not in use it will travel to that particular floor. The wiring is described, and the motors are illustrated.

POSSIBLE POWER FOR TRAMWAYS. Booth. "El'ty." Oct. 5; reprinted from the London "Railway World."—He calls attention to the power in the waste gases from blast furnaces, and advocates the use of this power for neighboring electric railways. Some figures are given concerning a blast furnace plant in Glasgow, of which he made tests. Other articles on the same subject by the same author have already been referred to in the "Digest."

POWER FOR WOOD-WORKING MACHINERY.—"West. Elec.," Sept. 24.—Results of some tests made by Dodge at the Navy Yard in Washington, in which he measured the power required by saws and drills under various conditions and at various speeds.

LANCEY.—"West Elec.," Oct. 1.—A translation in abstract, with some of the illustrations, of the description of this plant in the valley of Gresivaudan, which was noticed in the "Digest" last week.

SUBMARINE BOAT.—"Elec. Eng.," Sept. 29.—A translation in abstract, with illustrations of the Sandor Bak boat noticed in the "Digest" last week.

ELEVATOR DOOR OPENERS.—"Elec. Eng.," Sept. 29.—An illustrated description of a device in which the sliding doors are moved by means of a double solenoid acting on a lever above the door, the circuit being closed by a push button on the elevator.

Traction.

ELECTROLYTIC CORROSION BY RETURN CURRENTS. Fleming. Lond. "Elec.," "Elec. Rev." and "Elec. Eng.," Sept. 16; a reprint is begun in "El'ty" (N. Y.), Oct. 5.—A reprint in full of his Brit. Assn. paper on the electrolytic corrosion of water and gas pipes by return currents from electric tramways. One of the Board of Trade rules states in effect that if the pipe is negative to the rail the voltage shall not exceed 4.5 between them, and if the pipe is positive to the rail the voltage shall not exceed 1.5; this rule he shows does not afford protection. Electrolytic corrosion can ensue only under two conditions; the voltage must create a current which leaves the pipe, and the conduction throughout the surrounding soil, or at least into it, must be electrolytic in character; the danger areas are those in which the pipes are positive to the rails, and where the current flows out of the pipes into adjacent electrolyzable soil. He proceeds to discuss whether there can be any danger if this Board of Trade rule is obeyed. He describes experiments made with London clay and other soils, in order to measure the conductivity; he found that there was electrolytic conduction and that the resistance of the moist clay was nearly 17 ohms per yard cube; this is, however, greatly dependent on the state of the clay as regards moisture. A mass of damp sand moistened with salty water has an approximate resistance of 1 ohm per yard cube. Lindeck's measurements of cement blocks are briefly referred to; in the normal condition the resistance is about 50 ohms per yard cube, but this depended very greatly on the conditions of moisture. The conduction in all of these, being largely due to the presence of water, is in great part at least electrolytic in character; in the average condition of moisture he thinks the probable specific resistance of the average subsoils in towns will lie between 15 and 30 ohms per yard cube, which is of the order of 1000 million times that of copper, but although this is high, the actual total electrical resistance between extensive metallic surfaces may be numerically very small; between two 6-inch clean iron pipes, for instance, 100 yards long, placed in the ground 2 feet deep, the actual measured reesistance would in general be something like 1 ohm; a voltage of 1.5 may therefore cause the flow of very considerable quantities of electricity; moreover, a large portion, if not the whole, must be carried by electrolytic conduction, and if the current flows out of the pipe there will be electrolytic corrosion. One cubic inch of iron may be removed from the positive plate by the electrolytic passage out of it of between 127.7 and 182.5 ampere hours, depending on whether the metal is removed in a ferric or ferrous state; this quantity of electricity is, roughly speaking, 1 ampere week. He then discusses the question of the minimum voltage, which will produce electrolytic corrosion; if the surrounding soil favors electrolysis a far less difference of potential than the maximum of 1.5 volts permitted by the Board of Trade can produce rapid corrosion; he describes an experiment made to illustrate this; this also showed that the weight of iron removed may very much exceed the electrochemical equivalent, which is due, no doubt, to local action. In an experiment the loss was found to be nearly three times the theoretical amount. A practical experiment was tried in which three lines of iron pipe were buried parallel to each other in the soil; two adjacent rows were kept at 1 volt difference of potential night and day for six months, and daily readings were taken of both the voltage and the current; the third line of pipe was not connected, so as to observe the normal appearance of the pipes. When the pipes were dug up their appearance was very different; that which had been connected to the negative pole had a clean gray color, with scarcely a trace of oxidation; the one connected to the positive pole was uniformly covered with an orange yellow oxide; the neutral pipe was oxidized slightly in places, but not uniformly; 662 ampere hours had passed between two of the pipes; there was clear indication of electrolytic action; the difference between the two pipes amounted in effect to a greater rate of aging of the positive pipe. The question of the resistance of the joints is then discussed; if it were not for this resistance the conductivity would always be much greater than that of the soil which the pipe displaces; that of a 5-inch cast iron pipe would be about one-third of an ohm per mile, and with leaded joints the joint resistance may not be large; it is, however, probable that the network of pipes forms a system of conductors whose conductivity is greater than the soil displaced by it. He then considers the electric conditions in the neighborhood of an electric trolley line; he shows that if the ends of the pipes are at places where the potential is different, it is certain that a current must flow through them and no amount of conductivity in the soil, short of infinity, will altogether prevent this from happening; in the case of long lines it is unquestionable that the difference of potential in portions of the track involves as a certain consequence the flow of electricity through the earth, however sufficient the rail bonding may be. He then describes a small working model in which rails and pipes were imitated by conductors placed in the soil. In his final summary he draws the following conclusions, referring to street railways with uninsulated rails as return conductors: No amount of bonding of insulated rails will entirely prevent current through the adjacent earth; some portion of this current will pass through subterranean pipes, the amount depending on various conditions; a mere difference of potential between the pipe and the rail is not in itself a source of danger to the pipe, as there must also be electrolytic conduction out of the pipe through the soil, which must contain electrolyzable salts; if this electrolytic conduction exists there is no absolute surety in the Board of Trade limit of 1.5

volts, except that the less the voltage, the less the damage; a fraction of a volt will suffice to cause corrosion; the conditions most to be feared are when certain local soil conditions exist near the places where the pipe is most positive to the rail; for determining possible pipe corrosion an electrical survey should be made, showing the difference of potential between rails and pipes at various places. No reference is made to the question of a remedy, as he merely attempted to show that even when the Board of Trade regulations were carried out it must not be assumed that the danger does not exist.

SPEEDS ON STREET RAILWAYS. Geron. Lond. "Elec. Rev.," Sept. 16.—An abstract of a translation of his paper from the "Railway World." He made inquiries regarding the speeds found most suitable in various tramways and received replies from twenty-one companies operating steam, electric and other railways in the leading continental countries. He makes a distinction between suburban and urban roads. On the Italian tramways the maximum speeds vary from 16 to 20 km per hour (9.9 to 12.4 miles); these are reduced to from 6 to 12 km in the densely crowded streets. It is believed that the official maxima might well be raised to 24 to 30 km (18.6 miles), on an independent, permanent way. In Belgium the speeds are 7 and 10 km in populous districts, and 14 to 17 in other parts; outside of crowded districts it must not exceed 30 km; 18 to 20 are the limiting speeds in several other Italian cities, all of which join in the opinion that greater speeds might be used without additional danger and with additional profit. At Crefeld, Germany, the speeds are 12 to 20 in populous and outside districts. He thinks the Belgian companies' rules best conform to practical necessities.

LONDON CENTRAL UNDERGROUND RAILWAY. Tripier. "L'Eclairage Elec.," Sept. 17.—The continuation of the very long, profusely illustrated article on this railway, the first part of which was noticed in the "Digest" Sept. 17. Many details are illustrated and numerous diagrams are given.

AUTOMOBILES. Feldmann. "Elek. Zeit.," Sept. 15.—A long, well-illustrated translation in abstract of the long report of Hospitalier, which was noticed in the "Digest" last week.

ELECTRIC AERIAL RAILWAY.—"Elec. Eng.," Oct. 6.—A brief, illustrated description of the one which is now in course of construction between Elberfeld and Barmen. The Langon system is used; in this the car is suspended below the track. The line runs over a river all the way, and the track is supported by inclined girders resting on the banks. The line is 8 miles long; the cars will seat fifty to sixty persons; the speed is to be 25 miles per hour; the cost of the double-track road is "between two and five million" dollars (sic); it will be finished in about two years. The system is said to be perfectly safe.

SINGLE V. DOUBLE TRUCK CAR. Graham. "El'ty," Sept. 28.—An unfavorable criticism of the recent paper by McCulloch (see Electrical World Sept. 17). The present writer favors the single-truck car, citing a number of cases where it is used; he claims that McCulloch "did not know what he was talking about" and is not posted in the art.

EVAIN-LES-BAINS.—"Elec. Rev." and "El'ty," Sept. 28.—A brief description of this polyphase railroad plant (see "Digest" [illegible]

Installations, Systems and Appliances.

[illegible] FOR ELECTRIC ENERGY. Meymer. "L'Ind. Elec.," Sept. 10.—A short article suggesting a new method of charging which he considers rational. He argues that the most desirable consumer is the one who uses the greatest number of kilowatt hours per kilowatt installed; he therefore suggests a reduction which increases with the number of lamps installed and a second one proportional to the consumption per lamp; motors and other apparatus are represented by their equivalent in lamps; he re- [illegible] to the kilowatts [illegible] by the consumer. The consumers will not be too economical in their use of current [illegible] reduction.

BRISTOL. Proctor. Lond. "Elec. Rev." and "Elec. Eng.," Sept. 16.—A reprint of his Brit. Assn. paper describing the electric [illegible] to the auxiliary plant. Alternating current is supplied to customers and continuous [illegible] generating station and thirty-eight sub-stations. Tabulated data are given concerning [illegible]

[illegible]

[illegible]

[illegible] pointing out the ad[illegible]

WATER POWER PLANT. [illegible] —A brief, illustrated description of a 1000-light alternating-current plant at the St. Joseph Sanitarium in Sullivan County, which he constructed; it is driven by the water from a brook, having a 70-foot fall; a dam holds enough water to run the plant fifty-two days without rain.

SWITCHBOARDS.—"West Elec.," Sept. 24.—Some brief, illustrated hints concerning the construction of switchboards.

Wires, Wiring and Conduits.

COPPER, ALUMINUM AND IRON CONDUCTORS. Felten and Guilleaume. Lond. "Elec. Rev.," Sept. 16.—A communication referring to the recent article of Kershaw; they give the conclusions which they arrived at in a more practical way. The question must be limited to aerial conductors, as aluminum and iron could not be used for underground conductors, for which copper will continue to be the only practical material. It serves no practical purposes to compare the prices of the metals in the crude state, and the only comparison of value is that of the finished wire; as iron must be protected by a coat of zinc, and as the drawing increases its low value more in proportion than with copper or aluminum, the results of the comparison are necessarily different from those obtained by Kershaw. They start with the following values at which the wires can be bought at present; copper, 14 cents per pound; aluminum, 33 cents, and galvanized iron wire of 16.4 per cent. conductivity, 3.5, or of 12.5 per cent. conductivity, 1.8. Taking Kershaw's figures for specific gravity and conductivity, they obtain the following results: Ratio of copper to aluminum, 100 to 120; copper to iron of 16.4 per cent., 100 to 138; copper to iron of 12.5 per cent., 100 to 93. Commercially, therefore, aluminum is 20 per cent. dearer than copper; iron or 16.4 per cent., 38 per cent. dearer, and iron of 12.5 per cent., 7 per cent. cheaper. The low density and low tensile strength of aluminum are claimed to exclude it from overhead purposes; its strength may be increased by alloying with other metals, but this would reduce the conductivity and increase the specific gravity.

Electro-Physics and Magnetism.

FLUORESCENCE AND ROENTGEN RAYS. Arnold. "Mitt. Phys. Inst. Erlangen," March; abstracted briefly in the Lond. "Elec.," Sept. 16.—He investigated whether the fluorescence of the anti-cathode has a favorable or unfavorable influence on the production of these rays. The anti-cathode was made to consist of a fluorescent and non-fluorescent plate, and a pin-hole camera produced an image of the compound cathode on a sensitive plate. With none of the substances used could any difference produced by luminescence be observed? It appears, therefore, that there is no connection between Röntgen rays and luminescence.

ROENTGEN RAYS. Levy. "Elek. Zeit.," Sept. 22.—A reprint of a paper read before the Union of German Electricians, on progress in the technic of Röntgen rays. He first discusses the theory briefly, and then the construction and application of the apparatus as made by him. Regarding the theory, he states that in Germany the tendency is now to favor the theory originated by Crookes, according to which the cathode rays are negatively charged particles which are discharged at a high velocity from the cathode; their velocity has been calculated, but the results differ greatly; it is, however, likely that it is much less than the velocity of light. J. J. Thomson suggested that these exceedingly small particles are subdivisions of the atoms, and that the properties of these elementary particles are the same. When these particles strike the anti-cathode their velocity is suddenly checked, which produces ether waves of no particular period, which in their properties are analogous to the waves in air due to explosions; these ether waves having no particular period are the Röntgen rays, light rays being periodic. He then discusses and describes the apparatus as he constructs it, an illustration being given. Among the three methods of producing these rays—namely, with the Tesla transformers, the influence machine and the induction coil—he favors the latter, saying that the former is no longer used in Germany, as there are two centres of emission of the rays; to influence machines there are a number of objections, but if these could be overcome they would be a very cheap and good source of the rays.

LAW OF INDUCTION.—"Elek. Zeit.," Sept. 22.—The continuation and conclusion of the long discussion of Breslauer's paper (see "Digest" Aug. 20, Sept. 24 and Oct. 8), in which he endeavors to give a new and more general statement of the law of induction. Unfavorable discussions by Marburg, Westberg and Feldmann were noticed in the "Digest"; the present discussion contains a reply to these by Breslauer, in which he simply defends his original statement of the law, still claiming that it will cover all cases; the replies to his critics seem vague and unsatisfactory. This is followed by replies from each of the critics, in which they show that Breslauer's statement is not general, and in some cases lead to even wrong results; also that when applied to a reversal of the field, it is based on incorrect foundations; further illustrations showing that it is unsatisfactory are given. Feldmann suggests a critical experiment. The final reply from Breslauer is brief, and [illegible] the criticism. He still maintains that the theory of cutting lines of force cannot be applied to cases in which there [illegible]. The result of the whole long discussion seems to be that the theory of the cutting of lines of force is adequate to cover all cases and is perfectly satisfactory, and that the new law of Breslauer [illegible]

MAGNETS AND TEMPERATURE. Ashworth. Lond. "Elec. Eng.," Sept. 16; reprinted in "El'ty" (N. Y.), Oct. 5.—A [illegible] abstract of his Brit. Assn. paper on the construction of magnets of constant intensity under changes of temperature He describes experiments showing a remarkable property of drawn steel wires; magnets made with such wires, after a series of heatings and coolings, reached a state in which an increase of temperature produced an increase of magnetic moment and vice versa. In passing from this abnormal to the normal state a stage is reached at which a change of temperature neither increases nor decreases the magnetic moment, and for the ordinary atmospheric changes of temperature the intensity of such a magnet remains constant.

PERMEABILITY UNDER CROSS MAGNETIZING FORCES. Everett. Lond. "Elec. Rev.," Sept. 23.—A short article discussing this theoretically. He points out fundamental errors made in previous contributions on the subject. He shows that if a transverse force is applied to a magnetic circuit in which a longitudinal force is acting the effective longitudinal permeability will in general be altered in this portion, and hence also the total flux of longitudinal induction through every section of the circuit. An example of such a case is the counter-magnetization in the armature of a dynamo; this must slightly lessen the effective permeability of the iron in the armature and the lines due to the field.

TERRESTRIAL MAGNETISM. Ruecker. Lond. "Elec.," "Elec. Rev." and "Elec. Eng.," Sept. 16.—A long abstract of his presidential address to the international conference on terrestrial magnetism and atmospheric electricity. He pointed out the importance of international co-operation in the investigation of magnetic and meteorological phenomena; there is also urgent need for more perfect organization of a directing body which should decide what should and should not be done. He then considers the way in which such co-operation should be secured. In conclusion he refers to the serious menace to magnetic observatories of the rapid extension of electric railways.

TERRESTRIAL MAGNETISM. Cotterell. Lond. "Elec. Rev.," Sept. 16.—The conclusion of his article (see "Digest" Oct. 1). He endeavors to show the likelihood of his hypothesis that the earth is a recipient of an ethereal line of force, as distinguished from its being a huge magnet.

ANALOGIES BETWEEN METEOROLOGICAL AND MAGNETIC PHENOMENA. Van Rijckevorsel. Lond. "Elec. Eng.," Sept. 16.—A very brief abstract of his Brit. Assn. paper. He shows how exactly similar the yearly temperature curves are for a large part of Europe, and how the anomalies which these curves show may contribute to the discovery of their origin. He plotted six annual curves for temperature, air pressure, rainfall, magnetic declination, and vertical and horizontal components of the earth's force, and shows that all these curves, however dissimilar in their general direction, are exactly alike in their anomalies.

X-RAY WORK IN BALTIMORE. Fairchild. "Elec. Eng.," Oct. 6.—A brief account of the work done at several hospitals and a college in that city. At the latter, Tondorf has been experimenting on the blind, and although some remarkable results are claimed to have been obtained, they are said to be of little or no practical value.

Electro-Chemistry and Batteries.

ELECTRO-CHEMICAL SOCIETY. Muller. "L'Eclairage Elec.," Sept. 17.—The continuation of the abstracts of the papers read at the recent congress in Leipsic. Abstracts in German journals have already been referred to in the "Digest."

CALCIUM CARBIDE WORKS AT INGLETON. Matthews. "El'ty," Oct. 5.—A reprint of the article noticed in the "Digest" last week.

Units, Measurements and Instruments.

ELECTRIC TRACTION AND MAGNETIC OBSERVATORIES.—Lond. "Elec.," Sept. 16.—A long editorial referring chiefly to several recent papers in which protests were made against the interference of terrestrial magnetic observations caused by the proximity of electric railways to magnetic observatories; it refers more particularly to the discussion of this subject at the recent Brit. Assn. meeting. Ruecker stated that there was no desire to stop the spread of electric traction, but that the object of the inquiry was to discover some means by which electric traction might be extended without interfering with magnetic observations. At the Kew observatory provisions have been made which will affect the magnetic induction influences, as these are to be reduced to a negligible amount by keeping the return conductor within a certain distance from the feed and trolley conductors—that is, within the one-hundredth of the distance between the tramway and the observatory. The observatory authorities are apparently not alarmed at the possibility of disturbances from earth currents; for the latter he sees no remedy other than the complete insulation of the return conductor; S. P. Thompson claimed that all difficulties might be obviated by the simple expedient of abolishing continuous currents and using the three-phase current with insulated conductors. Editorially it is thought that the best protection would be the adoption of an insulating return conductor in such a position relatively to the supply conductor as will reduce the magnetic disturbance to a negligible quantity; this would apply chiefly to densely populated districts and not to rural districts.

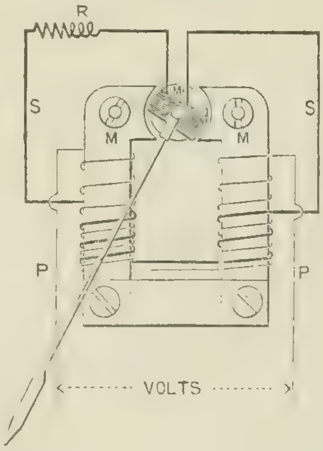
The Lond. "Elec. Eng.," Sept. 23, contains abstracts of the discussion of this subject at the recent Brit. Assn. meeting.—Schott (U. S.) exhibited curves showing the effect of electric railways on the records of magnetic observatories, the small alterations being entirely masked; there were also many abrupt changes, which rendered the record almost valueless. The observatories in Washington, Texas and Toronto have been rendered useless by electric railways; the vertical components suffered most; he considered that 4 miles was the shortest distance that should be allowed between an electric railway and an observatory. Ruecker described experiments made after the opening of the City & South London Railway: the vertical components suffered most; the question of distance alone, for preventing these disturbances, was not the best way of looking at the subject; in connection with the Kew observatory it is provided that the insulated returns in a neighboring tramway should be used to prevent earth currents; also that the two conductors should not at any point be farther apart than a hundredth of the distance of that point from the observatory; he had experimented with 500 amperes on two wires 30 feet long placed 1 km from the observatory, and had found that only the fifth place of decimals was affected. Eschenhagen gave his experience with measurements near Berlin; he found disturbing effects at a distance of 8 km; the earth currents were most to be feared; an uninsulated return conductor was the best preventive. Preece studied the disturbances on telegraph lines; the Metropolitan Railway, on which the experiments are soon to be made, will use a complete magnetic circuit. Ayrton advised the use of an insulated return.

DISSIPATION OF ENERGY IN CONDENSERS. Rosa and Smith. Lond. "Elec. Eng.," Sept. 16.—A brief abstract of their Brit. Assn. paper. They describe experiments in which they measured the heating effect of an alternating current on the dielectric of a condenser; they measured this with a wattmeter, using a coil of wire in series with the condenser to give resonance and raise the voltage. In a second series of experiments they placed the condensers in a calorimeter and measured the heat; the two results agree.

TEMPERATURE COEFFICIENT OF STANDARD COILS. Solomon. Lond. "Elec.," Sept. 23.—A reprint of his Brit. Assn. paper describing his determination of the temperature coefficient of the two 10-ohm standard resistance coils which were used by Ayrton and Jones in their determination of the ohm in 1897. The methods are described and the results given.

CABLE TESTING. Murphy. Lond. "Elec.," Sept. 23.—A short article giving some rules to facilitate the calculation of the influence of the "E. C." upon the results obtained by Schaefer's method of localizing breaks in submarine cables. The method is well spoken of editorially.

ALTERNATING CURRENT INSTRUMENT. Heap. Lond. "Elec. Rev.," Sept. 23.—There are two sources of error in alternating-current ampere and volt meters—namely, those due to changes in periodicity and in wave form; the instrument which he describes and which he has designed is claimed to overcome these sources of error, while at the same time there is considerable deflecting force; the temperature error is negligible, and the consumption but a few watts. The principle is shown in the adjoining diagram. The magnet is made of laminated iron; the armature core is stationary, and the small coil is movable. The iron frame is wound with two coils, one of which, the primary, is connected to the source of supply and forms the exciting current of the electromagnet; the other, the secondary, shown in thick lines, is short-circuited through a resistance and the movable coil; the coil will then be deflected through an angle, which varies with the volts supplied to the terminals of the primary; the calibration curve, which is shown, appears to be practically a straight line, except near the origin. In order that the readings may be free from the periodicity and wave form errors, the magnetic leakage should be small and should remain constant; the air gap is therefore made small and the secondary turns are wound around the lower part of the magnet. To show its freedom from these errors he gives the results of readings made with different currents. An amperemeter may be constructed on the same plan; the primary turns are then few in number, or may be connected to a small transformer through which the main current passes; the resistance *R* is replaced by inductance. The instrument can be made so as to have two or more ranges.



POTENTIOMETER.—Lond. "Elec. Eng.," Sept. 23.—Several descriptions of an easily constructed form of potentiometer for graduating small ammeters and voltmeters.

MEASURING TEMPERATURE FROM A DISTANCE.—"El'ty," Sept. 28.—A short description of an apparatus devised by

Whipple. A tube containing a german silver and a copper wire is introduced in the liquid or space in which the temperature is to be measured; they are connected as two arms of a Wheatstone bridge at the receiving end, and a telephone is used in place of the galvanometer; a pointer is moved over a dial by hand and points to the temperatures; this pointer is moved until no sound is heard in the telephone; it adjusts the other two arms of the bridge until the balance is reached. It is used in the State House in Boston for measuring the temperature of the rooms, by the engineer in the basement who is in charge of the heating. A further application is suggested in connection with cold storage warehouses; also to the measurement of temperature in high altitudes by means of kites or balloons.

Telegraphy, Telephony and Signals.

TELEPHONE STATISTICS.—"Elek. Zeit., Sept. 15; abstracted from the "Jour. Télégraphique."—A table of statistics for the year 1896 for the European countries and a number of countries in Asia, Africa and Australia. The table contains the usual data given in connection with telephone statistics; Great Britain is not included. Among the countries named Germany heads the list with 587 telephone installations, followed by France with 482. In the number of interurban lines Germany heads the list with 2001, involving 35,406 km of wire; this is followed by France with 637 and 50,008 km; then Sweden, with 611 and 28,667. The number of central stations in the two former countries is slightly greater than the number of installations; Sweden heads the list in the number of central stations, which is 633 belonging to the Government, 199 private and 188 on the co-operative system.

PACIFIC CABLE. Bright. Lond. "Elec. Rev." Sept. 23.—A reprint of his Brit. Assn. paper, in which he shows that there are no engineering or electrical difficulties standing in the way of laying an all British cable. He calls attention to the inactivity on the part of England. He discusses the matter under the different heads—namely, type of cable, the laying, repairing and electrical working, pointing out that there are no impossibilities involved. Cables have been laid and repaired in depths of over 3000 fathoms; the greatest depth in the route from British Columbia via Australasia is 3400 fathoms near the Fiji Islands. The alternative—namely, a cable from England to the Cape and to Australia via Gibraltar—is also discussed.

BRITISH TELEGRAPH DEPARTMENT.—Lond. "Elec.," Sept. 16 and 23.—Editorial criticisms of the Postmaster-General's annual report. Particular attention was called to the large deficit, which is far greater than for any previous year; although the growth of the telegraph traffic increased, notwithstanding the effect of the telephone service, the deficit nevertheless increases more rapidly. There is a 3-mile free delivery at all hours throughout the whole of the area of the metropolis, and some messages are therefore delivered at a great loss. Some figures from the report are also given in another part of the issue. Some extracts of the report are also given in the Lond. "Elec. Rev.," Sept. 16.

SYNCHRONISM IN WIRELESS TELEGRAPHY. Tietz. Lond. "Elec. Rev.," Sept. 16.—A translation in abstract of the article noticed in the "Digest" Sept. 10 (see also Oct. 1).

TELEGRAPHY BY ULTRA VIOLET LIGHT. Zickler. Lond. "Elec.," Sept. 23.—A translation in abstract of the article which was abstracted in the "Digest" Aug. 13.

COMMON BATTERY TELEPHONE CIRCUIT.—"Elec. Eng.," Sept. 29.—A brief, illustrated note on the common battery system of the Bell Company, which is being installed in many of their exchanges; in this all the circuits are operated by a common battery at the central, thus doing away with local batteries. In the circuit illustrated the receiver bridges the two wires; connected in parallel to this is the transmitter, which is in series with the primary [illegible] the transmitter itself is shunted by a condenser in series with the secondary coil. The discharge of the condenser with the voice currents tends to magnify the vibrations in the main transmission circuit leading to the central office; "when the resistance of the transmitter decreases the increased flow of current [illegible] tends to make a current flow through the secondary, charge the condenser, and this in turn increases the current in the primary, and consequently in the main line wire. When the resistance of the transmitter increases, the primary, acting on the secondary, tends to keep the condenser discharge through the transmitter and oppose the voltage from the central office, thereby [illegible] in the line wire," thus both the rises and falls in the transmitter current are magnified.

FIRE ALARM SYSTEM OF BALTIMORE. Fairchild. "Elec. Eng.," Sept. 29.—A brief, illustrated description of this system, which is said to be one of the best in this country.

Miscellaneous.

BRITISH ASSOCIATION MEETING. Lond. "Elec." Sept. [illegible]

TURIN EXHIBITION. Montel. "Elek. Zeit.," Sept. 22.—The second report on the electrical exhibits; single and multiphase current machinery is briefly described.

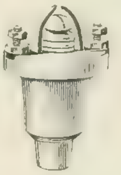
MAGNETIC ORE SEPARATOR.—"Eng. and Min. Jour.;" reprinted in "West. Elec.," Sept. 24.—A brief and not very clear description of a Russian separator which has been in use for some years in Finland. The ore is ground in water and is then passed through a separator consisting of drums; the particles not containing iron are washed away by fresh water, while the iron ore is held back. The material is enriched from 25 per cent. to 66 and 68 per cent., and the waste contains only 1 per cent. of iron.

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION.—"Elec. Eng.," Oct. 6.—An abstract of the presidential address at the recent annual meeting in Buffalo, and a list of the numerous papers read.

OMAHA EXHIBITION.—"West. Elec.," Sept. 24, and Oct. 1.—Brief, illustrated description of the Westinghouse exhibit and the personal exhibit of B. J. Arnold.

An Improved Electric Gas Lighting Burner.

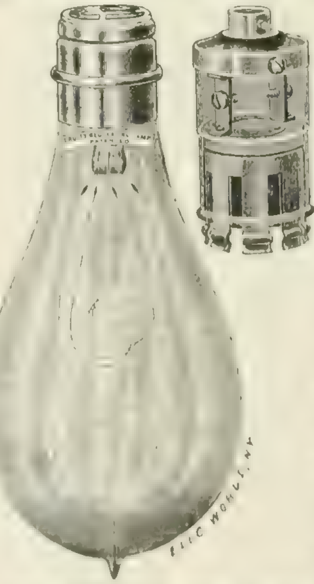
Lava is generally used in making tips for electric gas lighting burners, but it is regarded by some manufacturers as a poor insulator where currents of high potential are employed, such as those produced by the frictional machine or Ruhmkorff coil. To meet this objection the A. L. Bogart Company, 123 Liberty Street, New York City, has produced a tip of porcelain, the insulating qualities of which substance are well known.



The accompanying illustration represents the new form of burner which is intended to be used in series electric gas lighting. The base is arranged to fit the metal socket designed to receive and hold the common lava tip of the ordinary pillar burner, or of a candle burner. The porcelain used in the improved burner is less liable to breakage either through accidental blows or by the increase of temperature due to the flame. The tip, therefore, is more durable. The high insulation of the porcelain tip permits of the lighting of a greater number of burners in one series.

Near the top of the tip are provided grooves in which the electrodes are firmly held in position. This feature of construction preserves the original length of the spark gap. Another new feature consists of the means of attaching the wires to the electrodes, binding screws being used for this purpose. Thus a firm contact is obtained. The wires can be connected up easily and with dispatch. The nuts of the binding screws cannot be lost, as there is a head at the upper end of the screw. The tip being white in color is more attractive than those of the old style, but it may be colored with any desired tint to harmonize with the surroundings.

A Regulating Incandescent Lamp.



Regulating Lamp and Socket

Mr. Clarence Truitt, St. Louis, Mo., has brought out a regulating incandescent lamp, which is substantially constructed and should satisfy the evident want for a reliable regulating lamp. This lamp may be made to give 1, 8, 16 or 24 candle power by simply rotating the bulb in its socket different parts of one complete turn, by which means each of the two filaments is connected singly or the two are thrown in series parallel. In the porcelain base of the lamp are sunk three metallic terminal plates, each forming an arc of a circle. To one of these terminals one end of both filaments is connected, the other two plates constituting the terminals of the other ends of the filaments, thus giving three points of contact in the base of the lamp, which in every other respect resembles the ordinary Westinghouse base. The socket looks something like the Westinghouse keyless socket. It contains two contact points mounted upon springs and perfectly insulated. These two points bear against the plates on the base of the lamp, which, on being turned, changes the connection so that the filaments are either cut out of circuit or connected up in series, multiple or separately, thus giving the different degrees of candle power. When it is desired to use the lamp in a chandelier, ceiling centrepiece or wall bracket that is out of reach, the changes in connections are effected by means of a four-point switch conveniently placed for access and operation. Any number of lamps may be controlled by the same switch.

Regulating lamps are especially useful for show windows, theatres, dining rooms and in all other places where illumination of varying intensity is desired. The low intensity light gives a good night light, while that of the highest [illegible] in the library, reading room, reception room, etc.

The lamp burns equally well on alternating or continuous current circuits, and as it is not burned at its maximum candle power at all times its life in [illegible] is correspondingly extended. One filament is anchored at the [illegible] of the bulb, while the other, which has three coils, lies between the two legs of the first filament, as shown in the accompanying illustration.

The cut gives a view of the lamp and its base, and of the socket, and from it a very clear idea of the features of the lamp may be obtained.

An Electrically Driven Turntable.

In The Electrical World of August 27 last was described an electrically driven turntable, in which the motor was mounted upon a small car, and towed the end of the turntable around the pit circumference. The Erie Railroad, as one of the improvements incident to the general development of its Jersey City yards, has recently installed a new turntable driven by electricity, which furnishes an interesting example of a novel application of electric power.

Electric Turntable, Controller Shown at the Right.

The turntable has been constructed not upon the ordinary turntable principle, but rather upon that of the swinging drawbridge, combined with that of a gun carriage. The two longitudinal girders supporting the table platform are pivoted upon 7½-inch shafts, each girder carrying its own bearing. The girders rest upon an equalizing drum, and the entire weight rests on a set of rollers, as in drawbridge practice. The girders are free to tilt down at each end until their end wheels rest upon the pit track. In laying out the electric application the problem to be solved was to keep the motor in a fixed position relative to the gears, so that their alignment would be unaffected by any tilting end motion of the table, caused by the weight of the locomotive passing onto the platform. To effect this the motor is set on the circular base between the girders, and is thus independent of any vertical motion of the ends of the table. The power is communicated by a double reduction system of gearing from a 15-hp series-wound motor, installed with its armature and shaft in a vertical position. A pinion at the upper end of the armature shaft engages in a gear set at the upper end of a shaft running in the axle bearing of the motor. At the lower end of this shaft is another pinion engaging in a gear set midway on a third shaft, at the lower end of which is keyed a pinion which engages in the stationary rack.

The table is double ended, each end being equipped with a controller with a reversing mechanism, so that the table may be moved in any direction. It is desirable for the operator to be immediately over his work at the end of the table. When he has reversed an engine he walks back to the other end of the table, and operates it from that end, thus saving the power that would otherwise be necessary to turn the table back. The current is taken from the 500-volt power circuit of the Jersey City Electric Light Company, through a Thomson recording wattmeter, and is brought to a pole near the turntable. Descending this the wires run underground through a cast-iron pipe to the centre of the table, where they are brought up through the vertical steel tube forming the central pivot. At the top of this table the conductors are connected to copper collars or collector rings, from which other conductors pass, over porcelain ring insulators beneath the board foot walk, to the controllers and motor. On the pole near the turntable is a box containing the protective devices, switches, etc.—one M. M. circuit breaker, with magnetic blow-out; one 75 ampere double-pole switch and two M. D. magnetic blow-out lighting arresters, one on each conductor.

View of the Motor and Gears.

The amount of power required to turn the table through an arc of 180 degrees is very small. In practice the power is cut off when the table has moved over an acre of about 30 or 35 degrees, the momentum then acquired sufficing to carry it around through the remaining degrees of the semicircle much more quickly than is possible by hand power. The motion of the table as it approaches the stopping point is retarded by a band brake acting on a friction wheel set at the top of the second gear shaft. The diameter of this wheel is such as to insure rapid and powerful action.

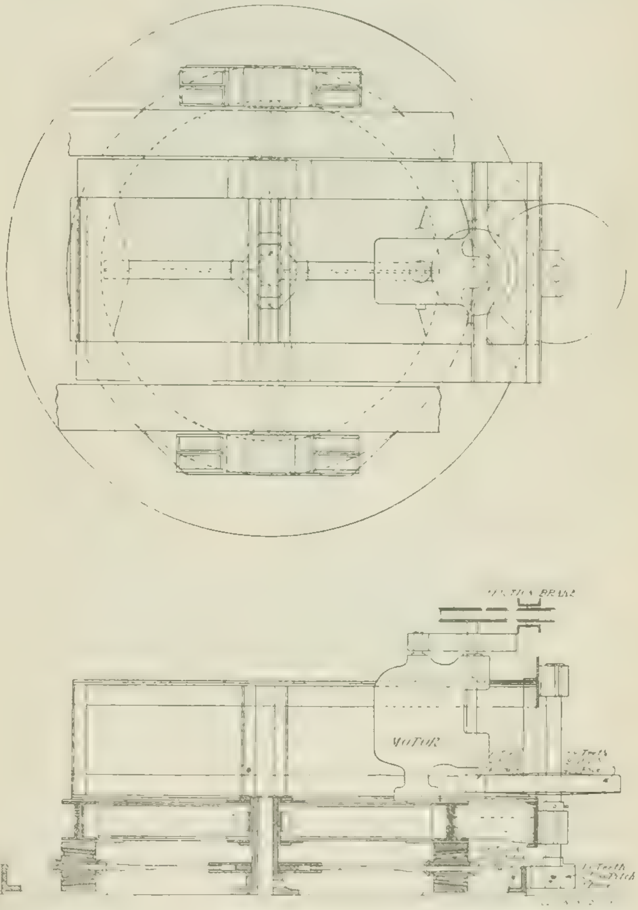
Turning the table over an arc of 180 degrees is accomplished in about one-half a minute in everyday practice, with the result that an accumulation of locomotives waiting to be turned is impossible. Before the installation of this electrical table, the handling of the locomotives was a question of serious moment in the yards, as moving them quickly enough to prevent accumulation was manifestly impossible. Now the work is performed without any delay even to a single locomotive. The number of engines turned ranges between 175 and 225 per day.

The economy of the new system over the old may be roughly estimated as follows:

HAND TURNED TABLE PER MONTH.	
Two shifts of four men each, eight men twelve hours per day	$400
ELECTRICAL TURNTABLE PER MONTH.	
Two men	100
Current, 30 amperes for 15 seconds each turn 200 hours per day, 50 minutes per day or 25 hours per month; minimum rate charged	200
Depreciation 10 per cent. on electrical equipment only (say, on $1200 per month)	10
	$130
Difference in favor of the electric power per month	$270

Even if no saving were actually made in the operating expenses, the convenience and rapidity of the electrical, as compared with the former, method of handling the locomotives would be a sufficient warrant for the expense incurred in making this installation.

The important feature of the design of this table is that the weight of the driving machinery is carried on the central roller wheels, which also carry the table itself. Electrically driven turntables have been built with the driving motor and accessories placed at one end. This necessarily imposes great extra weight on the circular rail in the pit, and a comparison between a table thus equipped and that which the Erie Railroad has just installed will undoubtedly show many advantages in favor of the latter.



Plan and Longitudinal Section of Central Portion of the Table.

This table was designed by Mr. Mason R. Strong, assistant engineer of the Erie Railroad Company, under the direction of Mr. Charles W. Buchholz, chief engineer, and was built by the New Jersey Steel & Iron Company, Trenton, N. J. The complete electrical equipment was designed and furnished by the General Electric Company.

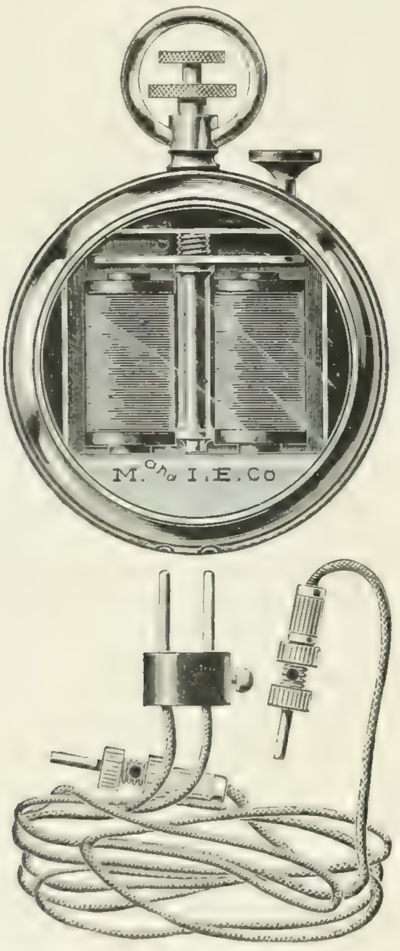
The Henry Street-Railway System.

On October 2 a public trial was made on the Park Hill line of the electric railway system of Denver, Col., of the regenerating system of traction developed and patented by Mr. J. C. Henry. It will be remembered that Mr. Henry was one of the pioneers of electric traction, and has been working for several years on a method of properly controlling car motors with shunt or separately excited fields, wherewith a wide range of speed and torque could be obtained, and with which power could be returned to the line on down grades and retardation.

The daily press accounts describe the test as very satisfactory from the passengers' standpoint, the acceleration and retardation being smooth and uniform and readily controlled. In general the system combines a series-parallel combination with the shunt field excitation, the strength of this shunt field being adjusted from the controller handle by means of the ordinary rheostat in series with the field winding. A greatly increased field strength is also obtainable for emergency purposes, either in starting overloads or sudden stopping, by putting the two field windings in multiple instead of in series with each other. An automatic overload alarm is also used in connection with the system, consisting of an ammeter closing a local circuit through an alarm bell. The controller is so situated that it can be operated from within the car as well as from the platform, thus allowing the motorman to be protected in severe weather with a vestibule.

The "Morse Watch" or Secret Sounder.

A very unique and serviceable electrical instrument is being placed upon the market by the Manufacturers and Inventors Electric Company, 96 and 98 Fulton Street, New York. It consists of a telegraph sounder, enclosed in a watch case of ordinary size. The play of the armature may be reduced to so extremely small a degree as to render the clicks inaudible a couple of feet away, yet they may be distinctly heard by placing the case to the ear, after the fashion of using a telephone receiver. It may, however, be varied at will, so that the instrument may be made to give a loud enough click to be heard all over a room. A flexible and adjustable headband of silk or mohair is devised in convenient form for fastening the watch over the ear, leaving the hands free for other work.



Secret Sounder and Connecting Cord.

The construction of this sounder is quite novel, in order to obtain the necessary [illegible]. The magnets are the same size as those used in the [illegible] and are carefully wound with silk covered wire. They are wound with low resistance for local circuits and high resistance for main-line work. They are rigidly supported on a metal segmental base set in the lower part of the case, as shown. Between the magnets, rising from the metal base, is a post [illegible] as high as the magnet. Attached to the under [illegible] is a short piece of tube, which fits over the post. [illegible] the upper knurled head in the proper direction. The lower knurled head regulates the play of the armature. The armature is not supported on trunnions or pivots, its action being an up and down movement, like that of a piston rod of an engine. This type of sounder is also made with a key, as shown in the illustration. The key consists of a short spring lever, fixed at one end. A finger knob projecting through the case enables the operator to transmit signals in the usual way. The knob performs the function of a circuit closer as well. The circuit is closed by turning the knob screw until it makes contact with the lower contact point. To use the key it is only necessary to unscrew the knob until the contact points are separated, and then the key is manipulated in the usual manner.

To connect the sounder in circuit a conducting cord is used. The cord connector has two terminals, which are pushed into corresponding holes in the case. Tips are provided at the other end of the cord.

This make of tip, to which is given the name "Manditip," is worthy of special mention. It is in reality a combined binding post and tip, and can be used to connect with another binding post, or as the binding post itself. The illustration shows these features of construction. Another improvement in this tip is the provision to effect repairs in case the cord breaks at the tip.

The "Morse Watch" is claimed to be the best instrument of its kind ever put upon the market, and its compactness and portability are commendable features. It will be found particularly useful by typewriter operators, train dispatchers, linemen, bulletin operators and in railway stations, newspaper offices, military telegraphs, police stations, hotels, etc., and all noisy places where it is desirable to maintain either uninterrupted quiet or absolute secrecy of telegraphic communication.

Mr. T. J. Smith, the manager of the Manufacturers and Inventors Electric Company, who was manager of the late firm, The E. S. Greeley & Co., being an old telegrapher himself, in confirming the design of this instrument knew precisely the requirements and conditions to be met in practice. He claims that the "Morse Watch" will give satisfaction, and will find a wide field of application.

Electricity in Tanning.

The use of the electric current for hastening the chemical process of tanning has long been discussed, but, as may not be well known, is now possible commercially with methods and apparatus exploited by the United States Electrical Leather Process Company, of 138-144 Lincoln Street, Boston, Mass. The development of this application of electricity is the work of Mr. George D. Burton, who is best known to electrical engineers, through the Burton electric forge, electric brazing machines and others similar metal working devices. Mr. Burton has not limited the exercise of his inventive abilities to the electrical field, and it may be a surprise to electrical engineers to know that he is the inventor of the now widely used Burton stock car.

But his latest work has been in the application of electricity to the treatment of leather, the results of which are described below. In these processes the electric current is not only used for hastening the tanning, but also for facilitating the unhairing of the animal skins as well as the extraction of the tanning elements from bark and other substances. The apparatus for the unhairing and tanning processes is shown rather diagrammatically in Fig. 1. Here *D* and *D* are the lead and carbon electrodes, respectively; *E* is a grating or perforated false bottom on which the skins, *Q*, rest in the solution, *B*, and *a* is a paddle wheel, which keeps the liquid in motion over the hides to be treated. The unhairing solution is the ordinary mixture of lime and arsenic, through which a small current density is maintained for a period of fifteen to twenty minutes. The current is then turned off, the skins remaining in the solution from thirty minutes to an hour and a half longer, when the hair is sufficiently loosened for the mechanical process of removal. By the ordinary process from ten days to three weeks are required to accomplish this same result. After the hair is removed the hides are laid in a similar vat with a proper tanning solution, the strength of which is varied from 2 per cent. to 18 per cent. Direct current with a voltage varying from 6 to 220 volts between the terminals, according to the nature of the leather, is put through the solution for about fifteen minutes, the effect being apparently to open up the pores of the hides, facilitating greatly the permeation of the tanning agents, this greatly accelerating the process. The figures of time required for tanning by this process are with bark liquor about twelve days for cowhide, one and one-half to three days for calfskin and one day for kangaroo.

The extracts of the bark and other substances used in tanning are prepared in an apparatus similar to that shown in Fig. 2, where the particles of bark are [illegible] covered by the liquid in the tank, through which liquor the electric current is passed. Sufficient energy is sent in to cause the solution to boil, this process requiring about thirty minutes. The purpose of the still shown at the right is the saving of the vapors given off in the boiling process. The ordinary process requires about three weeks' time.

Fig. 1.—The Unhairing and Tanning Apparatus.

[illegible]

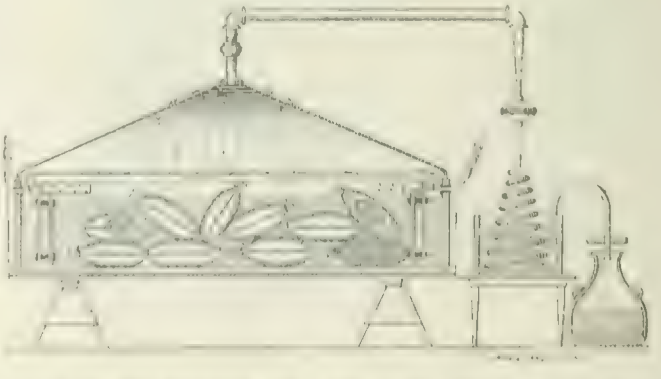


Fig. 2.—Apparatus for Preparing Tanning Extracts.

NEWS OF THE WEEK

Financial Intelligence.

THE BOSTON ELECTRIC LIGHT COMPANY, Boston, Mass., has declared a regular quarterly dividend of 1½ per cent., payable December 15.

DIVIDEND.—The New York & New Jersey Telephone Company has declared a quarterly dividend of 1½ per cent., payable October 15, to stock of record October 5.

TO INCREASE CAPITAL.—A special meeting of the stockholders of the New York & New Jersey Telephone Company will be held in Brooklyn, October 27, to vote upon a proposition to increase the company's capital stock from $5,000,000 to $8,000,000. The proceeds will be applied to extensions and the new stock will be offered stockholders at par.

THE THIRD AVENUE RAILROAD COMPANY, New York, has given notice to its stockholders of an increase in its capital stock from $10,000,000 to $12,000,000. The additional capital is required to equip its lines with electricity. It is stated that the directors of the Dry Dock, East Broadway and Battery line, the Union Railway Company ("Huckleberry" road) and the Forty-second Street, Manhattanville and St. Nicholas Avenue Railway Company have adopted resolutions providing for a consolidation with the Third Avenue road. The majority of stocks in these companies is controlled by holders of Third Avenue stock. The capital of the consolidated companies, it is reported, will be fixed at $53,000,000, of which $35,000,000 will be a new issue. As the Third Avenue road owns $6,000,000 of its own stock it is pointed out that the outside stockholders will have to contribute about $25,000,000. The Third Avenue road has several valuable franchises which it will develop.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
9 Murray St., NEW YORK, October 10, 1898.

MR. J. A. WILLIAMS, of Cleveland, is on an Eastern trip on the business of the Williams Electric Company, of which he is president and general manager. In Boston and other cities of New England, and also in New York, Mr. Williams secured a large number of orders for the well-known magneto bell, manufactured by the Williams Electric Company.

THE AMERICAN ELECTRICAL & MAINTENANCE COMPANY, 451 Greenwich Street, this city, was on October 4 placed in the hands of Aldred K. Warren and Francis Higgins, who were appointed by Justice Smyth as receivers of the company. This action was the result of proceedings brought by directors for the voluntary dissolution of the corporation on the ground of insolvency. The liabilities are stated to be $35,199; nominal assets, $29,126; actual assets, $17,398. The business was established in 1892, the present company being incorporated in July, 1897, with a capital stock of $250,000.

CONSUMMATION OF THE KINGS COUNTY-EDISON CONSOLIDATION IN BROOKLYN.—The consolidation of the Kings County Electric Light & Power Company and the Edison Electric Illuminating Company of Brooklyn was completed on October 3 by Mr. Anthony N. Brady in behalf of the former, Mr. George F. Peabody representing the latter. By the deal thus completed the Kings County Company becomes the owner of the Edison stock, and by virtue of the ownership of this stock will own the stock of the Citzens Electric Illuminating Company and the Municipal Electric Light Company, both of Brooklyn borough. The Kings County Company now controls practically all of the electric light business in the borough. On July 15 last a circular was issued by the Edison Company announcing the proposed sale to the Kings County Company, provided the agreement was ratified by two-thirds of the stockholders. Their acceptance having been obtained the deal was consummated as above noted. The terms of the consolidation were outlined in the financial columns of THE ELECTRICAL WORLD of July 30, 1898. On January 1 last the Edison Company was supplying 227,095 16-cp lamps, 6406 arc lights and 3750 horse-power to motors.

THE TELEPHONE IN BUSINESS AFFAIRS.—According to the last statement of the Bell Telephone Company the number of sets of instruments outstanding on September 20 was 527,793. Of this number about 25,000 are in use in Manhattan and Bronx boroughs. Many of the large business concerns in this city, however, utilize more than one instrument, and this fact emphasizes most strongly the importance of the telephone as an aid to the transaction of business between distant points. It is only thirteen years since the telephone made its bow to the public, and its rapid adoption in all civilized countries of the world is one of the marvels of industrial progress. As a time saver to business it takes first rank. It has become an actual necessity, and any business concern of any importance without a telephone is likely to be regarded as behind the times. An analytical study of the telephone directory of the New York Telephone Company reveals many interesting facts, most significant of all, perhaps, being that of the liberal use of instruments by many of the prominent private and public concerns in Manhattan and Bronx boroughs. The city of New York stands at the head of the list with no less than 131 telephones. Only three of the departments have one telephone each, while the street cleaning department employs twenty-five and the health department twenty-four. There is only one telephone door to the finance department. Whether this is a precautionary measure of Father Knickerbocker to prevent leaks in the city's strong box or not, our source of information sayeth not. Next to the city comes the post office, with thirty-six instruments, these instruments, however, being scattered over the two boroughs among the substations. The Metropolitan Street Railway Company requires twenty-two telephones to keep its service at the highest degree of efficiency, and to provide New Yorkers with ice cream, cool drinks, etc., the Consolidated Ice Company and the Knickerbocker Ice Company together employ thirty-one instruments. The large dry goods houses and department stores have five or six instruments each, and the express and railway companies are liberal patrons. It is a notable fact that the Western Union Telegraph Company does not use a single telephone at its headquarters. In many of the large private business houses five or more separate and distinct instruments are used. The list above given does not take into account the private exchanges, of which there are many.

A NEW LIGHT AND POWER COMPANY.—There is much speculation and curiosity in this city over the incorporation at Albany, on October 3, of the New York Gas, Electric Light, Heat & Power Company, with a capital stock of $25,000,000. The directors of the new company for the first year are: Henry J. Hemmens, Frank D. Allen, F. L. Allen, J. F. Yawger, Louis M. King, C. N. Flint and N. W. Smith, of New York City. The fact that these gentlemen are not recognized as promoters, and are comparatively unknown in the community, throws a halo of mystery around the the identity of the real promoters and the purposes of the new concern. Efforts to ascertain both have shed no certain light upon the prevailing general ignorance respecting the same, and interested outsiders are guessing as to what is going to happen. That the company means business there seems to be no doubt, for the reason that the incorporators paid to the Secretary of State corporation taxes to the amount of $31,250. The only ray of light that has penetrated the gloom comes from the director first named, Mr. Henry J. Hemmens, who is reported to have said that the field of operation of the new company will be Greater New York, and that the company would "take electricity from no railroad company." The latter part of this statement refers to a report that the company would utilize the surplus energy of the power station of the Third Avenue Railroad Company. As to the real backers of the new company it was thought by some that R. P. Flower & Co., bankers, had a hand in its affairs, but at the office of the firm it was stated that they knew no more about the scheme than the public does. Prominent gas men think that the directors named are merely dummies. The fact that the Metropolitan Street Railway Company is laying a very liberal supply of conduits along Broadway immediately adjacent to its tracks is regarded by some as an indication that the company may in some way be concerned in the new enterprise. What the railway company proposes to do with all the ducts is yet unknown to any but the elect. In some places along Broadway as high as forty ducts have been laid; the number varies at different points along the line. With its immense resources the Metropolitan Company might make itself mightily felt in the electric lighting industry. Representatives of the company deny that it has anything to do with the new company. Another suggested explanation of the object of the new company is that it represents a move on the part of the Kings County Electric Light & Power Company, which is consolidating the electric light interests of Brooklyn, to greatly enlarge its scope and take in more territory. Such a company as the New York Gas & Electric Light, Heat & Power Company would, it is believed, enable the Kings County Company to do this. Officials of the Third Avenue Railroad Company deny that their company has any connection with the new enterprise. The directors of the new concern appear to be bound to secrecy regarding its affairs. As one of them stated: "To make the facts public now would injure the enterprise." Different views and explanations—all seemingly plausible—were expressed during the week, the last one being the alleged discovery that the new company will probably absorb the charter of the "Block" Electric Light & Power Company, which, it is said, has a very valuable charter obtained in 1894 under the old laws. This company operates a small plant in the theatrical district in this city. William F. Sheehan, the former lieutenant governor, and several friends whose names are withheld, it is stated bought up the little Block Electric Company last January, and ever since that time there has been gossip as to what use they intend to make of it. Mr. Sheehan is intimately associated with former Governor Flower in many of his electric enterprises, and it was stated on apparently good authority that the Block Company is to be used by the big $25,000,000 New York Gas & Electric Light & Power Company as an operating company. It is said that the New York company will probably not attempt to get a franchise of its own from the Municipal Council, to whose use it would be limited to twenty-five years, greatly handicapping it in the floating of its securities. The franchise of the little company, however, is very liberal, and any electrical service may be carried on that is desired, even to the furnishing of power for traction purposes, which is said to be a part of the plan of the new company. But Time is a good secret-revealer, and will no doubt in due time throw the rays of his searchlight upon the innermost thoughts of the new comer and expose them to public criticism.

NEW ENGLAND NOTES.

Branch Office of THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, MASS., October 8, 1898.

THE ELECTRIC GAS LIGHTING COMPANY, Boston, has recently increased the floor space of its factory 50 per cent., the extension of which was made necessary by the rapidly increasing sales of its varied line of electric gas lighting, open circuit battery, and house goods specialties.

THE PHILLIPS INSULATED WIRE COMPANY, Pawtucket, R. I., because of continued increased demand for its wire manufactures has been compelled to extend its already large factory facilities, and is at present doing so in a most active manner. It is virtually duplicating its present plant by the erection of a four-story building 120x50 feet, and a one-story building 120x65 feet. The whole, when completed, will represent 75,000 square feet of floor space, and the buildings will present an attractive appearance architecturally.

PHILADELPHIA NOTE.

Branch Office of THE ELECTRICAL WORLD,
929 Chestnut Street,
PHILADELPHIA, Pa., October 8, 1898.

MR. ELLWOOD IVINS, of the Ellwood Ivins Tube Company, Oak Lane Station, Philadelphia, has invented an ingenious method of blowing a steam factory or other whistle at any predetermined time. The device consists of a combination of steam, electricity and clockwork. The clock is provided with an index, which may be set at the time at which it is desired to blow the whistle. When the pointers of the clock reach the set time the circuit is closed and by means of an electromagnet the steam is turned on and the whistle blows. The method is also applicable as a protection against fire, by including a thermostat in the circuit. It is entirely automatic, and requires no more attention than the winding of a clock. Mr. Ivins intends to take out patents. The device is in practical use at the company's factory, and is giving excellent results.

BUFFALO AND NIAGARA FALLS NOTES.

BUFFALO, N. Y., October 8, 1898.

THE UNION CARBIDE COMPANY, Niagara Falls, N. Y., has just closed a contract with the Niagara Falls Power Company for 5000 additional horse-power for use in its Niagara plant. The Union Carbide Company has recently remodeled its plant at the Falls, and introduced many improvements, which, it is estimated, will cost about $100,000.

THE CATARACT POWER & CONDUIT COMPANY has closed the contract with the McKinnon Dash Company at Black Rock in this city for furnishing 100 horse-power from Niagara to run the works. The machinery is to be of very peculiar construction, and will be some time in building. The bids for it will not be in till next week. There will be a 25-cycle induction motor to receive the current at 2200 volts. This is provided with a pulley at each end, one for driving the 60-cycle alternator which supplies the Thomson welding machines with current. The other pulley will drive a 40-kw, 110-volt generator, which will supply current to an arch welder and small motors for ordinary motive power, such as running the stitching machines, and also to excite the alternator. The current will probably be taken from the main Niagara line at the Niagara Street car barns, which station is putting in additional transformers of about [illegible] horse-power.

CHICAGO NOTES.

Branch Office of THE ELECTRICAL WORLD,
936 Monadnock Building,
CHICAGO, Ill., October 7, 1898.

THE ELECTRICAL EXCHANGE, 174 South Clinton Street, this city, which has since November, 1896, been engaged in the electrical business, has made an assignment to Mr. L. O. Gilman. The assets are placed at $12,000 and the liabilities the same amount.

AN ELECTRIC LIGHT PLANT FOR NORTH CHINA.—Mr. A. Louis Kuehmsted, treasurer and general manager of the Charles E. Gregory Company, this city, states that his company has just received an order for an electric light plant for North China. This is said to be the first plant of this character installed in that part of the world. It consists of a 1000-light dynamo, together with a complete equipment.

ST. LOUIS NOTES.

ST. LOUIS, Mo., October 6, 1898.

THE CENTRAL TRACTION COMPANY sent to the Board of Public Improvements this week the plans for its route. This is considered the first step in beginning the construction of the road. The plans were referred to the Committee on Streets and Railroads of the Board of Public Improvements.

THE LUNDELL RAILWAY bill providing for the consolidation of all the lines now under the control of the Lundell Railway Company and the connection of all those lines with tracks was killed in the Council last Monday by a vote of six to seven. The bill has already been killed in the House, and is now [illegible]

PACIFIC COAST NOTES.

[illegible], Cal., October [illegible] 1898.

[illegible] called for.

[illegible]

[illegible] sentative of the Hearst estate while the "Examiner's" electric power plant was [illegible]

[illegible] Los Angeles to Pasadena and the other from Los Angeles to Santa Monica. [illegible] with the others which it owns, and operate the combination under the name of the Los Angeles Railway Company. The combined trackage will be about 128 miles of electric road. It is said that the capital stock of the new company will be $5,000,000, and that bonds will be issued to the amount of $5,000,000.

MEXICAN NOTES.

MONTEREY, Mexico, October 4, 1898.

A NEW telephone line connecting this city with San Bernabe has just been placed in operation.

THE AUTHORITIES of the city of Durango have just added forty street arc lights, which now makes that city one of the best lighted places in Mexico.

THE CITY COUNCIL of Linares, State of Nueva Leon, is negotiating with an American company for the establishment of an electric lighting plant for that city.

MEXICAN AND SPANISH capitalists of the State of Vera Cruz have formed a company for the purpose of obtaining a concession from the Federal Government for the utilization of the Tonata Falls in the Tlapacoya district for an electric power plant, which is intended to furnish power for industrial enterprises. These falls are capable of producing an enormous power.

TELEGRAPH LINE construction on an extensive scale is being carried on in all parts of Mexico, particularly in the State of Chiapas. That State recently transferred its telegraph lines to the Federal Government, and many extensions are now in progress. A net work of telephone lines is also being constructed and will soon bring San Bartolome, the capital of La Libertad, into talking distance with the rest of the State.

CANADIAN NOTES.

OTTAWA, October 8, 1898.

A SCHEME is on foot in the County of Halifax, Nova Scotia, to construct an electric railway from the town of Waverly to the city of Dartmouth, and from that point to Musquodoboit Harbor.

THE CITY OF TORONTO, ONT., wants tenders by Wednesday, November 9, for the construction of a complete electric lighting plant, or for the various portions of the work, viz., engine equipment, countershaft and pulleys, belting, boilers, feed pump and condensers, water and steam piping, economizers, dynamos and station electrical apparatus, arc lamps, mast arms and lamp attachments, poles and overhead circuits, conduits and cables.

MR. E. C. JENISON, of Chicago, is promoting a scheme to build a water power canal from above the Ecarte Falls, on the Kaministiquia River, to the boundary of Port Arthur, where an immense storage reservoir will be built. The intention is to supply electric light and power to Port Arthur, Fort William and other towns in the vicinity. The immediate expenditure for the canal would be about $1,000,000. The town of Port Arthur has made arrangements for the supply of 560 electric horse-power and 500,000,000 gallons of water per annum from the power canal. The contract is to be submitted to the ratepayers for their approval at once, and Mr. Jenison agrees to have the works completed within three years. He actually expects to have the power ready by January 1, 1899. The proposition is regarded as fraught with more possibilities than anything that has occurred in that district for a long time, as, to make the gigantic enterprise pay, Mr. Jenison will have to get manufacturing institutions established there to utilize the power thus generated.

General News.

THE TELEGRAPH AND TELEPHONE.

AMHERST, MASS.—The Amherst Telephone Company has been incorporated with a capital stock of $4000.

ALBION, MICH.—The Calhoun County Telephone Company, which has been making plans for an exchange here for some months, has commenced active operations. It is expected that it will be in operation within thirty days.

COMPETINE, IA.—The Competine Telephone Company, composed of Dr. C. A. Henry, D. H. Thompson and L. Dudgean, of Competine, and Dr. P. Sherlock, of Martinsburg, is erecting a new telephone line, which will connect Hedrick, Martinsburg and Competine.

EDWARDSVILLE, ILL.—The Central Union Telephone Company has completed its line from the north of Alton, and now telephonic communication is open with Godfrey, Jerseyville, Brighton, Kane and about fifty towns in Jersey, Macoupin and Greene counties.

SUMMIT, N. J.—The Township Committee has received an application for a telephone franchise from the Newark Telephone Company. Owing to the frequent fights with the New York & New Jersey Company the committee was disposed to listen to the Newark Company's proposition.

ALLEGHENY CITY, PA.—The new fire-alarm system in this city, which is being installed by the Gamewell Fire Alarm Telegraph Company, is said to be the finest that has ever been built for any city in the United States. The switchboard and some of the instruments have been placed in position.

LORAIN, OHIO.—Officials of the Black River Telephone Company have entered a contract with the Ohio Telephone Toll Line Company for the construction of a line from this city to Elyria to connect the local system with that company's line. Later the local exchange will be connected with the Home Telephone Company at Cleveland.

BLOOMINGTON, ILL.—The McLean County Telephone Company has completed arrangements whereby its lines will cover a large section of central Illinois heretofore undeveloped. It will connect with the Fulton County Telephone Company's lines, and give service to the towns now covered by that corporation. The new system will be in operation by January 1 next.

THOMASVILLE, N. C.—The Thomasville Telephone Company has been incorporated with a capital stock of $6000. F. S. Lambeth, J. W. Lambeth, C. A. Julian, J. F. Haden, W. E. Evans, R. W. Thomas, C. R. Thomas, W. M.

Morton, A. Johnson, J. B. Boone and J. A. Green are the incorporators. The corporation purposes to erect a telephone system in the town of Thomasville and the surrounding county.

BOSTON, MASS.—The Bell Telephone Company's instrument statement for the month of September 20, shows, gross output, 31,977; returned, 12,931, leaving net output, 19,046. This represents a net increase of 7000 over the number outstanding the same day last year. The gross output since December 20 is 244,724, and the net output 136,465. The total number of instruments outstanding on September 20 was 1,055,586, an increase over last year of 188,100.

IRONTON, OHIO.—The Mutual Telephone Company, at Ashland, has bought out the Bell Company up there, which withdraws from the field after a long fight. There were but few paying instruments in the system at the wind up. This cuts the Central Union Company at Ironton out of a connection with Huntington, but it at once moved across the river and established a long distance station at Ashland, utilizing the metallic circuit river span already up between Coalgrove and that city.

RICHLAND CENTRE, IA.—The Union Telephone Company, having purchased a controlling interest in the Southwestern Telephone Company, will proceed at once to make connection betwen all the surrounding towns ,including Platteville, Lancaster, Fenimore, Boscobel, Richland Centre, Lone Rock, Spring Green, and in fact all the important points in Grant, La Fayette, Richland, Sauk and Dane counties. Also a line from Dubuque and Madison. Poles are now being delivered along the line.

VICTORIA, B. C.—The recent extension of the wires of the Western Union Telegraph Company has had the effect of cheapening the rates and of securing prompt and satisfactory communication with the United States at all times. The Western Union Company, being incorporated under the laws of the United States, has no right to operate in Canada, and consequently it has established connection with the Port Angeles, Wash., line operated by the Great Northwestern Telegraph Company, which connects with the Western Union. The new line includes a cable across Puget Sound, from Seattle to Port Townsend, thence it goes by land and water to Victoria. Since this line was built the Canadian Pacific Railway Company has also laid a cable from Victoria to Port Angeles, so that now Victoria has two telegraph lines direct to the United States. Each wire is duplexed, thus permitting the transmission of messages from both ends of the line at the same time.

PONTIAC, ILL.—The Livingston County Telephone Company was incorporated February 1, 1898, and was bought by the present company July 19. The cables are 3500 feet in length, and some of them contain as many as 200 wires, all insulated. The switchboards are of the make of the Sterling Electrical Switchboard Company, of Chicago, and of the Bell type. The company has eighty-eight stations and connections at present, and 295 exchange 'phones. The present company has been successful in coming to an agreement with the Eastern Telephone Company, with offices at Patrick City, to complete a connection with that company, giving it an additional service of 385 miles of line and also affording it direct connections with several of the prominent cities of western Indiana. The connections with the McLain County lines at Bloomington are also very complete. The instruments used by this company are of the latest design, being made by the Stromberg-Carlson Company, of Chicago. The officers are as follows: L. S. Rupert, president; H. W. Snow, vice-president; A. M. Legg, secretary; John S. Murphy, treasurer, and G. B. Ortman, general manager.

ELECTRIC LIGHT AND POWER.

CANTON, ILL.—A new electric light plant, which cost nearly $25,000, is being put in place by the Parlin & Orendorff Company.

MANCHESTER, N. H.—The Lancaster & Jefferson Electric Light Company has filed articles of incorporation. The company's capital is $36,000. Lancaster is the place of business.

NORWICH, N. Y.—The Standard Light, Heat & Power Company has been incorporated with a capital of $60,000, and intends to furnish electricity for the villages of Unadilla, Gilbertsville, Otego, Sidney, Franklin, Bainbridge and Afton.

STEVENS POINT, WIS.—The Stevens Point Lighting Company has been placed in the hands of a receiver. The action is an outgrowth of foreclosure proceedings instituted by the First National Bank of Milwaukee, which holds its paper.

LITCHFIELD, ILL.—Sealed proposals will be received October 22 for the purpose of furnishing electric lights for lighting the city of Litchfield and also for furnishing an electric light plant to the city, in accordance with the plans and specifications on file in the office of the city clerk, Oscar W. Gooch.

BROOKHAVEN, MISS.—The city electric light plant, which began operation January 1, 1898, is now running at its full capacity. The plant consists of a 30-light arc machine and a 1000-light incandescent machine. The city now has thirty arc and 1400 incandescent lights connected, and still there is a demand for more lights.

UTICA, N. Y.—The Utica Electric Light Company has made contracts which will enable it to increase the output of the plant. A 1000-hp cross-compound condensing engine has been ordered from the Corliss Steam Engine Company of Providence, R. I. Contracts have also been made for two 125 arc light dynamos, and a 250-kw generator for power purposes.

PATCHOGUE, L. I.—An extension of the lines of the Patchogue Electric Light Company is about to be made, and to meet the expense the capital stock will be increased $10,000. It is proposed to extend the lights through Blue Point, Bayport and Sayville. The erection of a new plant on the Patchogue River is also contemplated.

FREMONT, OHIO.—Eastern capitalists have acquired possession of the Northwestern Ohio Natural Gas Company's plant in this city, as well as the plants of the Fremont Electric Light & Power Company, the Fremont Gas Company, the Creager Light & Power Company and the Fremont Street Railway Company. All of these plants are to be merged into one and operated under one head.

SEATTLE, WASH.—Dawson is to have electric lights this winter. A full plant, including five dynamos and apparatus for operating twenty arc and 2000 incandescent lamps was taken north on the steamer Dirigo. There is a small outfit already at Dawson, which was expected to be operating 800 incandescent lamps by September 15. The charge for the arc lamps will be $14 a day, and for the incandescents 50 cents. G. M. Easterly is the superintendent of the works.

CHARLOTTE, N. Y.—Bids will be received October 15 for a light and water system. The electric light equipment will consist of two simple high-speed engines, with fittings, foundations, piping, etc., arc light dynamo of a capacity of 60 lights of 1200 candle power, an incandescent light dynamo of a capacity of 1000 lights of 16 candle power; switchboard, arc lamps, pipe line, line work, belting, shafting, clutch pulleys for engines and dynamos and other appurtenances. Mr. John M. Allen is president of the board.

PORT CHESTER, N. Y.—The Port Chester Electric Lighting Company has just purchased the plant and franchises of the Westchester Gas & Electric Company, and will begin in a short time to build an entirely new plant to supply the villages of Port Chester, Rye, Harrison and Mamaroneck. The capital stock of the new company is $50,000, and the officers are William E. Ward, president; J. Addison Johnston, vice-president; William L. Ward, treasurer, and Walter S. Comby, secretary.

SOUTH MILWAUKEE, WIS.—The Common Council of South Milwaukee unanimously resolved to purchase the electric light plant of the South Milwaukee Electric Light & Power Company, paying for it in monthly installments covering a period of ten years, the amount paid each month being the same that the city would pay as rented for the lights. The city is to take immediate possession, operating the plant, collecting rentals and keeping up all repairs. The total amount to be paid is $19,000 in monthly installments of $242.50, with the privilege of paying the principal at any time.

WASHINGTON, D. C.—Consul-General Gowey, at Yokohama, Japan, informs the State Department at Washington, under date of September 1, 1898, that almost every prominent American and European manufacturer of incandescent electric lamps is represented in the Japanese markets by specially appointed agents or by correspondents. Sixteen-candle-power lamps of German make, and with a guaranteed life of 1000 hours, have been offered in Japan for 12 cents each. American and other lamps of the same quality are now selling there for 16 cents each. This unusually low price, the consul states, is the result of overcompetition.

JERSEY CITY, N. J.—The North Hudson Light, Heat & Power Company has been incorporated at Trenton with a capital stock of $2,000,000. The incorporators are: Albert B. Carlton, of Elizabeth; Frank M. Stillman, of Rahway; Samuel Hathaway and George W. Waite, of Jersey City; David Young and George W. Roe, of Newark, and Arthur K. Bonta, of Hoboken. The principal object of the new company is to enlarge the electric facilities in Hoboken and North Hudson. The present concern has been supplying steam for power for several factories near its plant, as a matter of convenience, and a clause has been inserted in the articles of incorporation to include that function.

THE ELECTRIC RAILWAY.

JACKSON, MISS.—The generators for the street railroad have been bought, and work will be commenced on the track as soon as the yellow fever scare is over.

ALBANY, N. Y.—The State Railroad Commission has approved an increase of capital stock of the Delaware Railroad Company, from $200,000 to $260,000. This company will build an electric road between the villages of Delhi, Bovina Centre and Andes, in Delaware County.

TRENTON, N. J.—The Hartford & Springfield Railway Construction Company has been incorporated, with a capital stock of $100,000 for the purpose of building and equipping railway lines. The incorporators are Henry Seligman, Benedict Nahm, Edward B. Gilman, Thomas A. Lee and George W. Dunham.

BRISTOL, R. I.—The sections between Warren and Bristol of the Consolidated road will be equipped with electricity, the same as from Providence to Warren, but will not be double tracked at present. New rails have been distributed along the roadbeds of both these sections, and will be laid at an early date.

CHICAGO, ILL.—It is reported that the City Railway Company has secured control of the South Side Elevated Railway, and will assume active management of the line January 1 next. It is said that the City Railway Company assumes $750,000 bonds outstanding and guarantees 4 per cent. dividends on the capital stock of $10,328,800.

DETROIT, MICH.—A proposed consolidation of the Detroit & Ann Arbor electric line with the projected Ann Arbor & Dexter Railway and the partially built Lansing & Dexter electric line will give the State an electric line 85 miles long, reaching from the capital to the metropolis of the State. There is said to be ample money behind the scheme.

DOYLESTOWN, PA.—The Newtown Electric Street Railway has awarded the contract to build the 14-mile extension of its system from Newtown to Doylestown. The road, which is to be completed by the middle of December, will pass through Wrightstown, Penn's Park, Wycombe, Forest Grove and Bushington, opening up one of the finest agricultural territories in the State. The cars to be run over the Doylestown route will weigh 18 to 20 tons each. It is expected to cover the 28 miles in one hour and fifteen minutes. The fare for the entire trip will be 50 cents. It is also expected that mail cars will be put on with a clerk to distribute the mail along the line.

ELECTRIC RAILWAY MEN ORGANIZE.—The employees of the electric street railway company of Terre Haute, Ind., have reorganized the union, which went by the board a year ago, when Mr. Russell Harrison was president of the company. Casper Ovebaugh, organizer for the State, was present, and assisted in the organization. The officers elected are: President, Ed. Rose; vice-president, J. Q. Adams; secretary, Bert Wright; treasurer, R. M. Merring; watchman, J. Haut. A few weeks ago the men asked Receiver Jump if he had any objection to the men organizing, and he told them that, on the contrary, he thought it was the right thing for them to do.

LOUISVILLE, KY.—The Louisville committee appointed to arrange for the reorganization of the New Orleans Traction Company announces that all arrangements have practically been completed. The company owns the City and the Lake and the Crescent Street Railroads in New Orleans, but has been unable to meet its fixed charges, which amount to $600,000 a year. By the new plan the two systems will be combined and expenses reduced to $400,000 a year, which will put the company at once on a dividend-paying basis. The stockholders will raise $300,000 to pay off the floating debts, getting preferred stock in return. The old capitalization of $7,500,000 will be reduced about one-third.

FEMALE CONDUCTORS.—For several months the experiment of using young women as conductors on the street railway was introduced in Madison, Ind., and it excited much attention and comment. The innovation, however, was a pleasing one. The street railway is now under the control of a receiver. Last Saturday evening the girls were paid off as usual, but no notification of a change was given. On Monday the receiver began discharging the girls one at a time, until only one remained on Wednesday. For the present at least the fares will be collected by the motormen. It is claimed that the girls will be called back when the receivership is ended. The prejudice against female conductors had died out, and the girls were pleased with their work.

BROOKLYN, N. Y.—A case which will be of interest to street railway companies was decided in the Supreme Court in this city on October 5. Mr. John Jenkins was given a transfer to the Fulton Street line from the Montague Street line. The first car which passed him was crowded, and so was the second and third, and he waited half an hour before he got on a car in which a seat was vacant. The conductor refused to take Mr. Jenkins' transfer ticket and demanded another fare. Mr. Jenkins refused to pay a second fare and was put off the car and arrested, but was afterward discharged. He brought suit for damages, but the suit was dismissed by the trial judge. Mr. Jenkins, however, took the case to the Appellate Division of the Supreme Court, where he was awarded $400 damages. The defendant was the Brooklyn Heights Railroad Company.

BALTIMORE, MD.—Surveyors are now engaged making an estimate of the cost of construction of the proposed line of electric railway, which is to run from Baltimore through Anne Arundel County to Gibson's Island, or Mountain Bar, as it is sometimes called, on the shore of the Chesapeake Bay, 14 miles from Baltimore. A certificate of the incorporation of the company has been filed at Annapolis, and the commissioners of Anne Arundel County have granted the company the use of the necessary public roads and bridges. The capital stock of the company is $50,000, and the incorporators named are Messrs. Frank S. Revell, Elijah Williams, F. Eugene Wathen, George E. McDonald, Frank L. Hancock, B. R. Anderson, Robert Moss and James P. Bannon, of Anne Arundel County; Walter R. Townsend, of Baltimore County, and James Bond and John F. Williams, of Baltimore city.

Directory of Scientific Societies, Associations, Etc., and Meetings of the Same.

THE NEW YORK ELECTRICAL SOCIETY.—President, Gano S. Dunn; secretary, George H. Guy, 120 Liberty Street, New York.

HENRY ELECTRICAL SOCIETY meets every other Friday evening between October and May. Headquarters, 115 West Twenty-eighth Street, New York City.

THE BROOKLYN INSTITUTE OF ARTS AND SCIENCES, Brooklyn, N. Y. Henry T. Weed, secretary. Meetings and subjects of lectures: November 4, illustrated lecture by T. C. Martin; December 2, lecture by Prof. William E. Geyer, Stevens Institute; January 6, lecture on "The Electro-Metallurgy of Copper," by John B. F. Hereschoff; February 3, lecture and experimental demonstrations by Prof. M. I. Pupin; March 3, illustrated lecture on "Electricity in the Navy," by Captain Zalinski, U. S. N.; April 7, lecture on "Cable Telegraphy," by A. E. Kennelly; May 5, lecture by Prof. William A. Anthony.

CHICAGO ELECTRICAL ASSOCIATION.—Meetings, first and third Friday of each month, from October 1 to June 1; J. R. Cravath, secretary, Monadnock Block, Chicago. [illegible] Meetings and subjects of papers: October 21, "Practical Points on Electrical Measurement," by W. B. Hale; November 4, "The Electrical Equipment of a Model Printing Establishment," by George A. Damon; November 18, "The Development of the Motorcycle," by F. B. Rae; December 2, "Practical Points in Street Railway Engineering," by W. A. Harding; December 16, "Wireless Telegraphy," by Arthur V. Abbott; January 6, 1899, "Telephone Engineering—Some Problems Solved and Unsolved," by S. G. McMeen; January 20, "Observations on Ventilating Fans," Gerard Swope.

FRANKLIN INSTITUTE (Electrical Section), Philadelphia, Pa.—Secretary, [illegible] "Lightning and Lightning Arresters," by Mr. A. J. Wurts; November 8, "Con- [illegible] Electricity," by Mr. C. J. Reed, and "Electric Elevators," by Mr. William [illegible] Transmission."

LEGAL NOTES.

LIMITATION OF DEBT.—A debt for the purchase of an electric light plant for a municipal corporation is not one of the "necessary expenses" of the town, within the meaning of Constitution, Art. 7, Sec. 7, so that it can be created without a vote of the majority of the qualified voters and legislative authority. Mayo v. Town of Washington, North Carolina Supreme Court, 1898.

TAXING PATENTS AS PROPERTY.—The Court of Appeals has affirmed the decision of the Appellate Division of the Supreme Court vacating the assessment imposed upon the capital stock of the Edison Electric Illuminating Company of Brooklyn, which assessment included the "value of certain patent rights." Chief Justice Parker, in his opinion, states that patent rights are not taxable by the State. The assessed valuation placed upon the Edison Company's patent rights by the assessors was $945,000.

COMPARATIVE NEGLIGENCE.—When both parties are negligent, the true rule is held to be that the party who last has a clear opportunity to avoid the accident, notwithstanding the negligence of his opponent, is considered solely responsible for it. Hence, a recovery may be had for an injury occasioned by a street railway employee's omission, after becoming aware of the plaintiff's danger, to use ordinary care for the purpose of avaiding the injury to him. Thompson v. Salt Lake Rapid Transit Company, Utah Supreme Court, 1898.

FREE EXHIBITIONS.—The risk of injury from careless handling of the implements used by the performers on a stage in an exhibition of target practice, even though given by an independent contractor to the patrons of the street railway company, is not, as matter of law, assumed by a patron of the street car company who attends the exhibition given by the company, and he may recover from the street car company for an injury received from a shattered bullet. Thompson v. Haverhill Street Railway Company, Massachusetts Supreme Court, 1898.

PERSONAL NOTES.

MR. E. I. GARFIELD has severed his connection with the Fort Wayne Electric Corporation, as New England representative, and is now with the Boston Electric Light Company, at 74 Ames Building, Boston.

DR. S. S. WHEELER, president of the Crocker-Wheeler Electric Company, New York, was married on the afternoon of October 11 to Miss Amy Sutton, at the home of the bride, in Rye, N. Y. Dr. Wheeler's many friends extend congratulations, and wish him and his bride a long life of happiness.

Trade and Industrial Notes.

THE STOREY MOTOR & TOOL COMPANY, Philadelphia, Pa., has moved its business to 464 South Broad Street, Trenton, N. J.

MR. WILLIAM MUELLER, 713-715 Burling Street, Chicago, well known to the electrical supply business, has secured the agency for the R. C. Demary quick break switch for the city of Chicago and vicinity.

THE CENTRAL ELECTRIC COMPANY, Chicago, in addition to its regular large stock of all kinds of standard and special telephone wires, states that it is carrying full stocks in all sizes of special tinned annunciator wire for telephone switchboard work.

MESSRS. ZIMDARS & HUNT, 127 Fifth Avenue, New York, report a heavy demand for their general catalogue, just issued. One of the features that make this catalogue exceptionally valuable is the completeness of the illustrations, the list of sizes and prices, and general information regarding panel and feeder boards.

THE LIPPINCOTT STEAM SPECIALTY COMPANY has been organized in New York to manufacture steam engine indicators, oil filters and a full line of engine and steam supplies. The company's headquarters are at 169 Broadway, and a copy of its catalogue will be sent to engineers on application. Mr. A. C. Lippincott is preparing an indicator instruction book for distribution among engineers.

THE AMERICAN ELECTRICAL HEATER COMPANY, Detroit, Mich., is selling a great many of its new design portable electric heaters, No. 180. The height of this little heater is 22 inches, and the diameter of the jacket is 9 inches. Its simplicity and efficiency, together with the good workmanship and reasonable prices asked, are responsible for its popularity. The company has had a great deal of experience in portable electric heaters.

THE MONTAUK MULTIPHASE CABLE COMPANY, 100 Broadway, New York, will ship a large order of its Montauk cable, to be used by the Milwaukee Auxiliary Fire Alarm Company in installing the fire alarm telegraph system for the city of Detroit. Chief Foley, of the fire department of that city, gave orders that this wire should be used. Superintendent Glassner of the fire alarm telegraph of the same city also indorses the cable for that purpose.

A NEW CONE PULLEY.—An ingenious belt drive with an adjustable velocity ratio has been put on the market by the Penn Electric & Manufacturing Company, of Wilkinsburg, Pa. The device uses a V shaped belt running in pulleys, each of which has something the form of an hour glass. These pulleys are collapsible in such a way that the diameter at the waist may be varied, one increasing as the other decreases, thus maintaining a constant belt tension with a variable ratio of diameters.

THE KNIGHTS TEMPLAR IN PITTSBURG.—The programme for the entertainment of the Knights Templar, which meet in triennial conclave at Pittsburg October 11-14, includes excursions on Wednesday and Thursday, October 12 and 13, to Homestead, Duquesne, Wilmerding, East Pittsburg and [illegible], at each of which places large iron and other industries will be [illegible]. At East Pittsburg an hour each afternoon will be spent at the works of the Westinghouse Electric & Manufacturing Company.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is calling attention to its new iron-centered automatic hook, which the company states is of its own design and for which strong claims are made. It is easy to install and occupies little space. The contacts are visible when the door is opened, which makes it easy at any time to see that everything is in working order. The hook is constructed with a cam at the back to prevent the lever being bent back out of shape. This hook is apparently a very desirable article.

MR. WILLIAM ROCHE, 259 Greenwich Street, New York City, is meeting with much success with his new "Standard Dry Battery." The United States Navy, whose requirements for all apparatus and supplies are always most rigid and decided upon only after careful tests, has placed large orders for the special A1 cell. Such an order alone is a sufficient testimonial to the qualities of the new battery. Mr. Roche reports orders multiplying to such an extent that it has become necessary to increase from time to time his facilities for the production of these batteries.

TELEPHONE CATALOGUE.—A very complete catalogue of telephone apparatus and construction material has just been issued by the Electric Appliance Company, Chicago, Ill. The American telephone switchboard is the first thing described and illustrated, and about everything in the way of telephone apparatus and construction tools is listed. Each article is designated by a code word to be used in ordering by telegraph, and for convenience in ordering by mail a trade number is given to each. A copy of the catalogue should be in the hands of everyone interested. It is well planned and executed.

TELEPHONE AND PROGRAMME CLOCK SYSTEM.—The State Normal School at River Falls, Wis., has been equipped with a complete telephone and electric programme clock system. The work was done by the Julius Andrae & Sons Company, Milwaukee, and is said to be perfectly arranged. The programme clock works automatically, announcing the exact time of new studies for the various classes, as well as indicating the department in which they will be held. In the superintendent's office is a switchboard, which enables him to communicate with any department of the large school without leaving his desk.

MACHINE TOOLS.—Screw machines, hand lathes, gear cutters, tapping machines, drill presses, universal and plane milling machines and other lines of machine tools are briefly described and well illustrated in a very complete catalogue just issued by the Garvin Machine Company, Spring and Varick Streets, New York City. The catalogue contains 126 pages, and its contents are carefully indexed. The dimensions of each machine illustrated are given, together with a brief description of its construction. The Garvin Machine Company has excellent facilities for the construction of both large and small tools, and its equipment is modern throughout. The size of the catalogue is 4 by 6 inches.

THE PETITE ENCLOSED ARC LAMP.— A catalogue very prettily illustrated and artistically executed in its general get up has been issued by the Western Electric Company, Chicago, to show the handsome designs of its Petite enclosed long-burning arc lamp. These lamps are made in different classes and types for direct-current service, and are adjusted for 110 or 220 volts. They burn from 130 to 150 hours on one trimming. The enclosing globes are made in a variety of ornamental forms, as well as in the standard form, and present a very handsome appearance. They are made in clear glass, opal and Redtag, the last being for inside use on 220 volts, burning singly. At the back of the catalogue are given carefully prepared directions for the trimming and general care of the Petite lamps.

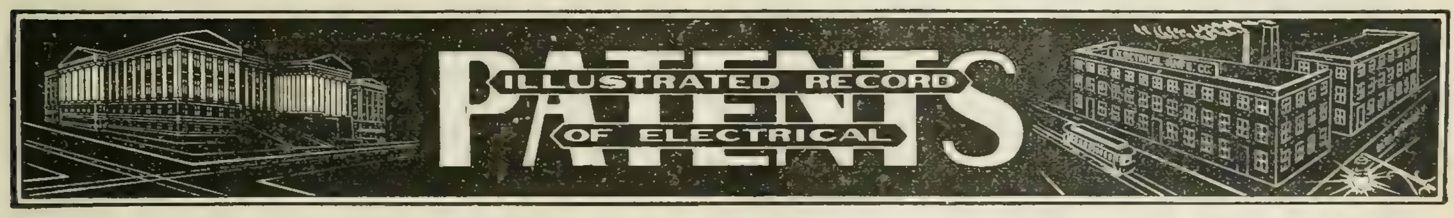
THE GOUBERT MANUFACTURING COMPANY, New York City, manufacturer of the Goubert feed-water heater, reports that it is exceedingly busy. Among the orders recently booked for heaters to go in steam plants are the following: One 3000-hp heater for the Cleveland Railway Company, Cleveland, Ohio; one 5000-hp auxiliary heater, for the Metropolitan Street Railway Company, New York City, making 35,000 horse-power now building for that company alone; and one 3000-hp heater for one of the New York & Pennsylvania Company's pulp mills. The company has just delivered 3000-hp to the People's Electric Light Company, Newark, N. J. These orders, in addition to regular calls for heaters of smaller sizes—among them being 1000 horse-power for the Schenectady Street Railway Company, Schenectady, N. Y., and 1800 horse-power for the Citizens Light & Power Company, Houston, Tex.—are indicative of the magnitude of the business done by the Goubert Company.

THE RASTER CARBON RHEOSTAT COMPANY, of Chicago, asks The Electrical World to say that it is not the company referred to in the circular letter sent out some little time ago by the Cutler-Hammer Manufacturing Company, of the same city, to the effect that a certain Chicago manufacuring company was about to put upon the market a rheostat an exact duplicate of its own and an infringement of its patents Nos. 418,678, issued January 7, 1890, and 368,804; issued August 23, 1887. The letter states that the circular letter referred to an entirely different manufacturing company in Chicago. The Raster Company adds that it has acquired a legal right to the use of patent No. 577,036, issued to Mr. Charles D. Jenney, on February 14, 1897, for an electrical switch as applied to an automatic motor starting box. The Raster Company says that this Jenney patent has been held by the United States Court in Indiana, in a case heard October 29, 1897, to be valid and not infringe the Cutler-Hammer rights in any way. Purchasers, therefore, it is claimed, run absolutely no risk in handling any of the Raster Company's goods, as its patents are valid and fundamental, and as it has the legal right to the use of patent No. 577,036.

Business Notices.

THE ILLUSTRATIONS in this issue were made by the Photo-Engraving Company, 9-15 Murray Street, New York City.

HAWAII AND THE PHILIPPINES.—Send 4 cents (in stamps) for an illustrated booklet issued by the Chicago, Milwaukee & St. Paul Railway, the direct route across the American continent to the new trans-Pacific possessions of the United States. Full of latest reliable information and valuable for reference. Can be used as a text book in school. Address William Kelly, Jr., G. E. P. A., 381 Broadway, New York.



UNITED STATES PATENTS ISSUED OCTOBER 4, 1898.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

611,601. ELECTRIC ARC LAMP; S. Bergmann, of New York, N. Y. App. filed July 10, 1897. An adjustable electrical resistance, consisting of a series of resistance coils arranged in one or more loops, and a movable metallic clamp engaging the two portions of the loop and capable of adjustment along said loop, whereby a greater or less portion of said loop of resistance coils may be cut out of the circuits, substantially as described.

611,638. SIGNAL APPARATUS; H. G. Leopold, of New York, N. Y. App. filed Sept. 3, 1897. In a signaling system, the combination of a controller, a signaling circuit, a series of order signals located at a distance and in shunt relation to said circuit; a telltale device included in said circuit, and located at the sending station; an open circuit around the controller; a recording device and a series of devices corresponding in number with the order signals and adapted to be actuated by the current traversing the signal circuit to close said open circuit around the controller and energize the recording device.

611,707. ELECTRICAL CONNECTOR; J. Pedriali, of Brussels, Belgium. App. filed March 30, 1898. An electrical connector, consisting of male and female parts, the former consisting of a handle of insulating material provided with a plug projecting therefrom, and carrying at its extremity an enlargement or head, and the latter consisting of a hollow plug or insulating material, and containing a U-shaped spring, the extremities of which are provided with contact plates between and beyond which the head of the plug passes, said U-shaped spring being reinforced by other springs located each side thereof, substantially as described.

611,719. ELECTRICAL CIRCUIT CONTROLLER; N. Tesla, of New York, N. Y. App. filed Dec. 10, 1897. The combination with a closed receptacle, of a circuit controller contained therein, and surrounded by an inert insulating medium under pressure.

611,722. ELECTRIC MEASURING INSTRUMENT; Ed. Weston, of Newark, N. J. App. filed Jan. 10, 1898. In an electrical measuring instrument, provided with a movable coil, pivot supporting plates having axially drilled holes, in combination with pivot pins or bearings secured therein by forcing them endwise, substantially as described.

611,723. INDEX NEEDLE OR HAND FOR ELECTRICAL MEASURING INSTRUMENTS; Ed. Weston, of Newark, N. J. App. filed Jan. 10, 1898. A pointer for an index needle, constructed of thin sheet metal, having substantially the contour shown and a raised stiffening of substantially the same contour.

611,724. ELECTROMETER; Ed. Weston, of Newark, N. J. App. filed Feb. 14, 1898. In an electrometer, a hollow pivot shaft, having secured thereto an electrostatic armature or needle and an indicating needle, the indicating needle being electrically insulated from the shaft, substantially as described.

611,752. TROLLEY EAR; H. Geisenhoner, of Schenectady, N. Y. App. filed July 15, 1898. A trolley ear, which is secured to the trolley wire by compressing the metal forming the wire around the ear.

611,760. SURFACE CONTACT RAILWAY SYSTEM; W. B. Potter, of Schenectady, N. Y. App. filed Nov. 29, 1897. In a surface contact railway, a feeder, sectional conductors or studs arranged in two sets, one furnishing current to the motor, the other upon the negative side of the system, and electromagnetic connecting switches; in combination with a movable vehicle varying motors, sliding contacts upon the vehicle for each of the sets of sectional conductors, a testing contact in the line of positive studs and in circuit with a circuit-breaker upon the vehicle in the main motor-lead, and an indicating device actuated by the said circuit-breaker.

611,766. DEVICE FOR SUSPENDING ARC LAMPS; J. Borka, of Buffalo, N. Y. App. filed March 4, 1898. A device for suspending an electric lamp from a pole consisting of a plate removably secured to the pole, sockets integral with the plate, a cylindrical rod removably secured in such sockets, a pair of tubular supporting arms journaled upon the cylindrical rod outside of its sockets, a casing integral with the plate and between the sockets, a pulley journaled in such casing, a frame in which the outer ends of the tubular supporting arms are connected, a pulley in such frame, a tie rod secured at one end to such frame and removably secured at its other end to the pole, and a cord passing over both pulleys for operating the suspended lamp, all combined and operating substantially as stated.

611,778. ELECTRIC RAILWAY; J. B. Entz, of Philadelphia, Pa. App. filed Dec. 21, 1895. In an electric railway, the combination of a rotary transformer having its alternating current end adapted to develop the average power required for driving a motor car or locomotive, and having its direct current end connected with a storage battery, which compensates for variations from the average load, a motor car or locomotive carrying said apparatus and having its driving wheels mechanically connected with the rotary transformer power station apparatus generating alternating current and having line or working circuit connections extending along the railway, converters, means for supplying current from said line or working circuit to the alternating current end of the transformer, and devices for including and excluding the rotary transformer in and from the line or working circuit, whereby the alternating current on the line or working circuit and on the power station apparatus is kept uniform, thus permitting of the installation of the latter for the average load, substantially as described.

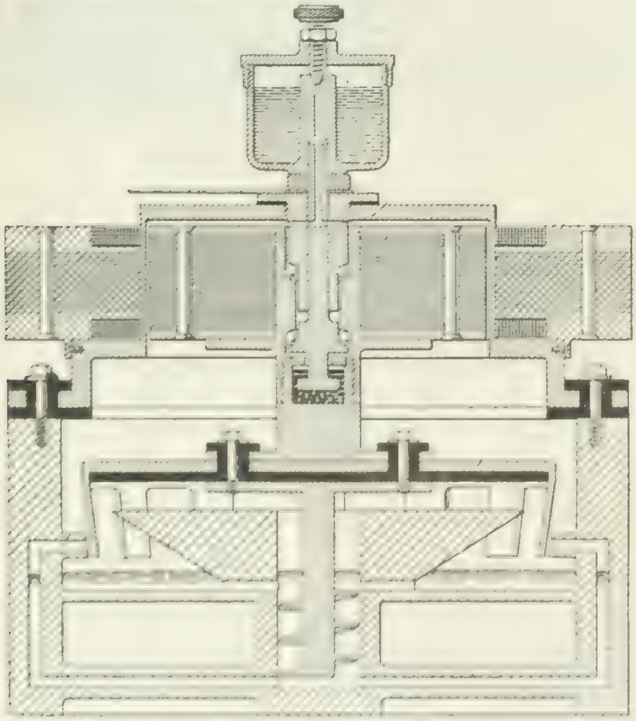
611,809. ELECTRIC METER; S. Evershed, of London, Eng. App. filed Dec. 21, 1897. In a motor meter, a vertical rotative axle, a self-actuated counting train, and means upon the said axle to control the speed or escapement of said train, substantially as described.

611,821. ELECTRIC RAILWAY CONDUIT AND TROLLEY; J. H. Robertson, of New York, N. Y. App. filed Oct. 20, 1896. The combination with a box fixed to a car and box frame, having a laterally yielding connection with said box and provided with contact plates, of a trolley arm provided with yielding contact pieces and means for removably connecting the trolley arm with said yielding box frame.

611,822. ELECTRIC TIME SWITCH; F. M. Schmidt, J. H. Gerry and W. S. Barstow, of New York, N. Y. App. filed Nov. 18, 1897. In a system of electrical distribution, the combination with an electric supply circuit and an electric consumption circuit, of a switch controlling the supply current to the latter circuit and an electric self-winding clock energized from said supply circuit, and controlling the operation of said switch to open and close the safe.

611,850. ELECTROMAGNETIC ENGINE; P. B. Watson, of Philadelphia, Pa. App. filed May 9, 1898. In an electromagnetic engine, a casing or housing, consisting of an upper and lower compartment, a horizontal intermediate division wall or partition therebetween, bearing on said partition a shaft mounted in said bearings, an armature adapted to rock in unison with said shaft, field magnets arranged in pairs in said upper and lower compartments, the heels or ends of said magnets being inclined to each other, the heels of the upper pair of magnets diverging upwardly and the heels of the lower pair of said magnets diverging downwardly, a cut-off having connections common thereto to said batteries and magnets, said cut-off having a lever, a contact on either side of said lever, conductors leading from said contact to said magnets, the latter having conductors common thereto, a slotted link or pitman adapted to be actuated in unison with said armature, the reciprocation of said link being imparted to said lever and crank shaft, and a pitman common to said crank shaft and to an extremity of said armature.

611,869. AUTOMATIC SWITCH APPARATUS; A. Schlatter, of Buda-Pesth, Austria-Hungary. App. filed Sept. 21, 1897. An automatic transformer switch apparatus having a switch lever and a controlling electromagnet therefor, in combination with an auxiliary magnet whose armature is provided with a catch for holding the switch lever, and whose circuit is connected with the circuit through said switching electromagnet, and a resistance included in the said circuit of such a nature that its value is reduced on heating, substantially as described.

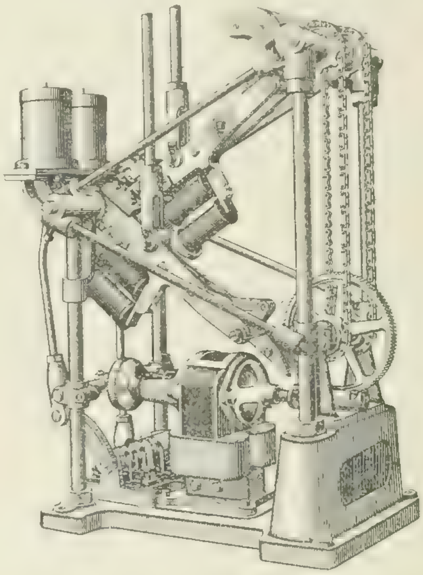


No. [illegible].—Electrical [illegible] Controller.

611,8[illegible]. [illegible]; [illegible], of [illegible] Park, Pa. App. filed [illegible] [illegible] [illegible]

611,8[illegible]. ELECTRIC SIGNAL DEVICE FOR RAILWAYS; [illegible] [illegible]

conductors extended along parallel to the rails, two sources of electric supply carried by each locomotive, each having its circuit formed through trolley wheels carried by the locomotive engaging respectively with one of the electric conductors, current reversing mechanism carried by each locomotive and interposed in the same circuit whereby alternating currents are sent through this circuit, and an electric bell carried by each locomotive and interposed within said circuit, the other circuit being so arranged that the trolley wheels traveling in one direction have a reverse polarity from the trolley wheel traveling in the opposite directions, and an electric bell carried by each locomotive and interposed in this circuit, substantially as described.



No. 611,943.—Railway Signaling.

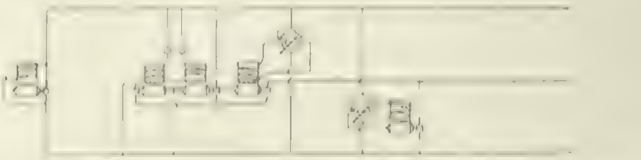
611,902. APPARATUS FOR ADJUSTING PHASES OF ALTERNATING CURRENTS; Johannes H. F. Gorges, Berlin, Germany. App. filed Dec. 27, 1897. The combination with a source of alternating current of a series circuit wherein the current flowing is derived from said alternating current and substantially coincides in phase therewith, a Wheatstone bridge circuit having branches, a circuit bridge across the terminals of said Wheatstone bridge circuit, resistances included in the sides of said Wheatstone bridge circuit, and phase modifying means included in the sides thereof.

611,919. TELEGRAPH KEY; F. E. Lewis, of Jefferson, Tex. App. filed Dec. 2, 1897. The key base, the upright bearing posts, and the key lever spring stamped from sheet metal and bent to proper shape, substantially as described.

611,927. MULTIPLE RATE METERING SYSTEM; F. T. McIntyre, of Washington, D. C. App. filed March 25, 1898. In a multiple metering system of electrical distribution, the combination with two independent meters having their register controlling elements connected in independent branches, or the distributing mains of independent control wires connecting said branches with the distant central or control station, and a switch mechanism for completing the circuit through one or the other of said control wires and meter in circuit therewith, substantially as described.

611,943. RAILWAY SIGNALING; K. G. Schreudern, of Edgewood Park, Pa. App. filed Jan. 3, 1898. In a signaling apparatus, the combination of signals, a motor for shifting said signals, independent connections from the signals to the motor, a lock for holding each signal in clear position, a magnet controlling each signal connection and lock, and a track circuit controlling the circuits of the motor and of the controlling magnets.

611,970. METHOD OF AND MEANS FOR CONTROLLING ENERGY DELIVERED TO TRANSLATING DEVICES; H. P. Leonard, of East Orange, N. J. App. filed Jan. 21, 1896. In a system of electrical distribution, the combination with the main conductors, each having a practically constant but different potential, an e. m. f. producing device connected therewith which develops a constant intermediate potential, a variable e. m. f. producing device having one terminal connected to the constant intermediate potential, and a conductor extending from the other terminal of said variable e. m. f. producing device, between which and one of the main conductors translating devices are adapted to be connected substantially as described.



No. 611,970.—Method of and Means for Controlling Energy Delivered to Translating Devices.

611,9[illegible]. AUTOMATIC SWITCHING AND TELEPHONE SYSTEM; L. G. [illegible], of [illegible], [illegible] App. filed March 9, 1896. In a box adapted to [illegible] [illegible] mechanism, consisting of an escape wheel, a balance, two [illegible] pawls adapted to impart an oscillatory movement to the balance by being acted upon by the escape wheel.

The Electrical World.

VOL. XXXII. NEW YORK, OCTOBER 22, 1898. No. 17.

PUBLISHED EVERY SATURDAY BY

THE W. J. JOHNSTON COMPANY,

9 Murray Street, New York.

Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York.

New England Office, 620 Atlantic Aye., Boston.

Western Office, 936 Monadnock Block, Chicago.

Philadelphia Office, 929 Chestnut Street.

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THE ELECTRICAL WORLD,

9 Murray Street, New York.

VOL. XXXII. NEW YORK, OCTOBER 22, 1893. No. 17.

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INCANDESCENT LAMPS FOR NIGHT DECORATIONS.

With the constantly increasing facilities for obtaining, wiring and erecting large numbers of incandescent lamps, more and more elaborate signs, arches and other decorations illuminated by hundreds or thousands of lamps each are constructed for temporary use during special celebrations and torn down after a few days' service. Notable among the recent illuminations of this kind were the effects obtained at Cincinnati at the recent Grand Army reunion and at Pittsburg at the more recent conclave of the Knights Templar. An illustrated description of the latter may be found on other pages, and is worthy of careful attention on the part of those who have charge of the work for the various peace jubilees about to take place, in which such effects will be the central feature of the display.

It is remarkable how perfectly the incandescent lamp adapts itself to this service. The desired effect is not intensity of illumination; if it were, the arc light would be more satisfactory than the incandescent, which is, as every one knows, not the case; nor is the effect wanted a perfect distribution of light. Transparencies with the lights concealed behind them and giving a solid illumination are not as satisfactory as the uncovered bulbs. The separate and distinct dots of light, outlining graceful figures, give a mental impression that is half unconsciously expressed by observers of displays of this kind, who speak of them as like a scene from fairyland. It is probable that, as the effect is not one of intensity of illumination but of its division into a large number of distinct points, lamps of a lower candle power would give just as satisfactory an effect with a correspondingly smaller consumption of power; but as the cost of power is a small feature in this work, the cost of construction being far greater, any saving made in this way would be a small one.

CARBIDE FURNACES.

The development of the electric furnace has been greatly accelerated during the last two years by its practical applications on a large scale, notably to the production of calcium carbide. It has been well said of the electric furnace that it gives mankind a new chemistry. The relative magnitudes of chemical affinities are transposed at the high temperatures obtainable in this manner, and compounds extremely stable at ordinary temperatures are dissociated and others of far smaller heat of combination formed. This gives a means of tearing apart elements that cling to each other with great tenacity and reassociating them into other compounds quite unstable at low temperatures, and hence giving strong chemical reactions even with otherwise inert substances. Notable among such reactions is the production of calcium carbide from lime and carbon. At the temperature of the arc the attraction of the oxygen and the calcium within the lime is overcome by the attraction of carbon for both, resulting in the formation of calcium carbide and carbon monoxide. When reduced to ordinary temperatures the calcium and the carbon of the former have so little attraction for each other that they greedily attack water to form more stable compounds, among them the valuable illuminating gas acetylene.

The problems set before the designer of carbide furnaces are several. First, perhaps, is the difficulty of making the electric arc, or more properly current, as the compound in a carbide furnace is a conductor, leave the path through the smelted product and attack fresh unheated mixture. This is due to the fact that the liquefied product is a better conductor than the powdered constituents. The arc thus tends to cling to the very path where it is not wanted. Many ingenious devices for overcoming this tendency are described in the article by Mr. F. Jarvis Patten, on another page.

Another problem is the design of a furnace for continuous operation. A limited run on an initial charge necessitates a waste of considerable heat—and electrically developed heat is valuable—every time the furnace is charged in raising and lowering the temperature of the apparatus. The voltage also must be varied during the run, starting very low when the arc is struck by bringing the electrodes together, and means must be provided for switching and controlling the voltage of currents and powers quite difficult to manage. Many continuous furnaces have been devised, but all the difficulties with apparatus fitted to withstand this high temperature are not yet surmounted.

Another important consideration in the design is, of course, the heat insulation of the furnace, for, as noted above, the heat is costly and its tendency to radiate is great, owing to the high temperature. One furnace, designed by Pictet, attempts also a saving by heating the raw material first to as high a temperature as possible by less expensive sources of heat than the electric current, the electric furnace proper raising them then to its own high temperature.

STREET TRACTION WITH SURFACE CONTACTS.

Objections to the overhead trolley on the score of appearances, and to the open conduit on the score of expense, will undoubtedly give a tremendous demand for the first really successful closed conduit or sectional-conductor surface-contact system. Each such system requires a switch for every few yards of track, and the one essential requirement to success not yet fulfilled is the high degree of reliability of this switch. The tendency in this line, as evidenced by Patent Office records and a few practical trials, is toward a switch operated by an electromagnet, and a device of this type, interesting because of its ingenious novelty, is described in a paper read before the British Association by Prof. S. P. Thompson and reprinted on other pages of this issue. Mercury contact is used, and the break is made under oil.

The switch itself seems to have the desired element of simplicity, but the complete arrangement is open to several criticisms. Among them is that which applies to all systems depending for their operation of the electromagnetic switches on current supplied from the power house, which is that, once the car has become disconnected from the source of power for any reason whatever—as an imperfect contact or faulty switch—it is henceforth helpless and cannot operate the next or any switch in advance. The opening of a circuit breaker at the power station would, with such a system, render every car absolutely helpless and unable to get further communication with the live feeder. For this reason any system dependent on electrically operated switches to be worthy of serious consideration must carry on the car a source of current—preferably storage batteries. This also, unless of 500 volts' pressure, necessitates another auxiliary rail or set of contact buttons to conduct the low-voltage current to the switch magnets.

The switch described has an ingenious arrangement for grounding its exposed contact in case it fails to open the circuit when the car leaves it. Unfortunately the grounding device provides only for the inaction of one of its two moving parts, and in case both fail to restore to the normal position the exposed contact may remain "alive." A better device, which has often been proposed in this country, is a [illegible] contact carried by the car and following at a proper distance the main shoe or skate, this grounded contact absolutely short-circuiting the line through any switch which may fail to open when the car leaves it.

The study of these switches is valuable on the part of electric railway designers, as it is more than probable that, by a combination of the good elements of the many imperfect devices designed, there may soon be attained a switch sufficiently reliable for the successful operation of surface-contact roads.

SPEED VARIATIONS IN ALTERNATING-CURRENT MOTORS.

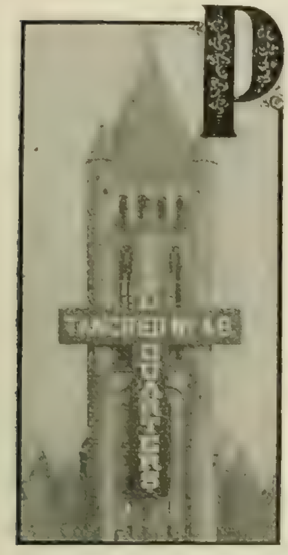
The control of the speed of alternating-current motors is more difficult than that of direct-current motors, as all types of the former, if designed for high efficiency, must be run with a peripheral velocity approximating synchronism, there being no means of varying this materially and maintaining efficient working by a variation of the impressed or counter e. m. f. as in the direct-current machine. With synchronous motors the speed must absolutely be maintained the same in cycles per second as that of the generators, and the only way of affecting the speed of the motors is to vary that of the generators, a plan sometimes used where one large motor is driven by its own special generator. With induction motors a method of changing the speed in a ratio of two to one, which has often been proposed but never practically used, consists of rearranging the windings by some suitable form of controller, so as to give one-half the number of slots per pole in one controller position that are given in the other. This can be effected, for example, in a motor which, when working at full speed, has four slots per pole per phase, by so rearranging the windings for half speed as to give two slots per pole per phase. This gives one-half the angular velocity of the rotating field with the same frequency, and consequently one-half the speed of the motor. The motor, however, if built for efficient running and a satisfactory economy of material per output for one speed, does not give the same good results as the other. Still another method of getting a speed variation in the same single ratio is that known as the tandem-multiple control, which is applicable to two motors driving the same load, this method calling for a wound secondary on one motor with the same number of turns per phase as the primary, the half speed being obtained by connecting this wound secondary with the primary of the second motor, the alternating-current supply being connected with the primary of the first motor. With the motors running at half speed the wound secondary becomes the source of alternating currents with one-half the frequency of those impressed upon its primary, these alternating currents entering the primary of the second and tending to drive its secondary also at one-half speed, minus the normal slip. This system has been proposed especially for traction work, but a serious difficulty is the extremely low power factor of the current when the motors are running in the tandem position. The magnetizing current is the same as that required for the two motors in parallel, and the energy current is for the same torque—one-half of that required when running with the machines in parallel.

The induction motor is also capable of other and less efficient forms of speed control, that most widely used being the insertion of variable resistances in the secondary, which gives speed, torque and efficiency characteristics closely comparable with those of direct-current shunt machines controlled with armature resistance.

Electrolytic Corrosion of Underground Piping.

According to Professor Fleming, about one ampere week will, theoretically, corrode electrolytically about one cubic inch of iron. In experiments imitating as closely as possible the conditions of underground iron-pipe systems and electric railway returns the actual corrosion was nearly three times this, owing probably to local action.

The Illumination at the Knights Templar Conclave.



PROBABLY the most elaborate and extensive electrical illumination of streets ever attempted was that carried out in Pittsburg at the recent conclave of the Knights Templar, October 11-14. The desire to surpass all previous records, a strong local patriotism and the reputation of Pittsburg as an electrical centre were some of the motives for undertaking this most elaborate display.

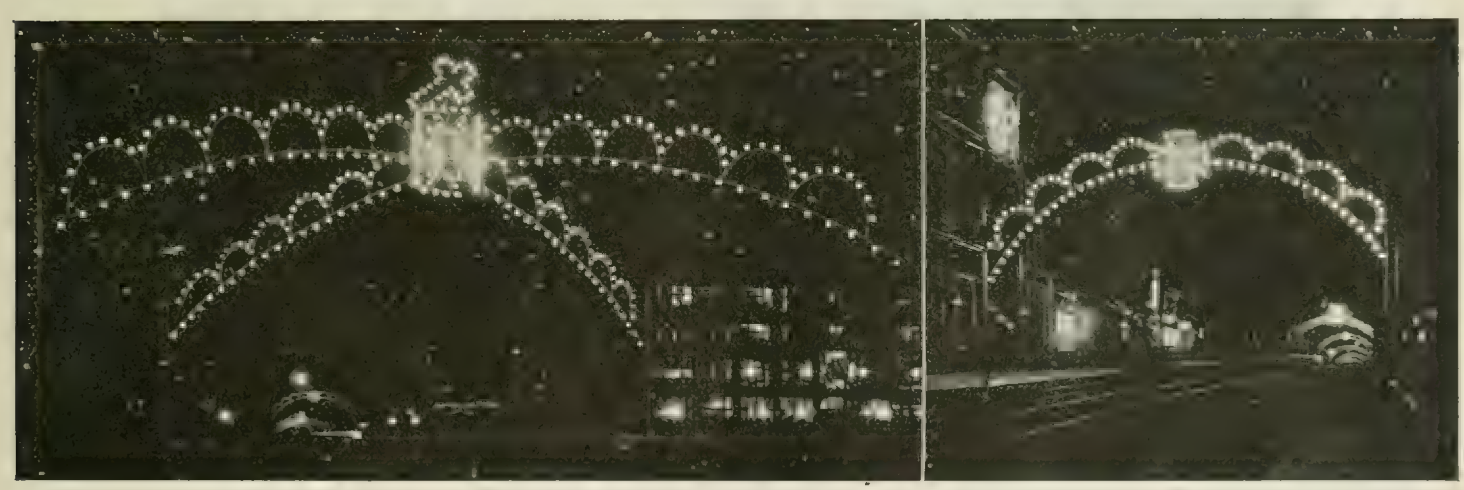
The main feature of the display was a series of metal skeleton arches, twenty-nine in number, spanning Fifth Avenue in Pittsburg, and its extension into Allegheny. These arches were in two general styles, one called the quadruple, of which there were ten, springing from the four curb corners of the street crossings to a common point overhead, and the other, or single style, spanning the street at points between the street corners. These arches are of a strictly temporary character, and will be scrapped as soon as their present service is completed, so that their construction for maximum economy of material and labor was rather an interesting problem. They were made up in general of a single wrought-iron pipe sprung from supporting columns bolted to a base plate on the curb, with small arches or loops, also of iron pipe, and more elaborate figures at the apex. The latter were of frame construction and of four different styles, showing different appropriate symbolic designs, among them the various crosses, shield, crown, etc., of Masonic significance. These centre pieces were on the single arches constructed in one plane, but on the quadruple arches were made up in the form of four similar designs arranged on the four sides of a square, facing the four street directions. The arches were constructed by the Pittsburg Ornamental Iron Works, of Allegheny, the electrical work being done by the Carter Electrical Company, of Pittsburg, and the lamps and current were supplied by the Allegheny County Light Company. The electrical work was simple, the fixtures consisting of porcelain wall receptacles wired to the iron piping or wooden frame and supplied with current through rubber-covered wire. Over 7000 Sawyer-Man 50-volt lamps with Sawyer-Man bases were used in this work.

The arches were built and wired in sections, each consisting of one-half of a single arch, or one-quarter of a quadruple arch, the erection of these sections being quite simply effected by joining them at the top of the arch and mounting the central figure. The work was complicated somewhat by the fact that the arches spanned the trolley wires with only a few feet of clearance. They were heavily guyed to prevent their falling, and gave remarkably little trouble considering the haste and low cost of the construction.

The current, as above stated, was supplied by the large central station of the Allegheny County Light Company, a description of which has previously appeared in these columns.* Each arch was supplied with current by a specially installed transformer, that for quadruple arches being of 375 lights capacity, and for a single arch of 150 lights capacity. The number of lights varied from 125 to 165 on the single arches and from 350 16-cp lamps to 450 of 10 candle power on the quadruple arches. In the downtown district, where the lighting mains are placed underground, the transformers were mounted aloft on wooden poles, either those for supporting the regular arc lights, or, in case these were not available, special poles, the transformers themselves being of the indoor type protected with rubber covers. Besides these arches the same company supplied almost all of the elaborate private display signs, the total additional load due to the conclave being estimated by Superintendent W. J. Hunker at about 3500 horse-power, making the evening peak of the combined arc and incandescent service in the two stations almost 9000 horse-power. The rated engine and generator capacity was sufficient to carry this, but the boilers, which are of the Babcock & Wilcox make, were loaded 50 per cent. above their rating. These boilers are fitted with Roney mechanical stokers, and the fact that there was no apparent crowding or priming, and that a greater load could have been carried, is a good answer to the argument that mechanical stokers reduce the overload capacity of a boiler. It should be stated, however, that one reason for the ease with which these boilers held this load is probably the care taken in cleaning the boilers of the large Twelfth and Etna Street station. Here two men are kept at work continuously, blowing the soot from the tubes, and a regular boiler-cleaning crew is always at work cleaning the water surfaces. Of the eighteen boilers, two are shut down every Saturday night, allowed to cool over Sunday, and cleaned thoroughly from steam-drum to blow-off by the crew during the whole of the following week. Thus the round of the eighteen boilers is made in nine weeks' time.

The most beautiful illuminated piece in the whole display was a triumphal arch erected by the city, spanning Sixth Avenue in front of the building occupied by the Department of Public Safety. This arch was built and wired complete by the Electrical Bureau, the work being under the immediate supervision of Chief Morris W. Mead. The arch, a night view of which appears in the accompanying supplement, was, of course, of wood, the lower part being boarded up and covered with canvas, the upper part being lathed and finished with mortar, the whole being painted white. Handsome appropriate staff decorations and two large paintings of appropriate scenes added to the beauty of the arch by day, while at night it was illuminated by 1685 incandescent lights supplied with current from the isolated plant of the adjacent building. Unfortunately but a poor idea of the beauty of this work can be given in an illustration, as the softness of the illumination and the charm of the various colors cannot be reproduced. The whole suggested the advisability of fitting permanent marble arches of this type with illuminating equipments for use either on special occasions or regularly.

The streets of Pittsburg were a blaze of electrical signs, largely of appropriate symbolic figures, of which the largest, and perhaps the



PHOTOGRAPHIC REPRODUCTION OF QUADRUPLE AND SINGLE ARCHES.

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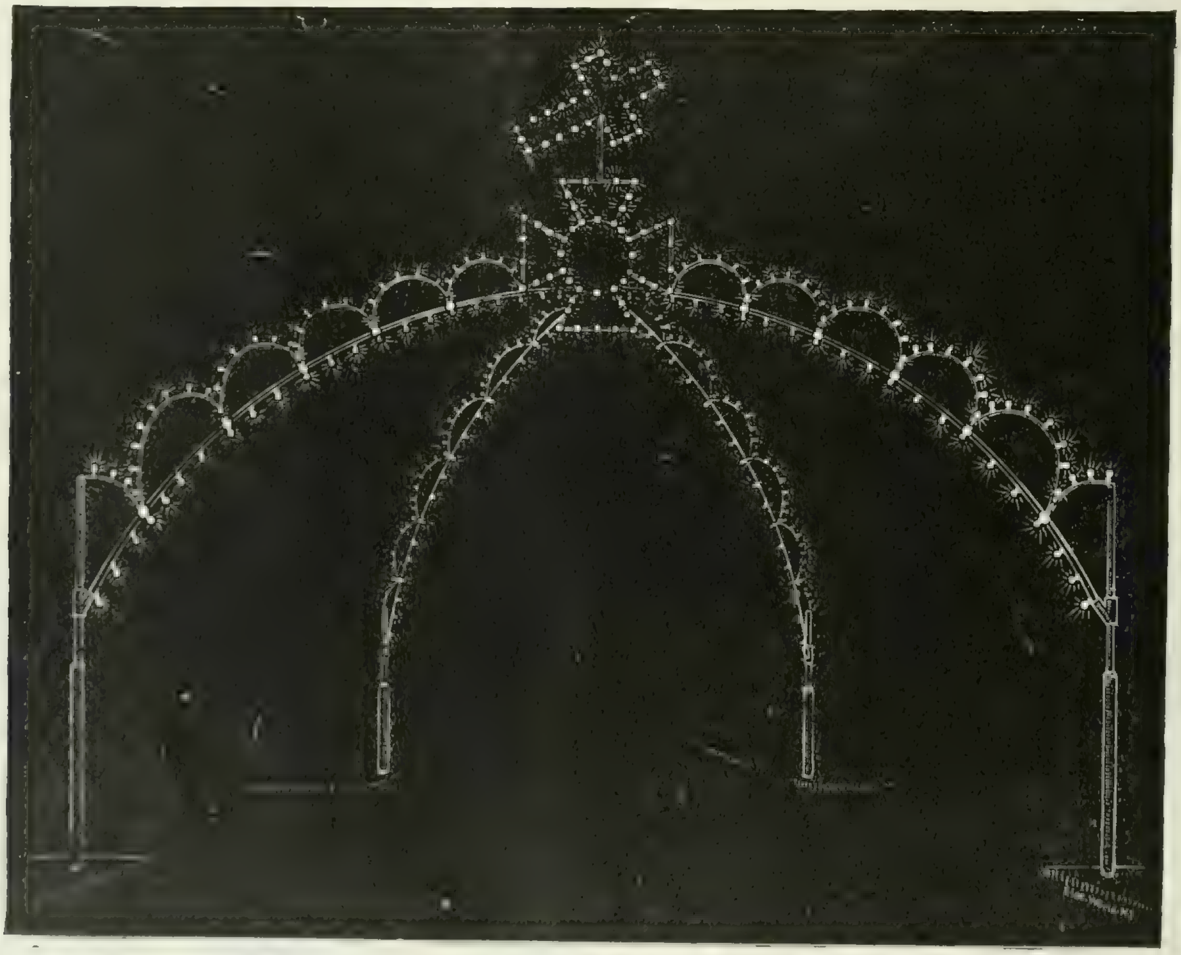
*See THE ELECTRICAL WORLD of November 20, 1897.

largest single-set piece ever constructed, was a mammoth Christian cross on the tower of the court house. This great cross, which is shown in one of the supplemental illustrations, and also in the initial heading this article, was 110 feet in height by 60 feet in width over all, the trunk and arms being 12 feet wide and the whole illuminated with 300 incandescent lamps. The construction and erection, high in air, of this great piece was carried out by Mr. John H. Dorrington, a contracting electrical engineer of Pittsburg. The framework of the cross was 3 by 4-inch angle iron, and as the whole weighed over 10 tons it was put up in sections each 25 feet in length. The background of the figure was of wooden flooring bolted to the angle iron frame, painted red, with letters painted white. The cross was outlined with a double row of 688 red lamps and the letters were illuminated with about 2300 frosted white lamps. All the lamps of this great sign, as well as of the triumphal arch, and many of the electrical signs put up by private parties, were made by the Shelby Electric Company. Many other signs, with interesting variations from conventional practice, were to be seen all over the city, some interesting ones being waving flags, a knight on horseback revolving on a vertical pivot, interior figures made of miniature lamps and buried in palms, circles of lamps under fountain sprays, etc.



Quadruple Arch, Showing Method of Construction.

The Automobile in Flemish.

The London "Electrical Engineer" states that the Flemish Academy [illegible] had suggested as the correct equivalent of the term "automobile" the Flemish [illegible] [illegible] The important part of the mechanism should certainly not be slighted.

Train Lighting in Germany.

[illegible] Government in the postal service which are lighted electrically.

An Instrument for Synchronizing Alternators.

BY CHAS. A. PERKINS.

There is an optical device, called the cyclostat, not unknown in laboratories, which seems to be specially adapted for synchronizing alternators under the circumstances described by Mr. E. P. Burch in The Electrical World of October 8.

When any rotating machine is viewed through a right-angled prism the machine seems to stand still, provided the prism rotates half as fast as the machine, and in the same direction.

I have made an apparatus on this principle for reading the graduated circle of a transmission dynamometer, to avoid the levers and cams by which the torque of a spring is usually transmitted to a pointer which is at rest. To secure the rotation of the prism I have placed it in a tube, which acts also as the shaft of a gear wheel. This wheel is geared to another of one-half the number of teeth, which is driven by a flexible shaft connected with the dynamometer.

In case it were to be used to synchronize an alternator, either of the machines would be connected to the prism, mechanically or by a synchronous motor, so that the prism should run one-half as fast as the machine with which it is connected. It is then to be placed with the axis of rotation and the longer side of the prism in exact line with the axis of rotation of the machine to be viewed. When this machine seems to stand still, the machines are synchronous, and the phase can also be observed by seeing where the axle seems to be standing, if some point or mark on this axle has previously been observed when the machines were running together in phase.

I have not used my apparatus for this purpose, but it seems well adapted to it. Certainly some such device is to be preferred to the hit or miss method often employed.

Inspector of Motor Cars.

The City of Paris has recently appointed an inspector of motor car traffic, a newly created post, on the competition for which must [illegible]. To this office holder the city pays the municipal salary of [illegible] per year, or about $[illegible] per week, with an allowance of $[illegible] per year for traveling expenses.

The Electric Furnace.

BY LIEUT. F. JARVIS PATTEN.

THE highest temperature known to science in terrestrial processes is that of the electric arc, and it corresponds closely to that degree of heat required to volatilize carbon, and may be expressed as somewhere about 6000° Fahrenheit. We can easily imagine therefore that early after the discovery and first use of this extraordinary degree of heat all electro-chemical processes requiring excessively high temperatures were immediately the field of renewed activity, scientists knowing very well that many of the unsolved problems remained so only by reason of the fact that the requisite degrees of heat for their operation could not be obtained by known methods.

Hence the immediate raison d'être of the electric furnace, which, even with recent developments and improvements, is little else to-day than an electric arc light built and applied on an extended scale for purposes of heating and smelting refractory substances instead of for lighting space. Most of the mechanism of the electric furnace, as operated to-day, is directed to the work of getting the material to be treated into the electric arc or flame space and keeping it there, and is almost entirely auxiliary to the arc itself and its action. In fact the electric furnace may even now be described as perhaps the most crude and certainly the least developed of recent applications of electricity to the arts, and this fact doubtless explains the present activity in this line. Though twenty years old modern types of furnace differ hardly at all in principle and not in any marked degree in detail from the earliest forms.

Historically, this device dates from the seventies and, like most all simple and fundamental electric machines, it originated, or was first put into practical use, in Europe. The first patent of record describing such an apparatus that I have been able to find bears the name of Charles William Siemens and is dated 1879. The simplest form of furnace including all actually essential features is shown in Fig. 1, which depicts a good form of furnace for laboratory work. There are two carbon electrodes or pencils, *K* and *K'*, the one in the base of the furnace being fixed, the other being movable vertically to determine the length of the arc. The furnace part is made of two blocks of carbon, one superposed upon the other as a base, the top one being removed when the process of fusion is completed. A tube, *S*, permits feeding to the arc the material to be operated on, and a vent, *G*, allows the useless gases to escape.

It is but a step from this simple form of furnace to that shown in Fig. 2, which is the earlier form of the Willson and other American electric furnaces. In this type a fixed block of carbon, *G*, is placed at the base of the furnace chamber and forms the lower electrode, a movable carbon pencil, which may be 8 or 10 inches in diameter, being the upper movable electrode. A tuyere pipe, *E*, allows the products of fusion to be withdrawn when in a fluid state.

Before referring to the improved developments of these simple forms it may be of interest to describe two of the earlier historical forms, interesting chiefly by reason of the celebrated names in applied electrical science that they bear. That illustrated in Fig. 3 is the early Siemens furnace alluded to above. It is more strictly speaking an electric crucible, having horizontal electrodes projecting inward through its sides, both being laterally movable on a system of rollers and carrying between them the arc by which the contents of the crucible are heated. The following excerpt from the Siemens specifications of 1879 shows all the essential features of the electric furnace of to-day:

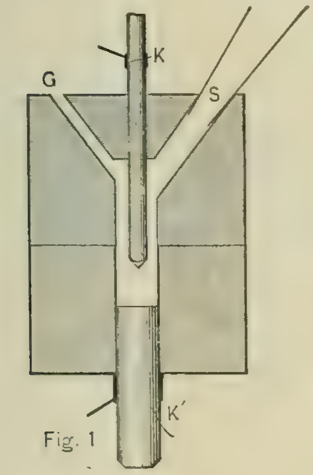


Fig. 1

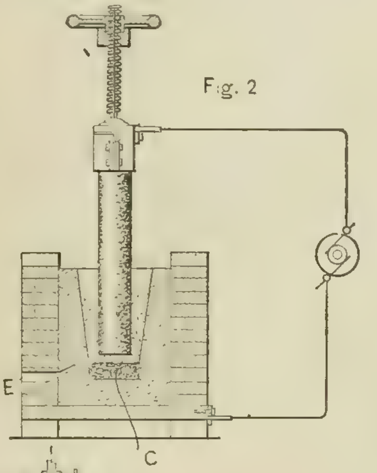


Fig. 2

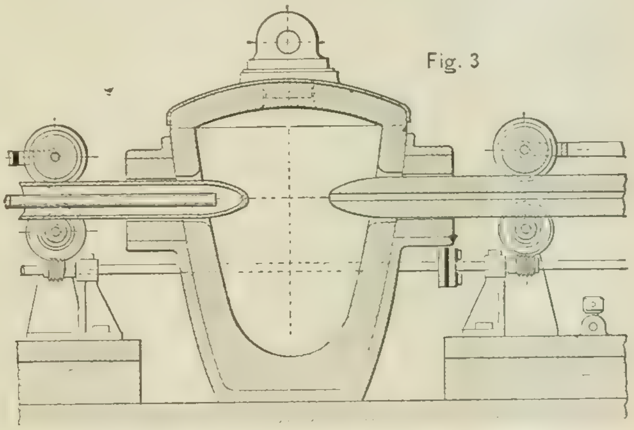


Fig. 3

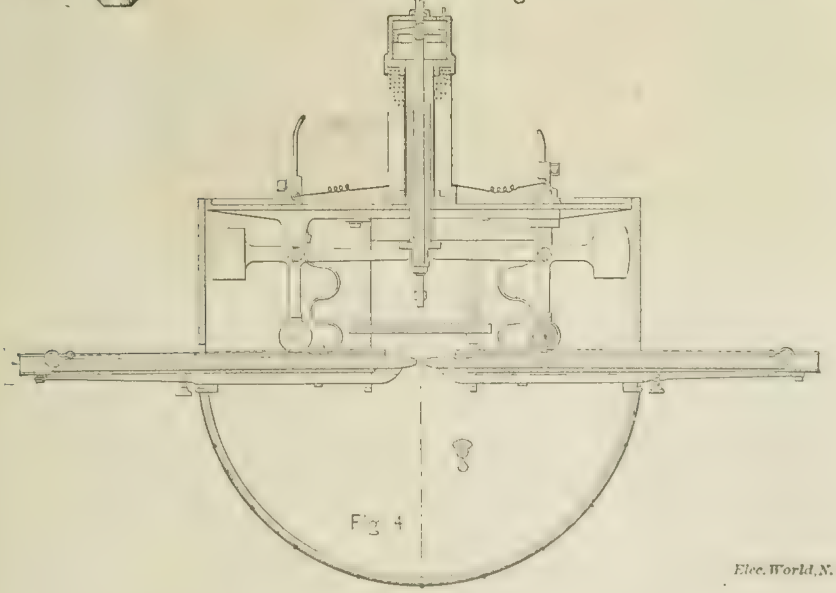


Fig. 4

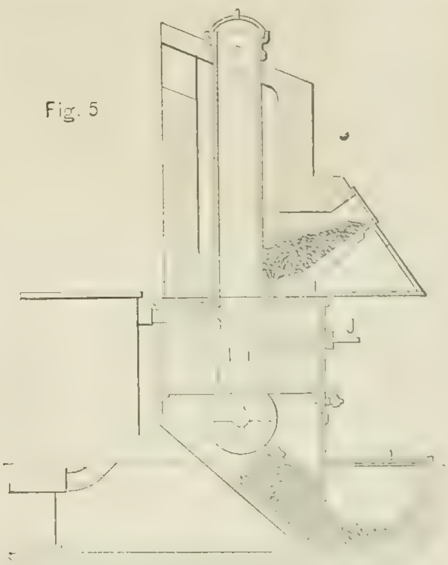


Fig. 5

Elec. World, N.Y.

"In applying the electric current to the production of intense heat for the fusion of refractory substances I employ two carbon rods fitted to slide toward each other horizontally through opposite sides of a crucible made of highly refractory material, such as lime or alumina, a water jacket or casing being used for cooling if necessary. The carbons are movable on rollers, and are operated by clockwork to hold them at a suitable distance from each other for the proper maintenance of the arc."

Fig. 4 represents another modification of the Siemens furnace, with more detail in the regulating mechanism of the electrodes. The other furnace of historical note is that shown in Fig. 5, and is from an English patent granted in 1882 to Camille A. Faure, of storage battery fame, and is described by him as a furnace designed for smelting iron ores. A number of electrodes, *J*, project radially into the centre of the furnace through holes *I I*, and through the arcs maintained between them the material to be treated is caused to pass. There is no evidence that this system of furnace ever came into general use, and the confessed disclaimer of its general utility appears to be sufficient evidence that its author had little idea of the many useful applications of the electric arc furnace in extreme high temperature work, as he describes it only as suited for smelting iron ores and the like. It seems, in fact, that the electric furnace did not receive the serious attention of scientific inventors until it became known in comparatively recent years that such refractory materials as lime and carbon could be readily fused by its intense heat.

The possibility of making calcium carbide on a commercial scale by electrically fusing its two only ingredients, lime and carbon, gave an immense stimulus to this field of research and investigation, and we may soon look for a new-born engine of science destined to accomplish marvels by the simple application of the highest possi[illegible]. Through a wide range of temperature carbon's strongest affinity is for oxygen, but at the temperature of the electric arc a greater part of the carbon in a mixture of lime and coke unites with the calcium of the lime to [illegible] only uniting with the oxygen present to form carbon monoxide (CO) which burns with a [illegible] (CO_2) [illegible]. The reaction is as follows:

$$CaO + 3\,C = Ca\,C_2 + CO.$$

[illegible]

[illegible] artificial diamonds by its aid. Though not as yet commercial articles there is no sound reason why electric furnaces may not become so at an early day.

Before passing to a description of some interesting variations in methods of controlling the arc it may be well to refer briefly in passing to the celebrated Willson furnace at Spray, N. C., which was the first to produce carbide in commercial quantities. It is shown in Fig. 6 and is plainly little else than the general plan of Fig. 2 built on a more extensive scale. This furnace had electrodes of rectangular cross section, about 10 or 12 inches, and the output of a single run was a nugget of a carbide about 3 feet high, weighing over 200 pounds. The first electric furnaces at Niagara turning out nuggets of about 800 pounds differed in no essential particular from that erected at Spray, except in size and output. More recent developments have, however, introduced a number of innovations, and the tendency is constantly to increase the size and output. More recent furnaces at the Niagara plant are built as 1000-hp units, and are designed to produce a nugget of a thousand pounds or more at a single operation. These stacks are about 30 feet high and are built on the general lines of Figs. 7 and 8, the latter differing mainly in the system of feeding the material into the arc by the worm screws, *K K*, at the base of the hoppers, *J J*. Fig. 7 shows a multiple arc furnace designed for a large output. The general features of this furnace are almost self-evident. The heavy rods, 5 5, etc., are the movable vertical electrodes actuated by the hand screws, 20 20, etc. The base plate of the furnace forms a common opposite electrode to all the movable ones. The product of the operation flows into the receiving kettle, 10, the gases escaping through flue 17 to the chimney.

Quite early in the development of the electric furnace are found attempts of a highly ingenious sort to control the action and motion of the arc. It was long before known that when placed in a magnetic field the electric arc would take up a certain position depending upon the magnetic direction of the field and the direction of the current producing the arc. The earliest intimation of this system that I find is illustrated in Fig. 9, which is taken from an old German patent granted to Dr. Zerener, of Berlin, and is styled by him an electric arc blowpipe, and, though far from being a furnace, it contains the elements of later forms. A strong magnet, *D*, has one pole placed near the points of the two electrodes, *B B*, between which the arc is sprung and the magnetism has the effect of driving the arc out, as shown in the figure in the form of a pointed flame, evidently well adapted in this form to blowpipe use. Not long after the date of this published description of an electric-arc blowpipe I find the same identical principle applied to a fur-

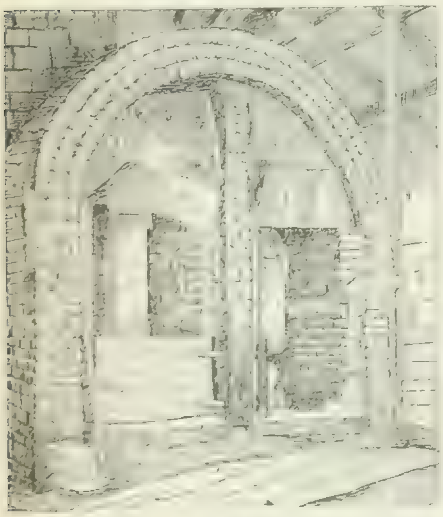


Fig. 6

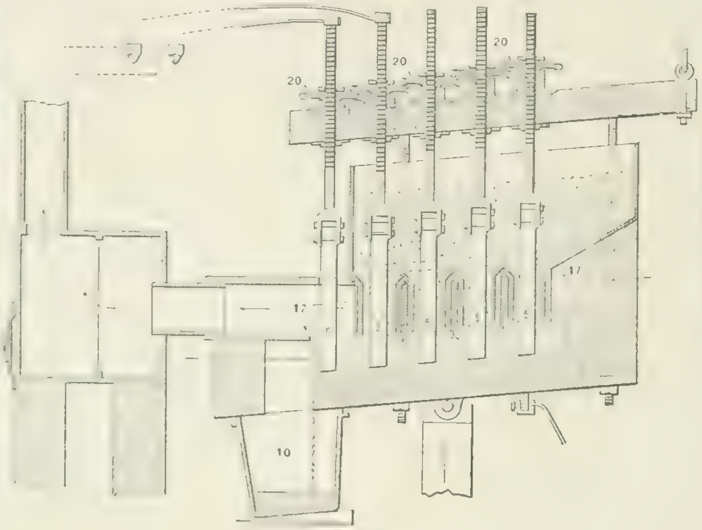


Fig. 7

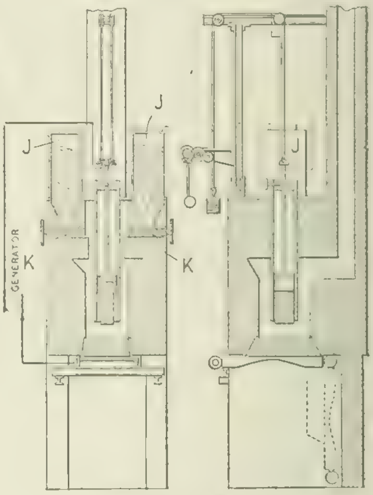


Fig. 8

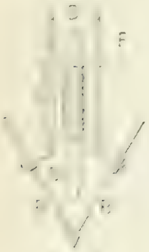


Fig. 9

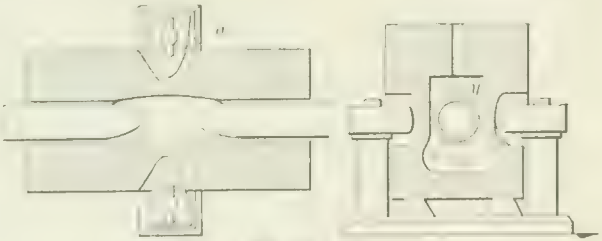


Fig. 10

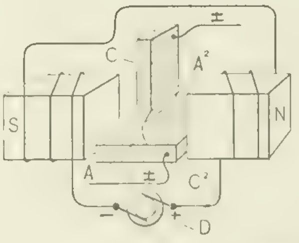


Fig. 11

Elec. World, N. Y.

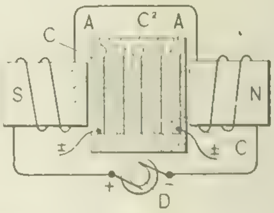
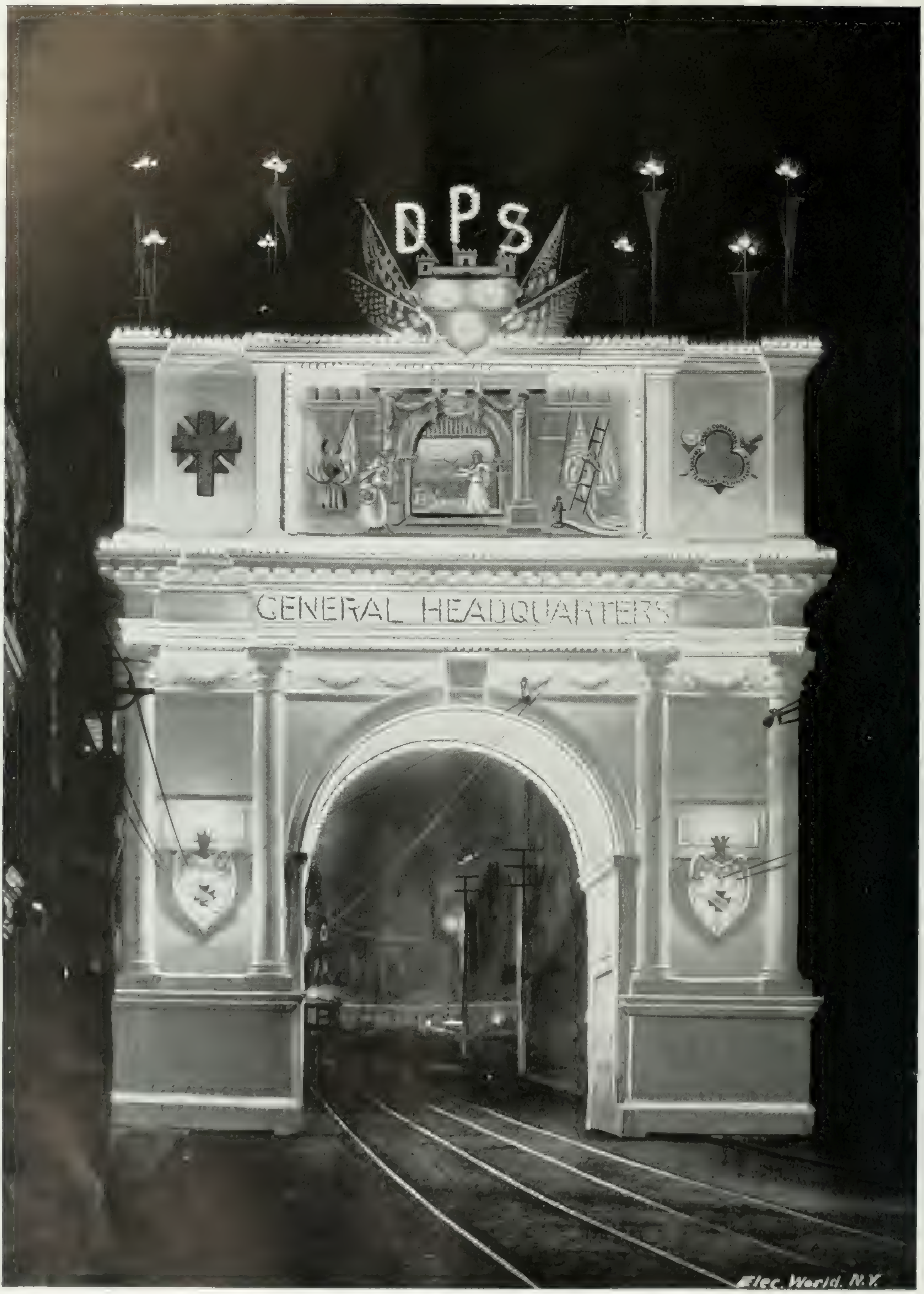


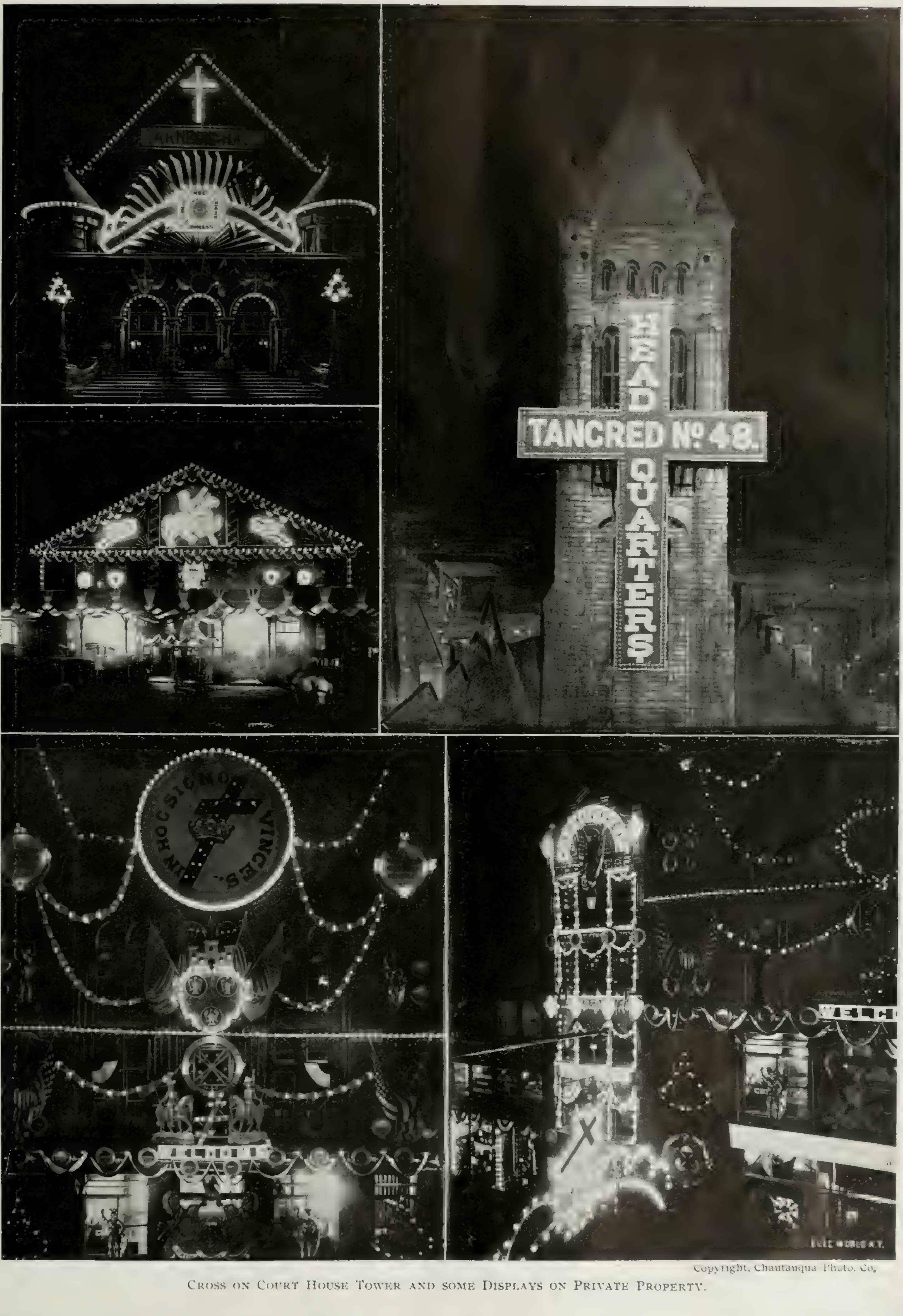
Fig. 12



Elec. World. N.Y.

Arch Spanning Sixth Avenue in Front of Public Safety Building.

The Illumination of Pittsburg for the Knights-Templar Conc



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CROSS ON COURT HOUSE TOWER AND SOME DISPLAYS ON PRIVATE PROPERTY.

nace proper, and this also in a German patent, dated as early as 1877, and granted to three Englishmen, Rogerson, Statter and Stevenson, who, as pioneers of an original system, certainly deserve passing mention here. Two views of this furnace are given in Fig. 10, and represent the first actual furnace in which the position of the arc is defined and fixed by enclosing the arcing space in a magnetic field, either fixed or movable. This brings me to a description of two furnace systems, with moving electric arcs, which are the invention of the writer and are in extension of the principle applied in the furnace just described, in which the arc was held rigidly fixed in space by a constant and unchanging magnetic field. The system is plainly indicated by the diagrams in Figs. 11, 12 and 13.

In view of the fact that the idea of using a magnetic field for determining and fixing the position of the arc is so old it seems indeed strange that the same agency should not have been long ago applied to move the arc about from place to place or give it a reciprocating or even rotary motion.

The three figures, 11, 12 and 13, illustrate the operation of the reciprocating or sliding arc furnace system. In Fig. 11 C^1 represents an upright carbon slab placed at arcing distance from the horizontal slab C^2, and N and S are the poles of an electromagnet embracing the arcing space. Supposing the lines of force to flow from N to S, the arc between the carbons will assume a position depending upon the direction of current flow. If it flows from the upper to the lower carbon it will take up the position, A^1, at the left hand corner of the upright slab when looking from N to S and remain there as long as the magnetism and the direction of the current are unchanged. If either of these, however, be reversed in direction the arc will immediately pass over to the other corner of the upright slab and remain at A^2. In these physical conditions therefore lies the possibility of a moving arc system, for if either the magnetism or the current be slowly reversed the arc will see-saw back and forth across the lower edge of the upper carbon and so be constantly moving to and fro. Fig. 12 shows a number of slabs similarly arranged with respect to a common lower electrode. Now in such an arrangement it is evidently a simple matter, by causing the current to flow upward in one vertical slab and downward in the next, to have, upon reversing the field magnetism, adjacent arcs moving to and fro simultaneously in opposite directions. Fig. 13 shows the general features of a furnace constructed on this principle. It requires no special description, being simply a plain application of the principles just elucidated except perhaps to state that there is provided a current reverser or pole changer, Fig. 13a, the purpose of which is to very slowly reverse the magnetizing current and magnetism of the magnet built into the body of the furnace and so cause the several arcs between the upper electrodes and the lower one to slowly oscillate back and forth through the material to be fused as its passes down the inclined floor of the furnace.

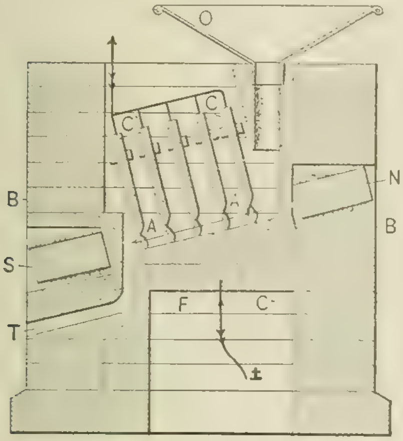


Fig. 13

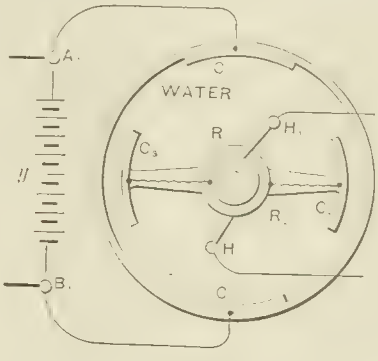


Fig. 13 a

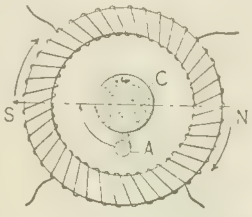


Fig. 14

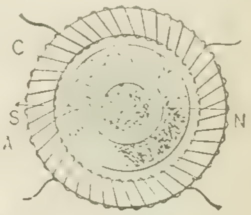


Fig. 15

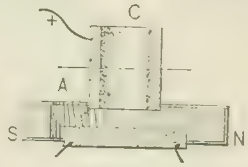


Fig. 16

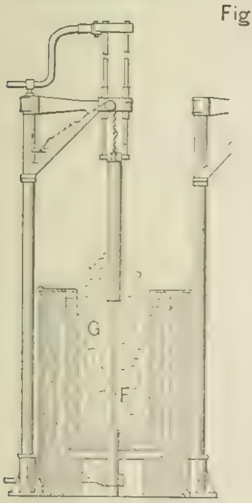


Fig. 17

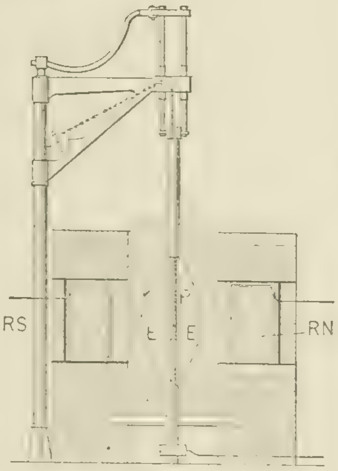


Fig. 18

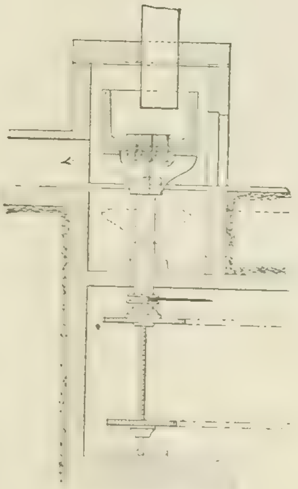
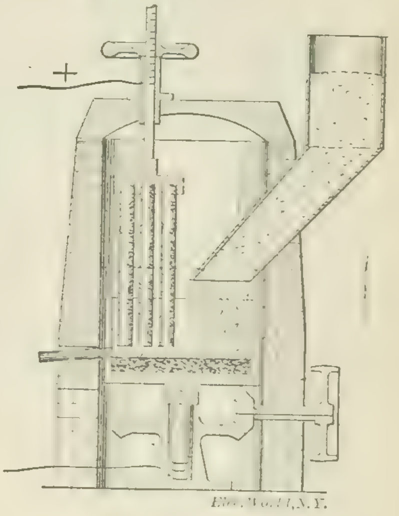


Fig. 19



Elec. Ill. N.Y.

Fig. 20

It is a simple matter to pass from the preceding to the rotary or revolving arc systems, illustrated in Figs. 14, 15 and 16, in which a ring magnet, with a rotary field, induced by a multiphase current excitation, is built into the furnace in such a way as to embrace the arcing space. Under these conditions the arc between the electrodes is forced to move in a circle around the carbon in its endeavor to keep out of the revolving magnetic field. Various methods of applying this principle are almost self-evident. Fig. 16, for instance, shows a tubular electrode in juxtaposition to a horizontal lower electrode. In this case the revolving magnetic field forces the arc to travel around the circular lower edge of the tube while the material to be treated may be fed downward through the centre of the tubular electrode. The broad principle here described is equally applicable to incandescent furnace systems in which there is no arc whatever to rotate. Such a general system is illustrated in Fig. 17. A slender pencil of carbon, F, passing through the middle of the mixture to be fused, connects the two electrodes. When raised to the fusion point it develops sufficient heat to fuse the surrounding mixture, but this once accomplished the current prefers this path, the resistance of the fused mixture being much less than that of the unfused and untreated portion. The current in such a furnace may, however, be forced to leave the direct path and take up a curved one through the unfused and untreated mixture by surrounding the current space by a ring magnet having a rotating magnetic field as before. This may therefore be styled a rotary current system in which the electric current, following the same law as the arc, is caused to revolve in its constant attempt to keep out of the slowly rotating magnetic field. See Fig. 18.

It seems strange that with such simple means at hand for rotating, or traversing the arc without the use of any mechanism or machinery in the furnace that mechanical devices should be resorted to for accomplishing this object and shows quite plainly that early improvements of the electric furnace will of necessity be in the direction of some form or type of a moving arc system.

Fig. 19 shows the general plan of a French furnace recently patented, in which the electrodes are movable with respect to each other, one being kept in motion by machinery during the operation so that the arc will be constantly brought into contact with fresh material. Fig. 20 shows a somewhat similar system from an American patent, in which the lower plate or electrode, built in the form of a circular table, is caused to move eccentrically with respect to a bundle of upper electrodes, the latter being simultaneously revolved about a vertical axis of revolution. This gives considerable latitude to the motion of the arc, but seems unnecessarily complicated and involved, in view of the fact that the arcs can be moved without the aid of any machinery whatever.

A great variety of other furnaces could be given, as illustrations of the already extensive development of the art, but they do not involve any new principle and only serve to show how every variation of detail is seized upon in the attempt to get something new. It may be stated briefly in closing that multipolar furnaces using multiphase currents are among the latest developments in Europe, but have not as yet given marked evidence of any particular advantage. So-called continuous process systems that do not require recharging are much vaunted and talked about of late, but none has come to my attention among a large number that has met the expectations of its friends, and there are few that ever worked in practice at all.

An Experimental Two-Wire 220-Volt Lighting System.

BY DR. LOUIS E. FOULKS, SUPT.

This plant is located in the country town of New Egypt, N. J., lighting its streets and business buildings. Power is obtained from the rather unusual combination of a water wheel and gasoline engine.

The engine and dynamo room is located under and a little to one side of a large flour mill, the room being kept free from dampness by cement floor and walls. A 40-foot shaft, connecting with the water wheel, enters the room through the wall at the lower end, and is belted to a C & C multipolar ironclad generator. The water wheel (50 horse-power) not being sufficient to carry our load, a 30-hp Brighton gasoline engine is used to help it out. A friction clutch pulley is used to throw the engine on and off the water-wheel shaft, as the load becomes heavy in the early part of the evening and light later on.

We frequently, to save water, as the supply is limited, throw off the water wheel late at night, when only the street lights are on, and run them with the engine alone. I would say right here that, if all gasoline engines work as well as ours, it is strange that more of them are not used. When run alone it never gives a variation of more than four volts, or 2 per cent., and when with the water wheel not more than one or two volts. This variation does not show in the lamps. The switchboard, made by Eyanson & Armpriester, is of polished and enameled slate, and contains the usual instruments, being arranged for four feeders. Up to January, 1898, a 110-volt system was in use, lighting only the stores and a few private houses; but, on account of the variation in voltage when a number of lights were turned on or off, it was not satisfactory to the people. At that time the town committee decided that if the company would guarantee to furnish a strictly steady and generally satisfactory light it should be given a contract to light the streets with about 200 incandescent lamps of 20 and 32 candle power.

The distance to which the street lines would have to be carried being a total of 16,287 feet, and as the various plants near here using the 110-volt system were not satisfactory on account of un- [illegible] that the 220-volt two-wire system, using 220-volt lamps, was the only way to solve the problem, and it has done so even better than [illegible]

[illegible] than two hours, the streets were arranged in three circuits, start- [illegible] far saved much time, as well as money. The lines are laid out on the feed and main plan, with a calculated drop to the end of each line of 8 volts at full load.

The inside wiring in all buildings is the same as if for 110 volts, using the closed-loop plan to insure even potential. Nothing larger than No. 12 wire has been used, most of it being No. 14. All fittings are the same as for 110 volts. Sawyer-Man 5 and 10 ampere cut-outs, with double-pole baby knife switches, are used. Out of the many makes of wall switches we have tested the Hartford snap switch is the only one found that would stand the voltage, the other makes arcing if double-pole and jumping the break if single-pole, when used to turn off more than six to eight lamps. I have found that in fusing cut-outs and ceiling rosettes it is best to raise the fuse wire free from any contact with the porcelain, otherwise the fuse will blow very slowly and damage the fitting. (This is doubtless due to moisture condensing on the porcelain). We had one mica-covered branch block, fused with 5-ampere fuse wire, so badly burned that it fell apart. This led me to make some experiments, when I found that by placing the fuse so that it would lie on the porcelain from post to post the same disastrous result would be obtained almost every time, while with other conditions the same, but keeping the fuse free from contact with the porcelain, it would blow instantly and do no damage at all. More care is required in wiring and fitting than for 110 volts, but when once done the work gives far less trouble. Extreme care should be given to all joints in wiring, otherwise prompt trouble will ensue.

Lamps at first gave us the most trouble, short-circuiting almost as fast as we could put them on. This was simply the fault of the lamp, so we obtained a supply of various other makes, the result being that we now use only the new-type Edison as made by the General Electric Company, and find them to be the best in respect to long life, candle power and economy, taking about 3¾ watts per candle. The filament in these lamps is short and heavy, and we have had them in all possible positions without any effect on the shape of the filament. All of the Edison lamps have now been burning over 700 hours, and show a remarkably small per cent. loss of candle power. Not a single lamp out of over 200 has blown and only one out of that number has burned out, while, on the other hand, of the makes we first put up very few are now left, and those that are left are, to say the least, very dim. We found from the first that lamps with long, thin filaments were worthless, as the filament soon drooped and cracked the globe.

We have also found that out of four makes of lamps the Edison is the only one that will stand any excess voltage. There are four pilot lamps on our switchboard, and when we first started on 220 volts we put in four different makes of lamps. As the switchboard voltage is 226 volts, at the end of two weeks only one of the original lamps was alive, that being an Edison. The same lamp is yet there, with a record of over 1000 hours at 226 volts. Our experience with lamps has brought out the fact that their inferior quality is more quickly developed in the 20 and 32 cp sizes than in the 16. This is just the reverse of what I have been taught to expect. We also use the genuine Edison socket, and have not had trouble with a single one of that make of key sockets, but the keyless Edison socket we cannot approve for 220 volts, as the ones we have in our street hoods will short-circuit, unless a lamp is in. This gave much trouble with the street lines at first, not having lamps in all the hoods. The fault is in the tongue of the socket, the space being too small between it and the side.

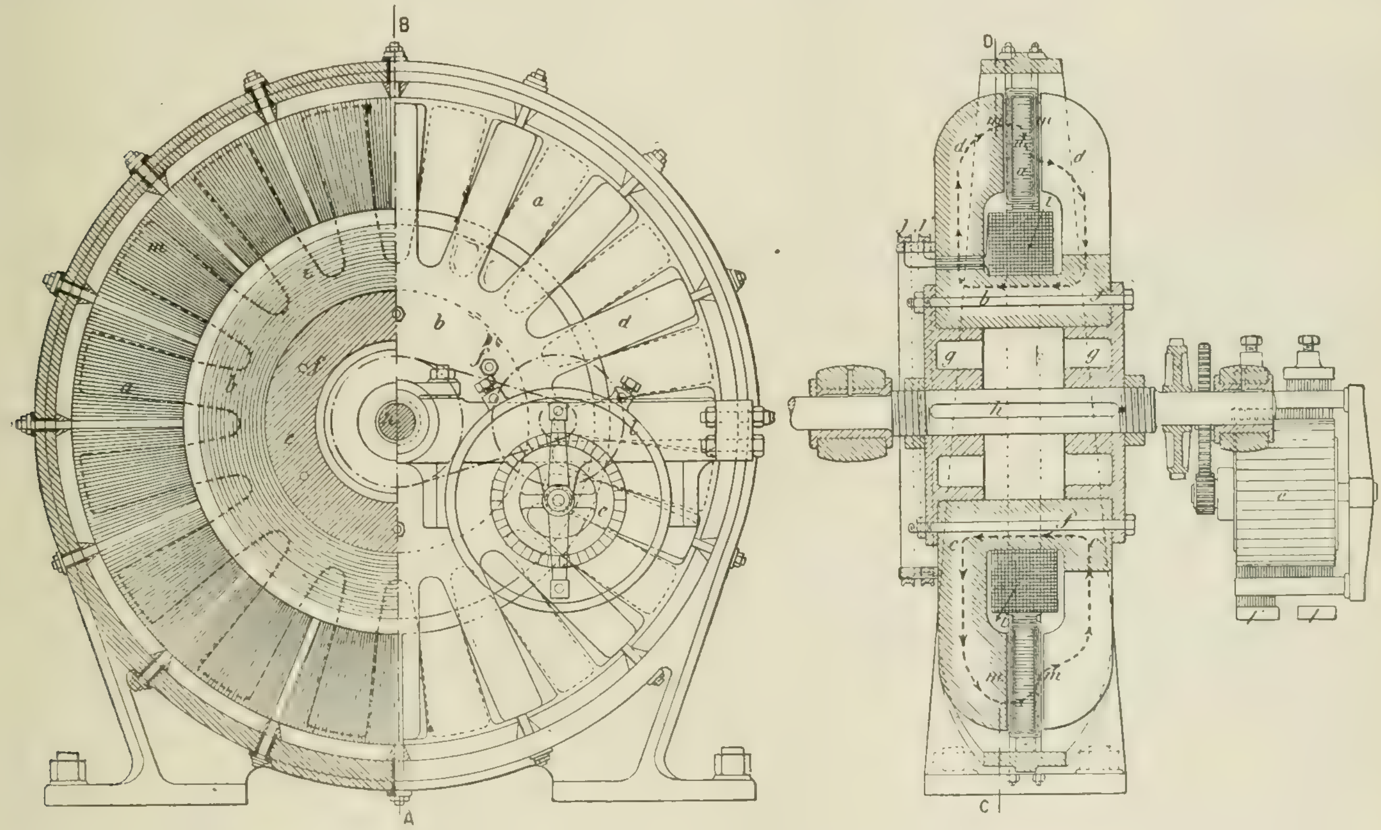
After a daily working experience with this 220-volt plant for some eight months past, my opinion is that for a country town this system will give better satisfaction to the people on whose patronage a plant must depend than either the two or three wire 110-volt system. The voltage on the lines can be kept free from any marked fluctuation; the life of the lamps and even the candle power compares favorably with the best 110-volt lamps. All faults in wire and fittings are shown more promptly, and give less trouble in the end. It costs a little more for power, but the saving on wire and general first cost of the plant, together with a larger list of well-pleased [illegible]

We have a small bipolar 110-volt generator, which is driven by a 20-hp water wheel, and which furnishes light to several stores near [illegible] the difference in [illegible] as to be noticed [illegible] to change them to the 220-volt system, on which the light is more steady. The plant is [illegible]

A Novel Direct-Current Dynamo.

An ingeniously designed electrical machine with revolving field and stationary armature and with commutator brushes driven by gearing at a much higher angular velocity than that of the main shaft is described in a recent number of "L'Eclairage Electrique," the design being that of Rémon-Casas and covered by French patents.

The machine, as shown in the accompanying illustration, comprises an internally rotating field with poles, *m m*, and a single field exciting coil, *i*, concentric with the shaft; all poles of one polarity being to one side of the stationary armature, *a*, those to the left, for example, being north poles and those to the right all south poles. The armature is ring wound, the radial lengths on the flat sides being the active part of the winding. The poles are staggered—that is to say, the south poles on one side are angularly displaced midway between the positions of the north poles on the other. The magnetic circuit thus passes from the north pole on one side through the winding into the armature core, along which it runs circumferentially until opposite the south pole, into which it enters by crossing the winding on the other side of the ring-wound armature. In the machine shown there are thirty-two poles.



A Novel Direct-Current Dynamo.

The most interesting feature of the machine is, however, the means of commutation. The commutator segments must, of course, be stationary and connected with the coils on the stationary armature, and the brushes must revolve. To avoid the expensive construction involved in a commutator of conventional design for a 32-pole machine with the large number of commutator segments needed per pole, the brushes are made to revolve at a much higher angular velocity, cutting down proportionately the number of segments. The commutator, *e*, is fixed and the two brushes are rotated by sprocket wheels and a gear, giving, in the case shown, an angular velocity to the brushes sixteen times that of the main shaft, so that the commutator connections and number of brushes are the same as for a bipolar machine. The brushholders also carry outwardly bearing brushes, which run on the collector rings, *l l'*, giving connection to its external circuit. Current is introduced to the rotating field winding through the collector rings, *j j'*. To adjust the brushes to a proper plane of commutation the hub of the driving gear wheel is driven from the shaft by means of an inclined key. The gear wheel can be moved along the shaft by hand, changing its angular relation therewith.

A Means of Reducing Friction in Motor Meters.

In patent No. 611,809, issued October 4, 1898, to Sydney Evershed, London, England, there are described several ingenious means of reducing the friction of motor meters, such, for example, as the Thomson recording wattmeter, and thereby increasing their light-load accuracy. One of these means is the use of a vertical magnet, preferably permanent, with one pole approaching closely the upper end of the motor shaft, which should be of iron or steel, the attractive force being so adjusted by varying the air gap as to just balance the weight of the shaft and the parts carried upon it—namely, the armature and brake. By this means the weight on the jewel, and consequently the friction, can be almost entirely eliminated, and the jewel life greatly lengthened. By pointing the pole of the supporting magnet the tuft of lines of magnetic force issuing therefrom can be made to hold the upper end of the rotating shaft in the proper position, and the friction of a journal for maintaining the upper end of the shaft in its proper position can be also eliminated. The patent also claims the use of a weight supported from a drum connected with the gear train, the weight being such that it will overcome the friction of the train and allow the worm wheel of the motor shaft to permit the train to move and control its movement rather than to drive it. For direct-current meters the patent describes a modified form of commutator intended to reduce the friction, the segments consisting of wires and the brushes also of wires stretched like bow-strings in a direction at right angles to the shaft and bearing lightly on the wire commutator.

American Competition Abroad.

Some of the English electrical papers seem quite concerned about American competition in England. The street railroad at Bradford, for instance, is equipped with an American plant, the important Middlesbrough & Stockton line is American throughout, the new railway at Cork will use American machinery and the extension of the Leeds railways will be made with American materials. Moreover, an extensive lighting plant of the Metropolitan Supply Company is being supplied from America. An editorial in the London "Electrical Review," commenting on this, states that the German and American manufacturers are quick to appreciate the wants of a community and will supply just what is wanted without inquiring whether it is a reasonable or foolish demand; it adds that Englishmen should study the reason of the successes of the Americans.

Electric Traction by Surface Contacts.*

BY PROF. S. P. THOMPSON AND MILES WALKER.

Surface contacts are of interest at the present time because local authorities object to trolley wires, tramway companies do not like the expense of conduits with open slots, and every one is disgusted with the weight and rapid deterioration of accumulator cells. The only other approved method of supplying a tramcar with electric power is by means of surface contacts, and with regard to these people are asking for information.

One of the pioneers in surface contact electric traction was the late Dr. John Hopkinson. In a patent specification filed in 1882 he was the first to describe all the essential features of electromagnetic mechanism for successively connecting the sections of a conductor to a supply main. The object in view at that time was the prevention of the serious leakage which would occur from a long insulated rail. The device that he proposed is shown in Fig. 1. The insulated rail *B* is cut up into sections, b_1, b_2, b_3. Each of these can be connected with a supply cable, *C*, through the switch points, *l l*. The switch is operated in the following way: Suppose a car to be running on the rails picking up current from the section, b_1, and putting it down to the return rail, *E E*. As soon as one of the collecting brushes comes in contact with the section, b_2, current passes round the shunt coils, *S S*, of the electromagnet and to the return rail, *E E*. This raises the armature, *H*, and completes the circuit from the cable, *C*, through *l l* and through *G G*, the series coils of the electromagnet to the section, b_2. At the same time the shunt circuit is broken, the electromagnet being now excited only by the main current passing through *G G*. Thus the car can pass over section, b_2, and as soon as it leaves it the current no longer flows through *G G*, so that the armature drops and the section, b_2, is cut out. It will be noted that the primary object of the invention was to enable *B* to be cut up into sections so as to diminish the leakage which would occur on a very long line. It was not intended to expose a high voltage rail in a public thoroughfare, so no special precautions were necessary to insure the absolute reliability of the switches.

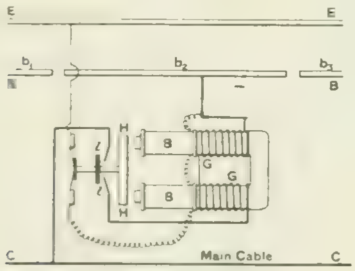


FIG. 1

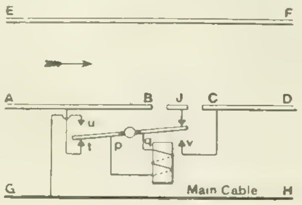


FIG. 2.

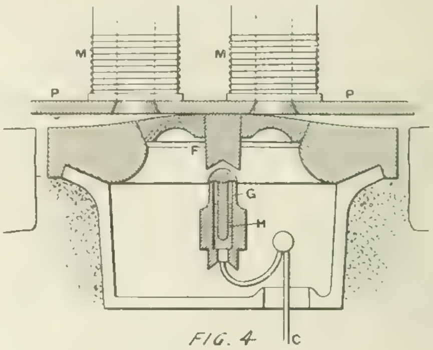


FIG. 4

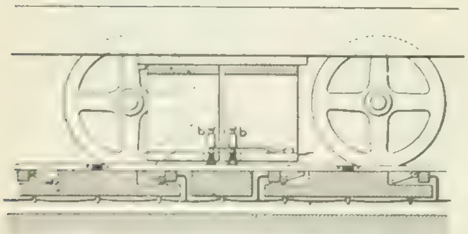


FIG. 3

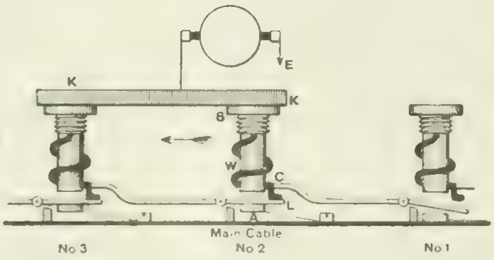


FIG. 6.

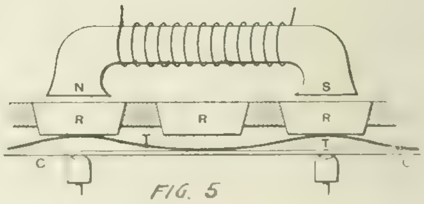


FIG. 5

A year earlier Ayrton and Perry had suggested mechanical and electrical means for effecting the same object, and in 1883 they filed [illegible] various ways of connecting up electromagnetic switches and various [illegible] In Fig. 2 [illegible] rests in the position shown. The locomotive is intended to run in the direction indicated by the arrow. Assuming that the section, *A B*, is "alive" when the locomotive reaches *J*, the main current [illegible] thus connecting *C D* to the main. It will be noticed that this method differs from Hopkinson's in so far that it is the main current on its way to the locomotive that first operates the switch. There are really two functions to be performed by the coils of the electromagnet: (1) the switch must be in the first place closed, and then (2) kept closed while the car is running over the section. In Hopkinson's switch the two functions are carried out by a shunt coil and a series coil respectively. Fig. 2 shows the first published method of both closing and holding on the switch by means of the main current. Ayrton and Perry also employed shunt coils as operating coils, and suggested the use of a magnet carried on the car to perform the same function. Indeed, so wide and varied are the descriptions in their specifications that they cover much of the ground of inventors who came after them.

So far the main object in view had been the prevention of leakage from a long line or the automatic blocking of trains by cutting off the supply of electricity from any second train that might run upon an occupied section. But the demand for some system of picking up current without employing a trolley wire or open slot in the road led inventors to try this method of surface contacts for ordinary streets. In 1886 Wynne devised a system in which the contacts were short pieces laid in the road, and connected successively to the main feeder by means of a little trolley that ran in a closed tunnel under the roadway. Then Pollak and Binswanger, developing a suggestion which had been thrown out by Ayrton and Perry, described a method of operating the switches by means of a magnet carried on the car. Fig. 3 shows their specification drawing which certainly has the air of simplicity. In connection with this system it may be well to mention at once Diatto's more recent experiments. Diatto employs an electromagnet (Fig. 4) consisting of a number of cylindrical magnets, *M M*, with their similar poles riveted into a long strip of steel, *P*, thus making up a long polar face which is suspended from the car and extends along its length. This pole comes in contact with an iron peg, *F*, fixed in each road contact, and magnetizes it so that it attracts a movable iron peg, *G*, floating in mercury, *H*, and connected to the main, *C*. Thus connection is made between road contact and the main. Diatto has worked out successfully the practical details of his system on a line in Italy.

There is no doubt that systems based upon this principle have one great advantage over many other systems. The force tending to keep the switch closed can only operate when the car is over the switch. If the contact points of the switch can be made so that they will never stick together, then so far as the safety of the public is concerned there is no better system than this direct magnetic pick-up system. It is, however, to be doubted whether in the small [illegible] under an ordinary electric car there is sufficient room to place a long electromagnet which will operate really reliable [illegible]. The difficulty is increased when going at full speed or round sharp curves. Some methods which are allied to the above are those described in the specifications of Lineff. Fig. 5 illustrates an early type. An iron or steel strip lies in contact with the insulated main conductor; immediately over it are the surface studs. A magnet on the car attracts the strip upwards so that it comes in contact with the surface studs, thus connecting them with the main. As the car moves forward the wave in the strip moves forward like the sinus in the back of the mythical serpent. The method is as ingenious as it is simple, but there must always be a difficulty in making in this fashion a good contact with the surface studs.

The feebleness of the effect under the roadway of a magnet carried on the car has led many inventors to prefer an electric method of communicating with the switch, after the manner of Hopkinson and Ayrton and Perry. Very many different methods of operating the switches electrically have been devised. They fall into three classes: (1) Those in which the operating coil is a shunt to the motor circuit; (2) those in which it is in series with the motor; and (3) those in which it is excited by a battery carried on the car. Each method has its advantages and disadvantages. The main objection to a shunt coil is its cost. It may further be open to the objection that a very small leak in the insulation of the main may be sufficient to keep it in operation when it ought not to be. On the other hand, it has points of advantage over a series coil. As it always exercises the same pull it can be designed to a nicety to do the work required of it, and, in general, can be put into a very small space; whereas a series coil is dependent in its action upon the current taken by the car, and while on the one hand its winding must be able to carry 100 amperes for a short time, it must have enough turns in it to operate the switch when only carrying two or three amperes. This necessitates a bulky winding, which increases the size of the switch and its box. Besides this the force operating the switch is apt to be too violent with large currents or too feeble with small currents. The great advantage of the series coil has always been that by its use the operation of the switch could be made more dependent upon the presence of the car. If the car is not over the surface-contact it cannot draw current from it, and it might be argued that the series coil would then of necessity have no current through it. This would afford abundant safety to street passengers if it were not for the fact that some current may be leaking from the road contact to mud in street, and this may be sufficient to keep the switch closed.

To illustrate this let us take a very old design of Frank Wynne's. The view (Fig. 6) is, of course, diagrammatic. The car is intended to run in the direction indicated by the arrow. When switch No. 2 is closed current can flow from the main cable by means of the armature, *A*, through the lever, *L*, to the contact, *C*; from thence it passes round the winding of the magnet, *W*, to a stud, *S*, laid in the road. In contact with the stud, *S*, is a long metal skate, *K K*, carried on the car. The current passes to this and on through the motor to earth. As soon as *K K* comes in contact with stud No. 3 the current divides, part of it going through the winding of switch No. 3 and operating it. Stud No. 1 is shown disconnected, the switch having opened when the skate left its stud; but it is easy to see that if current could leak from Stud No. 1 to earth there would be some current in the coil to keep the switch closed. Many devices have been suggested to remedy this defect. Mr. Wynne himself has proposed numerous methods. In a recent design carried out in conjunction with Mr. David Urquhart the current which operates the switch is an alternating current flowing into and out of a condenser. The continuous current which works the car cannot go through the magnet winding because it cannot get through the condenser. The methods suggested by some inventors are exceedingly complex, their diagrams being perfect mazes of connections and interconnections; the number of studs and skates being increased to an alarming extent. One of the simplest arrangements is that of Johnson and Lundell. They adopted a method which originated on the Continent, and consisted in operating the switches by the current on its way from the car to earth instead of on its way from the main to the car. Fig. 7 shows one of their diagrams. It will be seen that the current passes from the main cable through the switch direct to the stud marked S_1 without passing through any magnet winding, thence it passes to the motor by means of skate, K_1. From the motor, instead of going direct to earth, it passes to skate K_2, thence to S_2, and so through the magnet windings to earth. Now the stud, S_2, is at very nearly the same potential as the earth-return, so that the question of leakage from it does not trouble us. By placing S_2 outside the rails it can be effectually guarded against stray currents from S_1. One feature in this design is the interconnection of the switches whereby a switch is operated before it is required to supply current to the car. This gives greater time for the switch to close.

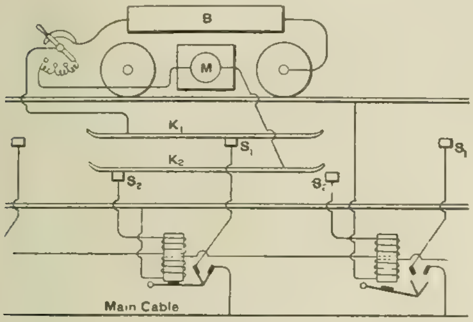


FIG. 7.

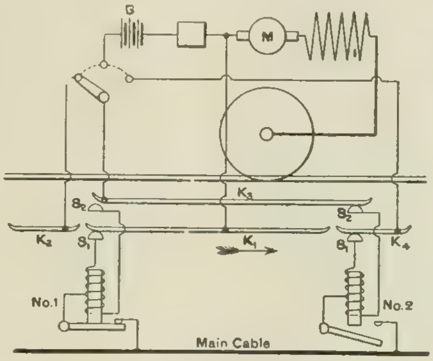


FIG. 8.

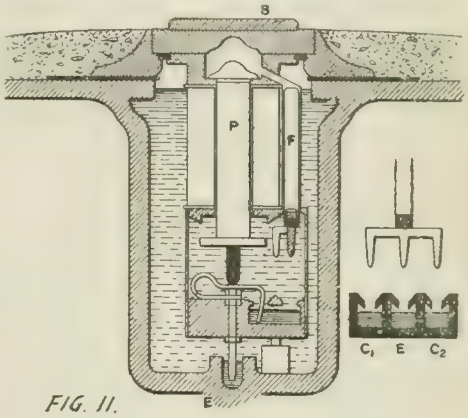


FIG. 11.

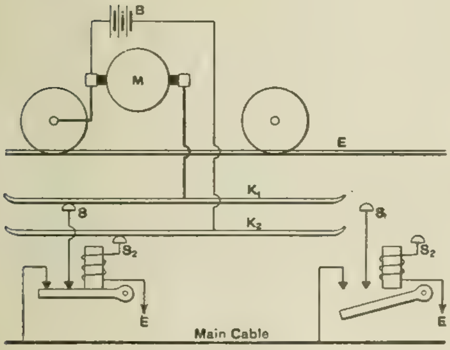


FIG 9

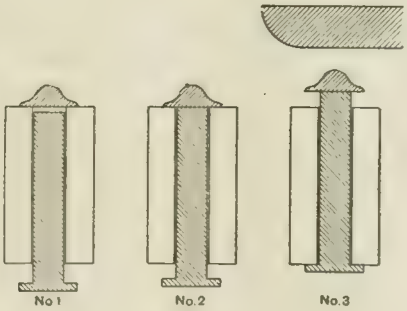
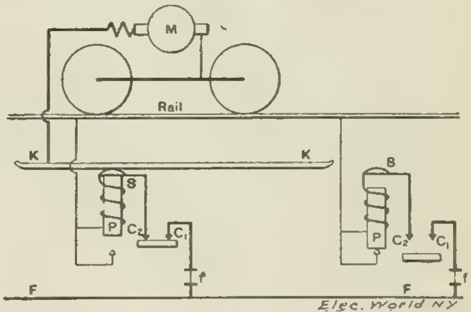

No 1 No.2 No.3

FIG 10



Elec. World NY

FIG. 12.

A large number of methods for series working are due to Mr. F. C. Esmond, of New York. One of his simplest is shown in Fig. 8. Here no interconnection is required between the switch boxes, the current being carried forward by means of several skates. In the diagram, Fig. 8, the current is flowing to the motor from the main by means of K_1 and S_1 of switch No. 1. A moment later K_3 will come in contact with S_1. The current will then pass to K_3 and thence by S_2 of switch No. 2, through the winding of that switch to S_1 and thence to the car. Thus switch No. 2 is closed, and the process made continuous. The method of closing the switches by means of an independent battery may be illustrated in Fig. 9. Two rows of studs, S_1 and S_2, are required, and two skates, K_1 and K_2. The diagram explains itself. The practical details of a system of this kind have been brought to great perfection by the Westinghouse Company of America. A branch line of the Washington tramways has been operated by this company since 1894 on what has been called the Wheless system. Mr. Holroyd Smith has described several modifications of the method. There are two drawbacks, apart from the necessity of two rows of studs. In the first place, the accumulator cells are continually in use, and the running of the car is entirely dependent upon them. In the next place, the low pressure of a few accumulator cells is not so satisfactory for overcoming the resistance of mud or ice upon the studs as the full 500 volts of the supply main. It would take too long to describe the commutator system of Claret-Vuilleumier as laid in Paris, and the line equipped at Monte Carlo by the General Electric Company of America. It is sufficient to note that these systems have proved the practicability of picking up current from studs laid in the road.

When we review all these different methods we see that the direct magnetic pick-up systems, with a magnet on the car, while operating with somewhat feeble forces, have a great element of safety in the fact that the forces cannot operate when the car is not there. The system in which the electromagnet is in the switch itself, on the other hand, can be made to operate with very great forces, but there is a danger (only to be avoided by complicating the system) of those very forces keeping the switch closed when the car is absent.

Now, it is possible to combine the advantages of both methods and to avoid their defects. All that is necessary is to make the magnet of the switch operate by attraction on a piece of iron on the car. When the car is absent the switch cannot be held closed because the magnet has nothing to attract; at the same time it is found possible in practice to obtain very great working forces. Upon this principle the authors have constructed an experimental line near Willesden Junction, the main object being to try the practicability of the system upon curves, crossings and sudden changes of slope.

Out of various designs depending on the closing of a magnetic circuit by the iron of the car, the arrangement which has so far proved most successful in experiment consists of an iron plunger sliding in a vertical tube. If we take an iron plunger with expanded ends, like that numbered 2 in Fig 10, and surround it by a solenoid of wire, carrying a current, it is possible to choose the size of the heads so that the tendency of the plunger to assume a central position is balanced by the attraction of the solenoid on the iron heads. With properly chosen heads the solenoid exerts no force whatever on the plunger. Gravity being the only force upon it, it will, of course, take up the position shown. If now, a piece of iron is placed over it, as shown in No. 3, the plunger may be raised by the attraction between the two. In case a very heavy plunger is used it is possible to support part of its weight by merely increasing the size of the lower head by a small amount. Thus we have a simple piece of mechanism whose movement is entirely dependent upon the presence of a mass of iron in its neighborhood, and which cannot be moved by the solenoid itself, even though the magnetizing current carries the iron up to the saturation limit. This has been converted into the operating part of the switch. Now, though the force of attraction is sufficient to lift a fairly heavy plunger and operate a switch, it is desirable to have something more than this. We want a switch which will, notwithstanding its massive moving parts, close in an exceedingly short space of time. We want a very great acceleration upon the moving parts during the first part of their motion. This is easily obtained by merely separating the [illegible] from the plunger by a [illegible] gap, and arranging matters so that the mass of iron comes over the switch before current [illegible]. As soon as current passes, [illegible] the plunger gets up a [illegible] with the result that [illegible]. A [illegible] can be employed to prevent the switch from being injured by the concussion.

[illegible]

cided upon, though there are some simpler modifications of it still under experiment. The diagram, which is merely an incomplete sketch for a lantern slide, shows, in the first place, the cast-iron box which is laid in the street. This is surmounted by a gun-metal stud, *S*, faced with a phosphor-bronze wearing cap. The stud is insulated from the iron box by a sheet of micanite. A non-porous road material is placed around the stud to make up the level.

The box is filled with oil, which, besides performing the function presently to be considered, maintains very high insulation throughout. The switch is attached to the stud and comes away with it in one piece. Being only about 4 inches in diameter no difficulty is found in making a perfectly water-tight joint. The next point to consider is the method of making electrical contact. The requirements of switchpoints for disconnecting surface studs are the following:

When closed the contacts should be of low resistance and capable of carrying 100 amperes easily. They should be incapable of fusing or sticking in any way, and should require only a small force to open them. They should retain their shape and efficiency unimpaired for a long time without requiring attention. It will be observed that the current through the stud ceases as soon as the skate parts company with the stud as the car moves forward. Hence in the operation of the car as the switch-plunger falls it does not have to break the main current, that having already ceased. Yet although the switches are not required in the ordinary course to break a large current, it is desirable that they should be able in case of accident to do so without injury. After experimenting with different forms of contact it was found that nothing fulfills these requirements so completely as a properly designed mercury contact. Mercury contacts are, therefore, used throughout these switches.

The yoke of copper which dips into the mercury is supported by a brass tube which floats in the oil and fits loosely into a fixed brass tube, which acts as a guide. When the plunger rises it takes the oil from under the float, which accordingly falls, and connection is made. When the plunger falls the float rises. As the plunger moves quickly the oil has not time to leak past the sides, notwithstanding the very loose fit of the parts and the force upon the yoke piece is very great. At the same time a long movement is obtained.

Safety to the public being the prime consideration, we have kept back our invention until we could be absolutely certain that by no circumstance likely in human probability to arise could the switch be left alive. To operate the switch contacts requires a fraction of an ounce. The forces which operate on the moving plunger (which slides freely in a brass tube in oil) are over 80 pounds at the commencement of the stroke, and are several pounds at the end. The sliding plunger itself weighs 3 pounds. We have, therefore, a margin of safety of many hundred per cent. As the car passes on, there is a breaking of the magnetic and also of the electric circuit, making security doubly sure. And there is yet a third line of defense to the public in that our switch is actually earthed, if when the car passes on the switch fails to open, for then the plunger earths the switch. In that event the fuse would be blown, effectually protecting the public from the possibility of a stud being left alive in the roadway.

It will be seen from the diagram that three cups are employed; the two outer being connected to the main and the stud, respectively. The main cup is enclosed in a metal sheath (not shown) permanently connected to earth, so that it is impossible for current to reach the stud except when the yoke is down. Now it will be seen from Fig. 11 that when the plunger is down it earths the centre cup, so that if from any accident whatever the yoke piece fails to open the switch after a car has gone past, the plunger puts the stud to earth and blows the fuse between it and the main. It is not necessary to have any special mode of connecting up the switch boxes.

Either shunt or series coils may be used. In practice we prefer [illegible] coil because the slightly increased expense is more than compensated for by the smallness of the bulk. Our connections are shown diagrammatically in Fig. 12, which sufficiently explains itself. Only one skate is employed, and this is in the centre of the car. This gives much greater facility in going round curves than where two skates and two rows of studs are necessary.

There are a number of practical details for which we have no space here, but which we hope shortly to bring before the Institution of Electrical Engineers. Throughout the work upon the experimental line we have been indebted to Mr. C. E. Holland for many valuable suggestions.

Report of the American Association for the Advancement of Science Committee on Standards of Measurement.*

The determination of the mechanical equivalent of heat by the electrical method, as reported by Griffiths,[1] and by Schuster and Gannon,[2] gave a larger value than Rowland's corrected result. This fact has created a demand for the redetermination of the ampere in terms of the electro-chemical equivalent of silver. At the Toronto meeting of the British Association last year a grant was made to the B. A. Committee on Electrical Measurements for the purpose of carrying out this investigation.

At the Detroit meeting of this association the grant of $50 previously made for the use of this committee was made available for the past year. Though this appropriation was clearly insufficient for the purpose, it was decided that the redetermination of the ampere should be undertaken for the committee of this association in the physical laboratory at Ann Arbor. The work has been ably carried to completion by Professor Patterson and Dr. Guthe.

The discrepancy between Griffiths' results and those of Rowland is about one part in 400 at all temperatures between 15° and 25° on the nitrogen scale. Those of Schuster and Gannon exceed Rowland's at 19.1° on the same scale by about one part in 500.[3] These differences exist after the final elaborate comparison of thermometers and the reductions to the same absolute scale of temperature.

Since the electrical methods employed to determine the mechanical equivalent of heat involve either the current and the e. m. f. of the Clark cell, or the square of this e. m. f., and since the e. m. f. of the Clark cell is determined by means of the silver voltameter, it is evident that the current enters the final result as the square. If the discrepancy is due entirely to an error in the value of the ampere, assuming the ohm to be correct, then the ampere should be one part in 1000 to one part in 800 larger than the present accepted value. That is, the electro-chemical equivalent of silver should be increased from Lord Rayleigh's value of 0.001118 to 0.0011191 or 0.0011194. Lord Rayleigh does not claim for his result an accuracy greater than one part in 1000.

The method used by Patterson and Guthe was that of a specially constructed electrodynamometer of large dimensions, and the employment of the torque of a phosphor-bronze wire to equilibrate the counter-torque due to the effort between the magnetic fields of the stationary and movable coils. This method eliminates entirely the value of gravity, *g*. The torque of the wire was measured by observing the period of vibration of a cylindrical brass weight of known mass and dimensions when suspended by the phosphor-bronze wire. The entire success of this part of the investigation was due to the fact that the observations were made with the whole apparatus enclosed in a fairly good vacuum. Under these conditions the vibrations could be followed for hours at various intervals; the logarithmic decrement was almost entirely constant, and it was easy to obtain a curve connecting temperatures and periods of vibration as a torsional pendulum. The wire was so connected to the support and to the brass cylinder that it could be transferred from the vacuum apparatus to the electrodynamometer and back again without disconnecting it from the terminal pins. From personal inspection at the several stages of the investigation assurance can be given that the work has been most carefully executed at every point, and all known sources of error have been as completely eliminated as possible. The result of the investigation is that the electro-chemical equivalent of a used solution of neutral silver nitrate, fifteen parts by weight of the silver salt to eighty-five parts of distilled water, is 0.0011192 gm. per ampere per sec. This exceeds Lord Rayleigh's value by about one-ninth of one per cent. and causes the discrepancy in the mechanical equivalent of heat to disappear.

The corresponding change in the e. m. f. of the Clark cell will be from 1.4342 to 1.4327 at 15° C. A direct determination has not yet been made and this redetermination is reserved for the coming year.

Dr. Kahle has obtained for the electro-chemical equivalent of silver the value 0.0011182[4] by the use of an electrodynamometer designed by von Helmholtz and a fresh solution of the salt. Pellat and Potier found the same value as that of Patterson and Guthe.[5]

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*Presented by Prof. Henry S. Carhart, secretary of the committee.

[1] "Phil. Trans., A," 1893.

[2] "Proc. Roy. Soc.," November, 1894.

[3] "Johns Hopkins University Circulars," June, 1898.

[4] "Wied. Annal.," Vol. 59, p. 532.

[5] "Journ. de Phys.," 9, p. 381, 1890.

Secrecy in the Telegraph Service.

An interesting incident in connection with the use of the telegraph system by the Secret Service is given in an account of the work of this department in connection with the recent war, by Chief Wilkie, in the New York "Herald," from which the following is reprinted:

When the "emergency men," as the temporary employees of the division were termed, were instructed in the use of the cipher code they were told that in communicating with headquarters they should use, instead of my name, "John Ehlen," which I had registered with the telegraph companies. This was simply a precautionary measure intended to protect the operators by eliminating the chance that some one might discover the message was for the Secret Service, identify the sender as a member of the division, and destroy his usefulness in that particular locality, if nothing worse.

Out of this arrangement grew a curious incident. In the latter part of May a young Western newspaper correspondent, stationed in Washington, sent in his card, asking to see me on important and confidential business. When admitted he explained that a telegraph operator, whom he had known for years in the West, and who had been transferred to the capital, had intercepted a cipher message from Montreal the night before, and believed it was from the Spanish headquarters to an agent here. We were particularly interested in the Spanish messages at that time, having possession of a cipher that was being used in some of their correspondence, and the newspaper man, knowing this, had suggested to his friend the operator that the suspected communication be submitted to our office.

He had tried to translate it, but was unable to succeed, and he wondered if we would have better luck. The copy of the mysterious message, which he then produced and placed before me on the desk, was addressed to my alias, the original, from one of my men, being in a drawer at my side. Under the circumstances I felt moderately certain that we could get at its meaning, but without explaining to the correspondent I told him that if we did succeed in deciphering it, and the contents wer of such a character as to permit of their publication, he should have a "scoop" on it. This satisfied him, and he went away.

A little later I called up the telegraph company and asked that the operator in question should be sent to the office for a moment. In a few minutes he was ushered in—a young, bright-faced fellow, with plenty of color in his cheeks and an air of suppressed excitement.

I only guessed that he felt his discovery had been of value to the Government, and he was to be rewarded in some way. In reply to my question he detailed how he had received the message, and how, when it occurred to him that it might be from one Spanish agent to another, he had surreptitiously obtained a copy of it. The fact that it bore no local address had made it doubly suspicious, as it indicated that it was to be called for.

"Didn't it occur to you to see if the person to whom it was addressed was registered in the office with delivery directions?"

"No, sir."

"Well, if you had consulted your company's books you would have discovered that I am 'John Ehlen,' and that this is a Government message."

The poor fellow's face was a study when he realized that he had held out an official telegram and had turned it over to a newspaper man.

He appreciated the gravity of the offense in violating his oath as an operator, and felt that his position was as good as gone, under circumstances that would make it impossible for him to obtain employment with any company. He said nothing, but his eyes filled with tears.

"Have you a family?"

"No, sir; but I am supporting my old father and mother."

"Your motive was the best in the world," I said, finally, "but your methods are open to criticism. Now, nothing shall be said to the company about this, but if in the future you catch any mysterious messages just bring them straight to me without intrusting them to any outsider. If your newspaper friend had succeeded in translating this message it might have been awkward for all of us."

This was true, for the message in question detailed briefly, but completely, the capture of the Carranza letter. He gave me a grateful pressure of the hand, and the incident was closed.

DIGEST OF CURRENT ELECTRICAL LITERATURE AMERICAN AND FOREIGN

By Carl Hering.

Dynamos, Motors and Transformers.

THEORY OF THE ROTARY TRANSFORMER. Kapp. "Elek. Zeit.," Sept. 29.—The conclusion of his long article (see "Digest" last week). He discusses the four-phase transformer; a rotary transformer supplied with two-phase current is really a four-phase transformer; he shows that a machine in which the pole breadth is two-thirds the pole distance will yield as a transformer 67 per cent. more than if it is used as a continuous-current machine; when the pole breadth is one-half the pole distance, the increase is 69 per cent.; with four-phase transformers the breadth of pole has therefore no particular effect on the output; the magnetic field can, therefore, be designed with reference to the conditions for the continuous current as distinguished from the alternating current. The three-phase transformer is next considered, and it is shown that it will yield 38 to 44 per cent. more, according to whether the polar width is great or small, than it would yield as a continuous-current machine in which the same heat was generated in the armature. The six-phase transformers are then briefly considered; they are shown to be more favorable than the four-phase transformer, as the armature, for phase equality, yields nearly double that of a mechanically driven continuous-current machine; the pole breadth has no effect and phase-shifting only a very slight one. In conclusion he gives a brief summary in the form of the following table; three, four and six-phase transformers were considered only for phase equality, and the numbers in the table for phase difference are only approximate. This table gives the output of the rotary transformer expressed in percentage of that output which the armature would yield as a continuous-current generator, for the same heat generated in the copper of the armature. The pole breadth is given in terms of the distance between the centres of the poles.

Type of Rotary Transformer.	Phase Shifting.	Theoretical Limit (Steinmetz).	Pole $\frac{2}{3}$	Width. $\frac{1}{2}$
Single-phase	cos = 1	85	88	95
	cos = 0.9	..	81	88
	cos = 0.8	..	73	80
	cos = 0.7	..	63	70
Three-phase	cos = 1	134	138	144
	cos = 0.9	..	128	137
	cos = 0.8	..	117	126
Two or four-phase	cos = 1	164	167	170
	cos = 0.9	..	160	167
	cos = 0.8	..	144	153
Six-phase	cos = 1	196	195	199
	cos = 0.9	..	192	196
	cos = 0.8	..	177	188

ROTARY TRANSFORMERS. Marchena. "L'Ind. Elec.," Sept. 10.—The conclusion of his long article (see "Digest" Sept. 24)). As the results of his study he draws the following conclusions: There is no advantage in compounding alternators intended for feeding such converters; neither is there any advantage in providing for close regulation; on the contrary, alternators having considerable self-induction are very well suited and give the least wattless currents; this refers to alternators which are used exclusively for supplying the converters. When the alternators are compounded to give a constant potential, or when the converter is attached to a constant potential circuit, it is necessary to insert in the circuit a reaction coil. There is no advantage in adjusting the excitation of the converter so as to have the power factor equal to unity at full charge; it is preferable to annul the wattless current for a load of 70 to 80 per cent.; this is illustrated with an example. He concludes that in every different installation it is necessary to study the particular conditions under which the converters are to be run, in order to determine the different data in a rational manner.

ELECTRIC GENERATORS. Parshall and Hobart. Lond. "Engineering," Sept. 16.—In this continuation of their long serial they begin the discussion of constant potential continuous-current dynamos. They show that the magnetic circuit, the thermal limit, the efficiency and regulation, although important, are all secondary to the question of commutation; the latter subject is then discussed at length; the important requirement for sparkless commutation is shown to be that the current in the coil short-circuited by the brushes, should be equal to half the main current—that is, to the current which will go through it after leaving the brush. The more general use of carbon brushes is pointed out. The proper design of the parts of dynamos has enabled manufacturers to dispense with the use of special and complicated windings for nullifying sparking, and it is therefore not necessary to resort to these, as the careful application of the ordinary method has brought the dynamo to such a stage of development that the thermal limit [illegible] [illegible] then begun.

CALCULATION OF DYNAMOS. Sumec. "Zeit. fuer Elek.," Sept. 25.—The first part of an article in which he describes a general method of calculating electrical machines, including continuous and alternating-current dynamos and motors; it is intended chiefly to give a general insight to the subject; the mathematics involved appear to be relatively simple; he claims that the method is free from the numerous coefficients and complicated formulas; it appears to differ considerably from the usual methods.

CALCULATING THE AIR SPACE RELUCTANCE FOR TOOTHED ARMATURES.—Lond. "Elec. Eng.," Sept. 30.—Answers to a request to show how this is calculated, and how the length of the path through such an armature is determined.

EXPLORING THE POTENTIAL AROUND COMMUTATORS. Shepardson. "Amer. Elec.," Oct.—Brief descriptions of the usual methods, with a reference to a simple method used in the laboratory of the Univ. of Minn. with satisfaction. There is a strip of hard fibre formed so as to encircle half the commutator; a row of radial holes is drilled through it, the spaces being equal to the divisions of the commutator; the piece of fibre is held in position by cords; the third brush consists of a wire, which is passed through each of these holes in succession, the voltage being measured between that and one of the other brushes, or between two brushes placed in successive holes.

MULTIPHASE ARMATURE WINDINGS. Stone. "Amer. Elec.," Oct.—The continuation of his well-illustrated article describing these windings.

Lights and Lighting.

ARC LAMP. Duflos system. "L'Elec.," Oct. 1, and "L'Ind. Elec.," Sept. 10; abstracted in Lond. "Elec. Rev.," Sept. 30.—An illustrated description of this lamp, which has neither a brake nor a similar mechanism; the regulation is produced by a shunt electromagnet, by means of which as great sensitiveness is said to be produced as that in differential lamps.

ARC LAMP. Souga system. "Elek. Zeit.," Sept. 29.—An illustrated description of this inclosed lamp, which is made for continuous or alternating currents from 2.5 to 9 amperes.

TRAIN LIGHTING.—"El'ty," Oct. 12.—A very short description of the system used on the postal cars of the Atchison, Topeka & Santa Fé Railroad. A dynamo is belted to the car axle, the current being stored in a battery. This system has been used since last March, and seems to have been perfectly satisfactory. The speed of the armature is kept as nearly constant as possible by an arrangement of pulleys not described. A note in "Eng. News," Oct. 13, states that electric lighting from the car axle has been adopted on the limited trains of that railroad, running a distance of 2209 miles; the aggregate candle power will be about 4928, which includes a locomotive headlight and a lamp in each berth.

TRAIN LIGHTING.—"Prog. Age," Oct. 1.—A reprint of an article from the "Railroad Gazette," Sept. 16, describing a system used in England. A dynamo and accumulators are carried in the guard's compartment, the dynamo being driven by a belt from the car axle; it is so mounted that when the speed of the axle exceeds a certain amount the belt is made to slip, so that the speed of the dynamo is practically constant. There are about 1000 cars in use which are provided with this system, known as the Stone system and invented by Gill.

INCANDESCENT LAMP MANUFACTURE.—"Elec. Eng.," Oct. 13.—A description of the process of the Shelby Company.

Power.

LIGHT AND POWER ON THE MIDLAND RAILWAY. Langdon. Lond. "Elec.," Sept. 30.—A reprint of a paper read before the Institution of Mech. Eng. on "The electric current for lighting and power on the Midland Railway, and driving machinery direct by electric motor, without shafting." This railway has established a number of installations, aggregating about 3500 horsepower; a list of these installations is given in a table, which also gives the cost of working of each for a half year; both the series and the parallel systems of arc lights are used. Recently high-tension direct-current machines have been added, the power from which is transformed down to a lower potential at distant stations; the transmission voltage is 2200 and the final 210. A more complete description of the Derby station is given; this contains compensators or regulators automatically controlling the voltage; these consist of two series dynamos coupled together and driven with a shunt motor, the current from the outside mains of the three wire system being sent through them in the usual way; they have an additional coil, which is connected in series with the middle or neutral wire, but it is wound in the opposite direction on each of the series machines; any drop in the third wire due to the current in it is thus compensated automatically by the volts being raised on one compensator and dropped in equal amount on the other. The latter half of the paper is on the application of power, which is becoming daily more recognized. Two tables, which are well filled, give the data for the power absorbed by tools and shafting, which was carefully measured; one of these contains much data for each of a number of machine tools driven by countershafts, both light and loaded, including also the amount of metal cut away. The second table gives a comparison between driving a lathe through countershafting and directly. A 9.5-inch screw cutting lathe driven by countershafting and cutting down a bar of gun metal, required 495 watts per ounce of metal removed per minute; by gearing to it directly an electric motor, the consumption was reduced to 214 watts; this was when it was making one cut; when making three cuts simultaneously the power averaged 275 watts per ounce per minute, or when direct-driven 143 watts; multiplying the watts by the time occupied to do the same work in each case, the relative values are for one cut 3 to 1, and for 3 cuts 2 to 1. The waste of power in shafting and belting would not be so great in relation to the work done, for larger tools; with large machines, absorbing 1 horsepower, there can be no question of the advantage derived by direct driving from electricity. The data are given in very complete form, and seem to be a valuable addition to the information on this subject.

TRANSMISSION OF POWER. Janet. "L'Eclairage Elec.," Sept. 24; translated in abstract at some length in the Lond. "Elec. Rev.," Sept. 30.—Abstracts of the article noticed in the "Digest" Oct. 8. He recommends that every workshop, warehouse and workman's lodging or home should be provided with power from some central point.

ELECTRIC STEERING GEAR. Fischer-Hinnen. "L'Eclairage Elec.," Sept. 24.—An illustrated description of the Giles and the Pfatischer systems, which he considers the two best systems now in use for vessels.

GRANADA. Ritter. "L'Ind. Elec.," Sept. 25.—An illustrated description of this plant in Spain, in which a water power having a fall of 330 feet is used. The simple alternating current of 4200 volts is used.

VARYING THE SPEED OF MOTOR-DRIVEN FEED PUMPS.—Lond. "Elec. Eng.," Sept. 30.—Brief descriptions of several methods.

BLAST-FURNACE GAS AS MOTIVE POWER. Savage. "Cassiers' Mag.," Oct.—A short article on the use of such gases for driving gas engines. Experiments seem to show that as much as 20 indicated horse-power may be obtained per ton of coke fed to blast furnaces; these gases are now going to waste at most places; he suggests that electric transmission would provide a convenient means for distributing this power.

ELECTRICALLY DRIVEN SHIPYARD TOOLS. Kodolitsch. "Cassiers' Mag.," Oct.—A well-illustrated article on the numerous electrical appliances used by his company at Trieste, Austria. He emphasizes the convenience and economy of electric power in such cases.

WATER-POWER PLANT.—"Amer. Elec.," Oct.—An illustrated description of the plant of the Fries Company in North Carolina, for transmitting power to Winston-Salem. One thousand horse-power is to be transmitted in the form of three-phase current at 10,000 volts, the line being 70,000 feet long.

ELECTRICAL REFRIGERATION. Fay. "Elec. Eng.," Oct. 13.—A continuation of his article (see "Digest" last week). He describes a number of machines which he constructed and criticises them.

Traction.

ELECTRIC TRACTION. Carus-Wilson. Lond. "Elec. Eng.," Sept. 30.—The beginning of a reprint of his Cantor lectures; these will be confined to the subject of the direct-current motor as applied to traction. He begins by considering the motor in a state of rest, the whole of the first lecture being devoted to this; he introduces the quantity which he calls the "induction factor," which takes an important part in his method of treating the subject. The method described appears to be similar, if not identical, with the one shown in a former paper abstracted in the "Digest" June 18, 25 and July 2.

SURFACE CONTACT SYSTEMS.—"Zeit. fuer Elek.," Sept. 18.—Illustrated descriptions of the Esmond, the Wynne and the Union Electric Company systems, taken from patent specifications. It is remarked that the Claret-Vuilleumier system "was" in use in France for a year and a half (from which it would appear that it is now abandoned); in Prague the Krizik system is in use; on an electric line in Monaco the contact knob system is in use.

ELECTROLYSIS OF WATER PIPES AT DAYTON.—"Eng. News," Oct. 6.—Long extracts from a report of what appears to be a very thorough investigation of the damage done by electrolysis to the water mains of that city. After pointing out the well-known principles of such electrolysis and referring to tests made by measuring the voltage betwen the rails and the fire plugs, a description is given of the condition in which pipes were found after being exposed. Among other well-known effects, it was found that tar seems to be no protection whatever, as the pipes were found to be covered with a black material resembling graphite, which was an excellent conductor; stone and pebbles near the pipes in some cases seem to have been electro-plated with the metal of the pipe, which one of the experts, Brown, believes has never been observed before; the tensile and transverse strength of the pipes was measured, and a reduction of from 30 to 50 per cent. was found. In a saturated solution of sal ammoniac 100 amperes will remove 3 pounds of iron in twenty-four hours, or with the proper solution 20 pounds of lead. According to Brown, the measurements do not bear out the claim that cast-welded joints will entirely obviate the effects of electrolysis. Some measurements showed that the pipes at certain points were carrying 95 per cent. of the current, the other 5 per cent. being divided between the two rails. The report concludes with an estimate of the damage done; it appears that the total length of pipe affected amounted to 46,000 feet. It is estimated that there would be no injurious electrolysis 20 feet either side of the car tracks. Rowe, of the Water Works, calls attention to the additional risk in case of fire, while the damaged pipes are being replaced by new ones; also to the cost of repaving the streets and the large portion which would be borne by the property owners; the cost of replacing the pipes is estimated at $77,000. With a difference of potential of 4.5 volts it is shown that a 6-inch pipe can become useless in five years (but this would evidently depend on the current, and not on the voltage alone.) He claims that the city should be reimbursed for the damage sustained, and questions the feasibility of replacing the pipes, as they will again be subjected to destruction.

STORAGE BATTERY FOR ELEVATED RAILROAD. Cravath. "Elec. Eng.," Oct. 13.—An article on the performance of the battery which is used on the South Side Elevated Railroad of Chicago. The load in this plant is said to be without doubt the most fluctuating of that in any other large station; the batteries are placed near the ends of the line and are connected directly to the line without any auxiliary regulating apparatus. Two diagrams give the curves of fluctuation with and without the battery, and show the effect of the battery in greatly reducing the fluctuations. With the battery in use the maximum was 5700 amperes as against 7500 without the batteries, while the minimum was 3000 as against 1700; before the batteries were in use the load was almost more than the four generators could carry, while now it is hardly a full load for three of them; the average current at the power house per car during heavy loads is less with the battery than without. The kilowatt hours per car mile required on this road are 2.08.

ELECTRIC STREET TRACTION IN ENGLAND. Knox. "Eng. Mag.," Oct.—A long article on the legal aspects of electric street traction in England. After referring to the social side of electric traction, he calls attention to the fact that London, although the richest city in the world, has the most meagre system of traction in the world, operated by the most antiquated method, and he then shows that this is due to the English law concerning tramway undertakings.

LIGHT RAILWAYS IN GREAT BRITAIN. Spagnoletti. "Cassiers' Mag.," Oct.—A brief article on light railways in general, without special reference to electric railways.

BRUSSELS.—"West. Elec.," Oct. 8.—A translation in abstract, with illustrations, of the article noticed in the "Digest" May 28, descriptive of the railway lines.

TRACK CONSTRUCTION. Gibbon. "Elec. Eng.," Oct. 13.—An article on its defects and the remedy, in which he describes his lap joint rail.

Installations, Systems and Appliances.

INSTALLATIONS IN SWITZERLAND.—"L'Eclairage Elec.," Sept. 24.—Statistics for the year 1897 compiled from official reports. There were thirty-five installations, comprising a total of 4989 kw; a double-page table contains data concerning the principal plants for the electric transmission of energy in Switzerland.

THEATRE PLANT.—Lond. "Elec Rev.," Sept. 30.—A brief, illustrated description of the private plant at the Palace Theatre of Varieties. Structurally and decoratively this is thought to be the finest theatre in London.

PLANT IN THE CHAMBER OF DEPUTIES. Laffargue. "L'Ind. Elec.," Sept. 10.—An illustrated description of this plant in Paris. There are four gas engines of 50 horse-power and two of 30; the two-wire system at 110 volts with a battery of accumulators is used.

HOFOR'S IRON WORKS.—Lond. "Elec. Eng.," Sept. 20; reprinted, without the illustrations, in "El'ty" (N. Y.), Oct. 12.—A brief description of this plant in Sweden, which is for both lighting and the transmission of power.

CHARGING FOR ELECTRIC ENERGY. Meynier. Lond. "Elec.," Sept. 30.—An abstract of the article noticed in the "Digest" last week.

COMMERCIAL ASPECTS OF ELECTRIC SUPPLY.—Gibbings. Lond. "Elec.," Sept. 30.—In this continuation of his long serial he gives some data regarding cranes and hoists; also a list of the number of motors used for electrically driven printing machines.

NEW YORK STATE CAPITOL.—"Elec. Eng.," Oct. 13.—Some illustrations of the building, accompanied by a very brief statement of the number of lights, their distribution and the difficulties encountered in the wiring.

MUNICIPAL OWNERSHIP. Hopkins. "Elec. Eng.," Oct. 13.—The first part of an article on some views and data on municipal ownership.

Wires, Wiring and Conduits.

INTERIOR WIRING. Gardner. "West. Elec.," Oct. 8.—An article describing how to calculate the wire for simple cases; it is intended for those who have no technical training and for beginners. It contains also a table from which the gauge numbers of the wires are found directly for various numbers of lamps at various distances.

INTERIOR WIRING. Knox. "Amer. Elec.," Oct.—An article on the feeders and mains in a building.

Electro-Physics and Magnetism.

ELECTROSTATIC CAPACITY OF WIRES. Moon. Lond. "Elec. Rev.," Sept. 30.—An article containing formulas for the capacity of wires under various conditions. These formulas are too numerous to be given here, but some of the deductions may be of interest. One of the formulas gives the capacity in microfarads of a mile of wire of any given diameter, suspended at any given distance from earth; another gives the capacity between two wires of the same diameter entirely isolated from other wires, and the earth; another gives the capacity of a cable. The capacity between a wire and a number of other wires and the earth cannot be as great as twice the capacity between that and the nearest wire, if the two wires are of the same diameter and are entirely isolated. Two wires would have to be nearly equal in capacity before their capacity as isolated wires is equal to that between either wire and the earth; therefore the capacity between one wire and any system of wires and the earth could in no case be as great as twice the capacity between one wire and the earth. There are certain well-defined limits between which the capacity between one wire and a number of others and the earth must lie, and it is not difficult to assign probable average values for the capacities of any such wires; this he discusses. He shows that the capacity between two wires is small, being in fact in practice between one-thirtieth and one-sixtieth of the capacity of one wire with the remainder and the earth. He discusses the charge the wires take. He shows that the effective capacity of one wire of a perfect looped circuit may be taken as the sum of the capacity of either wire with the remainder and earth, and the capacity between the two wires of the loop. In calculations relating to perfect telephone looped circuits one wire only of the loop should be taken, and it should be assumed that this wire is actuated by half the voltage of the circuit. A table gives the capacities of four different sized wires under various conditions.

LUMINOUS VARIATIONS CONVERTED INTO RELIEFS. Dussaud. "L'Eclairage Elec.," Sept. 24; "L'Ind. Elec.," Sept. 25.—Translated in abstract in the Lond. "Elec.," Sept. 30.—A French Academy paper in which he describes a method in which he endeavored to obtain a moving relief whose projection should be proportional to the variations of intensity produced in a beam of light. The light falls on a set of selenium plates, which in turn vary a current in the primary of an induction coil, whose secondary current is transmitted over a line to a telephone whose membrane acts, by means of a multiplying system, upon a system of rods, raising them more or less against a diaphragm on which a moving relief is felt by the fingers. It is thought in the English abstract that this may be a germ of something of great importance to the blind.

PRESSURE IN THE INTERIOR OF VACUUM TUBES. Seguy. "L'Eclairage Elec.," Sept. 17, and "L'Ind. Elec.," Sept. 25.—A reprint of an Academy note, in which he enunciates the following law: The internal pressure in an exhausted vessel is neither uniform nor constant in all the parts of the vessel when it is traversed by an electric current. To prove this he experimented with a tube 4 metres long and exhausted to a millionth of an atmosphere; when a current was passed he found that for about half the length of the tube from the cathode end the vacuum was about the same, but near the anode the pressure had been raised to about a thousandth of an atmosphere.

EARTH CURRENTS AND MAGNETIC PERTURBATIONS. Lemstroem. Lond. "Elec. Eng.," Sept. 30.—An abstract of his paper read before the Conference on Terrestrial Magnetism. He discusses the relation between the variations in the earth currents, the electric currents from the atmosphere, and the magnetic perturbations. After an historical sketch of the observations made on earth currents, he describes his method of measuring the e. m. f. of the currents from the atmosphere and shows that the variations of earth currents [illegible] about five minutes before the magnetic perturbations, and that the former are more numerous than the latter; all of the latter, however, are not preceded by [illegible] in the earth currents, and these are probably caused by atmospheric currents. The causes of magnetic variations should, in [illegible] the [illegible]

SPECULATIONS CONCERNING ROENTGEN RAYS. [illegible] d it."

[illegible]

MIXED SULPHIDE ORES.—"Eng. & Min. Jour.," Oct. 8.—A brief description of the Cowper-Coles electrolytic process, which has already been referred to.

DRY CELL.—"Amer. Elec.," Oct.—An article describing how to make a dry cell.

ceptions and methods of calculating magnetism. He claims that there are many reasons why the ampere-turn method of determining the magnetism of an electromagnet is entirely unreliable. A magnetic unit, he thinks, should be equal to the product of the amperes into the turns per square inch section of pure iron.

Electro-Chemistry and Batteries.

ELECTRICAL BLEACHING.—"L'Elec.," Sept. 24.—A reprint of an article from a paper journal. Attention is called to the success of the electro-chemical bleaching processes; the principal difficulties are in connection with the accessory reactions. The Kellner electrode is well spoken of; it consists of numerous platinum points projecting from a plate of ebonite, like the bristles of a brush; with this one can obtain solutions containing more than a hundredth of active chlorine, which is a degree of concentration probably more than sufficient for most practical purposes. The advantages, apart from the economy, are pointed out; for showing the economy, the costs are worked out for an installation using 900 kg of chloride of lime per day. Assuming twenty-four hours a day, then 100 horse-power would be required; the first cost of such an installation would be about $10,000; the daily costs, assuming water power, would be about $20, or assuming steam power, about $35; the estimates are made for the conditions in Austria; the cost of the 900 kg of chloride of calcium is at least $45, showing very good economy when water power is used, while even with steam power considerable economy is obtained.

ELECTRO-DEPOSITION OF CHROMIUM. Cowper-Coles. Lond. "Elec. Rev.," Sept. 30.—A summary of various processes, preceded by a description of the properties of this metal. A table gives the relative hardness of various deposits in the form of the number of grams weight on a diamond point required to produce a scratch; in this, chromium deposit on copper is 7.0, while nickel plate is 10.0.

ELECTRICAL DEPOSITION OF GOLD. Andreoli. "L'Elec.," Oct. 1.—The first part of an article on this method of obtaining gold from its ores as used at the Transvaal; this is the only place where the electrolytic process is used in practice. The method used is that of Siemens & Halske, in which the gold is deposited on the lead; Andreoli suggests using iron for the cathodes, but in no case should aluminum be used.

METALLIC SULPHIDE ELECTRODES. Bernfeld. "Zeit. Phys. Chem.," 25, p. 46; abstracted at some length in the "Zeit. f. Elektrochemie," Sept. 29.—Descriptions of researches in which he endeavored to use the sulphides of metals as anodes without first subjecting them to the roasting process; this would be very desirable in practice. His experiments were made chiefly with sulphide of lead. The article is somewhat theoretical in character, and no practical conclusions seem to be drawn in the abstract.

ANALYSIS OF COPPER SLIMES. Hollard. "L'Elec.," Sept. 24.—An abstract of an article on the analysis of slimes in the electrolytic refining of copper.

DETERMINING THE STATE OF IONIZATION. Macgregor. Lond. "Elec. Eng.," Sept. 30.—An abstract of his Brit. Assn. paper on the determination of the state of ionization in dilute aqueous solutions containing two electrolytes.

CHEMICAL ACTION OF THE ELECTRIC SPARK. Berthelot. Lond. "Elec. Rev.," Sept. 30.—A brief abstract of his recent Academy paper.

ELECTRO-CHEMICAL PROCESSES AND APPARATUS.—The "Zeit. f. Elektrochemie," publishes weekly illustrated abstracts of patent specifications, including chiefly German, English, American and French patents. They are quite numerous, and will not be noticed separately in the "Digest."

CHEMICAL CONGRESS. Lond. "Engineering," Sept. 23.—Abstracts of the papers of an electrical nature, which have already been noticed in the "Digest."

Units, Measurements and Instruments.

MEASURING HIGH VOLTAGES. Peukert. "Elek. Zeit.," Sept. 29.—After discussing briefly the various methods and pointing out the objections to the method of measuring the potential at the terminals of a fractional part of a very high resistance connected to the source, he describes another method in which these objections are claimed to have been overcome. This is also a method in which the voltage is measured on a fractional part of a circuit, but instead of using resistances he uses a series of condensers; if these are all of equal capacity, and there are n condensers, then the voltage measured at the terminals of one of them will be simply one nth of the total; the voltage is measured by means of an electrometer. He describes an apparatus consisting of ten small mica condensers, each of a capacity of [illegible]. The transformer system, in which the high voltage is transformed down to a low one for measurement, is a very handy one, but has the objection that the transformer ratio is in general not constant, which he shows by an example.

CORRECTION FACTOR OF WATTMETERS. Loppe. "L'Eclairage Elec.," Sept. [illegible].—A long, mathematical discussion of the factor which is the coefficient by which the indicated power must be multiplied in order to give the real power. He shows how to calculate it for different conditions, including curves of other than the sine form.

QUADRANT ELECTROMETER. Elster and Geitel. "L'Eclairage Elec.," Sept. 24.—An abstract of their article describing modifications, from the "Wied. Ann.," April, which has already been noticed.

MODIFIED PRONY BRAKE. Wettler. "Elek. Zeit.," Sept. 29.—A well-illustrated description of an improved arrangement of the prony brake, the main object being to facilitate the adjustments and the taking of the readings. The brake has the usual arm to one side, at the end of which is hung a weight; another arm runs out in the opposite direction, and the end of it is attached to the lower end of a spring balance or scale; such an apparatus will come to a state of equilibrium without the troublesome adjustment of the weights; the scale measures that weight which is in excess of the weight at the other end of the arm. As the length of the lever arm of the weight changes with the deflection of the beam, a calculation is necessary, involving this deflection. The construction of the spring balance is described and illustrated in detail.

MEASURING COEFFICIENTS OF SELF-INDUCTION. Morland. "Elec. Eng.," Oct. 13.—A brief abstract of his A. A. A. S. paper, describing an apparatus. It consists of two rectangular coils, which are alike except that one is short enough to be placed inside of the other at right angles to it; in the space inside of them there is suspended a hollow conducting cylinder, which is as large as possible; it is provided with a mirror to measure its deflection. If a divided alternating current is sent through the two coils a rotary magnetic field will generally be produced, but the resistances in series with the coils may be so adjusted that no rotation is produced; in that case the self-inductions will be proportional to these resistances; one of the self-inductions being known, the other is thus determined.

SIMPLE MEASURING INSTRUMENTS. Child. "Amer. Elec.," Oct.—An illustrated article describing several forms of simple volt, ampere and watt meters, which can easily be constructed by an amateur at small cost.

Telegraphy, Telephony and Signals.

ELECTRIC BALLOON SIGNALLING. Bruce. Lond. "Elec. Rev.," Sept. 30.—A reprint of his short Brit. Assn. paper, describing the balloon invented by him. The signaller and most of the apparatus remains on the ground or the deck of the ship; the balloon contains several incandescent lights, which are flashed to produce Morse signals. For the material he prefers gold-beaters' skin; the smallest size balloon which would lift the lamps and cable is 7 feet in diameter and has a capacity of 150 cubic feet (presumably filled with hydrogen and not illuminating gas). Through a telescope the flashes would be visible 80 or even 100 miles.

RAIL CONTACTS.—Lond. "Elec. Eng.," Sept. 30.—An illustration of one tried on an English railroad for completing signalling circuits. A wire brush is secured near the rail, pointing horizontally just across the top; it is separated from the rail by a space just equal to that occupied by the flange of the wheels, so that while a wheel is passing it connects the brush and the rail.

TELEPHONE STATISTICS FOR 1896.—"L'Elec.," Oct. 1.—A short table from the statistics of the International Bureau at Berne. Neither Great Britain nor the United States is included. In the number of subscriptions Germany heads the list with 150,481, followed by Sweden with 48,296; France, 38,854; Switzerland, Austria, Russia, etc. The number of communications per subscriber is also given, and in this Japan heads the list with 3750, followed by Austria, Germany, Russia and France.

AMERICAN TELEPHONE PRACTICE. Miller. "Amer. Elec.," Oct.—A short, illustrated article on protective devices.

Miscellaneous.

ACTION OF ELECTRICITY ON PLANTS. Cook. Lond. "Elec. Rev.," Sept. 30.—A long abstract of his Brit. Assn. paper. His experiments date back as far as 1886, and have been repeated many times; he discusses them under the head of germination, growing in the soil, and those on lower forms of plant life. Regarding the germination of seeds the general effect of a steady current was to produce an increased development, which amounted to 10 or 20 per cent.; there seems to be no difference between constant and intermittent currents; with currents from an influence machine a larger proportion of the seeds germinated, but the electrified seeds showed no increase of growth. When the current was applied to growing plants the plants matured earlier and were the first to show above the soil, but after that there appeared to be no increased rate of growth; they sprouted about four days earlier; there is, therefore, no advantage in continuing the application after the first appearance of the leaves; this applied to electricity of low tension; with high-tension currents a greatly increased rate of growth is obtained, the positive pole always producing the greater effect at first, but the negative pole rapidly caught up and took the lead; in the case of hyacinths the color produced under the negative pole was distinctly different from that at the positive or of the non-electrified plants. In comparing the effects of different kinds of currents he found that in every case the positive end of the coil produced the greatest effect with an e. m. f. of about 45,000 volts. From experiments with low forms of plant life no definite conclusions could be reached. He refers to the application of the "geomagnetifere," with which remarkable results were obtained in France; this instrument is practically a lightning conductor set up in the middle of the field and connected below with a series of cross wires running under the soil near the roots of the plants; a number of the remarkable results obtained are described; with potatoes the money value of the gain was $44 per acre. The theories to account for the action of electric currents on plants are briefly discussed, but it is thought that satisfactory explanations cannot be given until more experiments have been made.

GUTTA PERCHA. Obach. Lond. "Elec. Eng.," Sept. 30.—The conclusion of the reprint of his three Cantor lectures, which have been running through many issues of that journal.

CHANGING PEAT INTO COAL ELECTRICALLY.—"Elek. Zeit.," Sept. 29.—A brief description of a process which is said to be used in Sweden. It is followed by a calculation showing that the method is not practical, as the electrical energy required would have to be produced cheaper than it is now produced anywhere.

ELECTRIC MACHINERY AND FIRE-DAMP. Heise and Thiem. "L'Elec.," Sept. 17.—A translation in abstract of a long article noticed in the "Digest" Jan. 29, Feb. 5 and 12.

TURIN EXHIBITION.—Lond. "Elec.," Sept. 30.—The first part of a report on the electrical exhibits. It is stated that there is nothing epoch-making, but there are many improvements worth noticing. With the exception of a large exhibit from Germany, the exhibition is not really international; most of the dynamos and motors are Italian, and are of the alternating-current type, especially on the three-phase system.

ELECTROTHERAPEUTIC INSTITUTE. Collineau. "L'Elec.," Sept. 17.—A reprint of a short article describing the arrangements at the new Municipal Institute of Electrotherapy at Salpetrière.

SUPPLY OF PLATINUM.—"West. Elec.," Oct. 8.—A short article translated from a Russian journal. It appears that the platinum trade is controlled by a few British and German dealers, who buy the output up at about $100 per pound and sell it at about $250; thus both the producer and the consumer suffer. The miners are endeavoring to improve their situation.

ELECTRICITY IN MODERN SURGERY. Dickson. "El'ty," Oct. 12.—An abstract of his presidential address to the American Electro-Therapeutic Association.

DEATH BY ELECTRICITY. Hedley. "Sc. Am. Sup.," Oct. 8.—A reprint of the article noticed in the "Digest" Mar. 12 (see also Apr. 23).

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCES. Martin. "Pop. Sc. Mo.," Oct.—A long article on this Association, reviewing the historical features, the influence that it has exerted on the country, and offering some suggestions as to how this influence may be and should be increased in the years to come.

B. A. PRESIDENTIAL ADDRESS. Crookes. "Sc. Am. Sup.," Oct. 8.—The beginning of a reprint in full of his address, parts of which have already been noticed in the "Digest" and The Electrical World.

Book Reviews.

A LABORATORY MANUAL OF ELECTRO-THERAPEUTICS. By William James Herdman and Frank W. Nagler. Published by George Wahr, Ann Arbor, Mich. 163 pages, 53 illustrations. Price, $1.50.

This work is the result of various trials and experiences in electro-therapeutical work in the laboratory, and while the authors do not claim for it either perfection in the arrangement of matter or completeness in detail, they feel that the time has come for putting their plan of instruction in a form that will permit for it a wider usefulness, as well as gain for it the intelligent criticism of the experienced workers in the field which it seeks to cultivate.

Suitable batteries and other sources of electric current are thoroughly discussed in every aspect, and the various types of apparatus employed in therapeutic work are well described and illustrated. High frequency currents is a subject that receives the attention it properly deserves, and X-ray work is thoroughly gone into. A chapter is devoted to thermo-electric generators. The book no doubt will find an immediate demand in this important and rapidly extending field of application.

WIRELESS TELEGRAPHY POPULARLY EXPLAINED. By Richard Kerr, with preface by W. H. Preece. Imported by Charles Scribner's Sons, New York; 111 pages, illustrated. Price, 75 cents.

This little work is strictly up to date in that it describes the experiments recently undertaken by Signor Marconi and others, and is the first piece of literature comprehensively covering these recent developments. The induction experiments by Mr. Preece are also thoroughly described in a popular manner, and an attempt is made to locate where it belongs the much disputed credit for various developments in this new line. In this regard Mr. Preece states in the preface: "As regards Signor Marconi's position as a discoverer, it should be understood that he was the first to conceive and to patent the application of Hertzian waves to telegraphy apart from mere signaling. Branley made the first coherer, but Marconi was unquestionably the first to make the coherer into a telegraph relay."

SUBMARINE TELEGRAPHS, THEIR HISTORY, CONSTRUCTION AND WORKING. By Charles Bright. [illegible] [illegible] [illegible] & Son; 744 pages, illustrated. Price, $25.

This elaborate work [illegible] [illegible] [illegible] [illegible] [illegible] founded on an English [illegible] of M. Wunschendorff's [illegible] [illegible] "Traité de Télégraphie Sous-Marine," with further and original data and information bringing it strictly [illegible] [illegible]. About [illegible] [illegible] [illegible] [illegible] to the history of this [illegible] [illegible] [illegible] [illegible] [illegible] comprehensively presented [illegible] although the capital invested is greater than in any other one branch of electrical work. The construction is described with great thoroughness and detail, and the working of cable telegraphy is discussed technically with all the modifications and details that have either been in use or show indications of future value. Among the latter are quadruplex working, Silvanus Thompson's proposed cable with inductive leak and others.

HANDBOOK OF CORLISS STEAM ENGINES. By F. W. Shillito, Jr. Bridgeport, Conn. American Industrial Publishing Company. 197 pages, illustrated. Price, cloth, $1.

This little work is not a comprehensive or technical discussion of the Corliss steam engine, but is intended for those who wish to learn how to erect, adjust and take care of Corliss engines. The first chapter is on the preparation of foundations, and others describe how to determine the reference lines, templates, how to place the main parts in position, lining and leveling and the assembling of the moving parts. Adjustment of Corliss valves and the parts of the valve gear and governor, and the taking and using of indicator cards are also described, and the work closes with nine chapters devoted to descriptions, accompanied by illustrations, of nine American makes of Corliss engines. The work should prove particularly valuable to engineers without experience in Corliss engine work, especially to young or newly graduated technical engineers who may understand thoroughly the thermo-dynamics of the Carnot cycle, but who would be utterly at sea if called upon to look after the erection of an engine.

POOR'S MANUAL OF RAILROADS; H. V. and H. W. Poor, New York, publishers. Price, $7.50.

The 1898 edition of this standard work has been issued. It contains the usual statistical summaries of the financial affairs and operations of American railroad systems. The new edition contains 1600 pages, 130 more than that of 1897. It covers the statements of about 4300 corporations, having an approximate capitalization and debt of $16,500,000,000. The department of city and suburban railways, comprising electric, cable and horse railroads, is covered by 1187 corporate statements, and contains every item of information respecting those important enterprises. Corrections are made up to August 15, 1898.

THE CURE OF WRITERS' CRAMP AND THE ARM TROUBLES OF TELEGRAPHERS AND BALL PLAYERS. By S. H. Monell, M. D. Published by J. B. Taltavall, New York; 56 pages. Price, 50 cents.

This short treatise deals with electro-therapeutics as especially applied in the [illegible]

"THE ARITHMACHINIST." A practical self-instructor in mechanical arithmetic. By Henry Goldman. 150 pages; illustrated. The Office Men's Record Company, Chicago. Price, paper, $1; cloth, $1.25; leather, $1.50.

In large industrial enterprises, banks, etc., where accounts are diversified and complicated, the work of computing is necessarily onerous and exacting. This applies with particular force to electric lighting and electric power companies, many of which are practicing the most scientific methods of accounting. In work of this nature a rapid and reliable mechanical calculator would be a boon. Such a machine the "Arithmachine" is recommended to be. Full instructions for the operation of this interesting apparatus are given in this little book. The science of mechanical arithmetic is also treated in an exhaustive and interesting manner. The refinement of the science of accounting very naturally developed a demand for mechanical aids to lessen the labor, and this requirement seems to have been met in this machine.

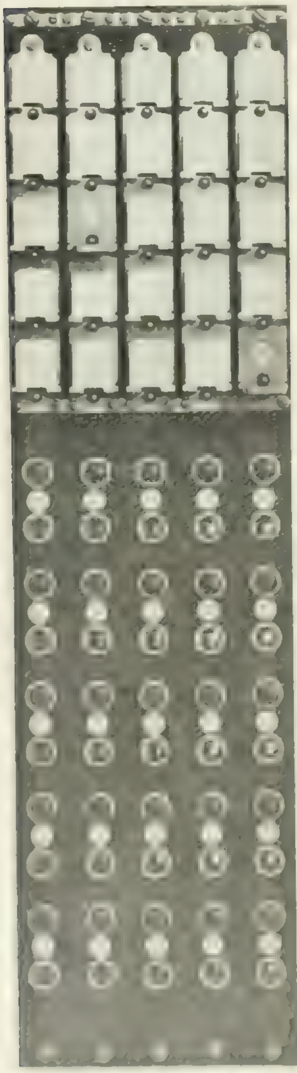
The First Common-Battery Switchboard in New York.

The New York Telephone Company has been necessarily, on account of the magnitude of its system and the consequent cost of any changes, a little slow about adopting the common-battery system, and it is now erecting in the new Harlem exchange the first board of this kind outside of small boards used in subscribers' private branch exchanges. The new multiple board will have a capacity of about 1500 lines, and will be fitted throughout with visual signals and all the latest improvements. It will be in operation probably in about one month's time.

The Victor Express Switchboard.

In designing and constructing the Victor express switchboard, views of which are shown herewith, the Victor Telephone Manufacturing Company, Chicago, has produced one of the most perfect forms of switching apparatus mechanism on the market.

By adopting as a basis a straight metallic system with double circuit cords, and with the ringing and listening circuits normally cut out on both sides, an exchange using this board can easily be divided into metallic, common return or ground circuits, and still have each division separate from the other. Owing to the mechanical construction of the Victor express board, this can be done [illegible]



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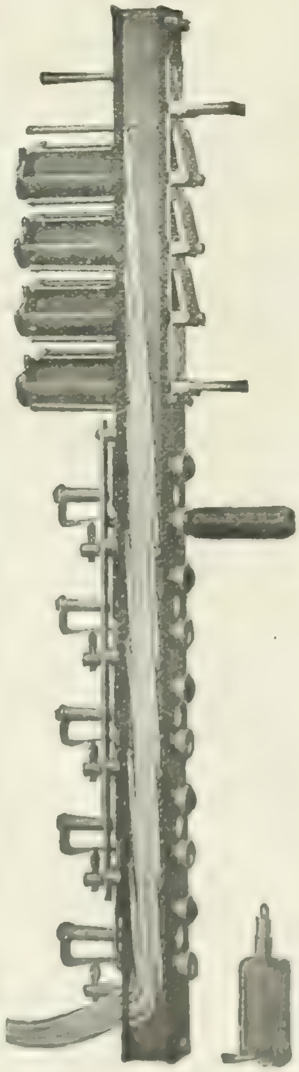


Fig. 2

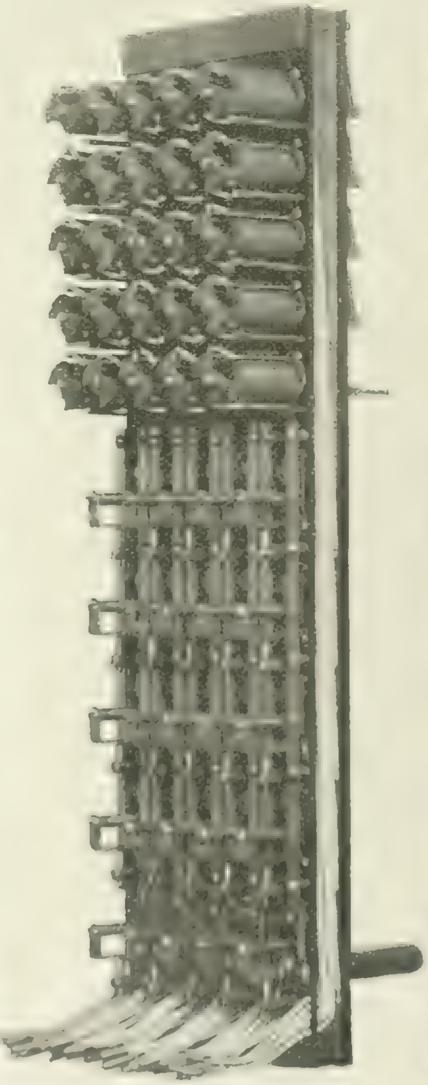


Fig. 3

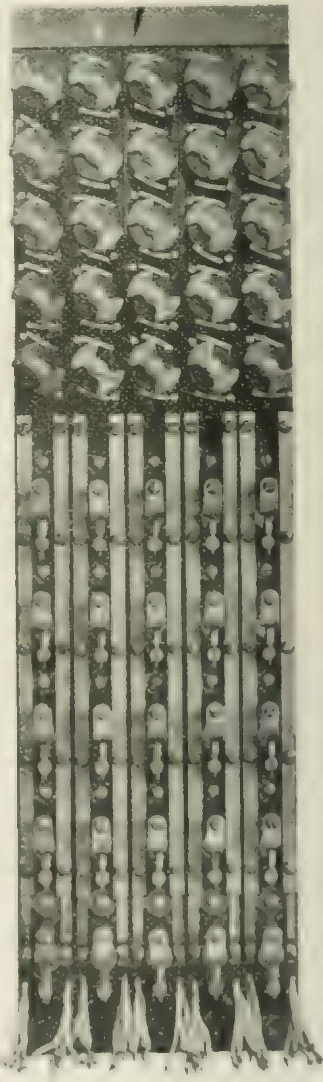


Fig. 4

[illegible]

[illegible]

ning at the top, and are numbered in the same manner or in any other way as may be convenient.

Below the drops are placed the jacks and ringing keys, arranged in the same way. An individual ringing key is provided for each line, so that any subscriber can be called, whether the plug is in the jack or not, or if any two subscribers are connected either one can be called without ringing back on the other line.

In the side view, Fig. 2, the arrangement of drops, jacks and keys is very clearly shown, the upper coil being removed, showing the ease with which this can be done, it being merely necessary to rotate the coil one-quarter turn to withdraw it from the strip. In Fig. 3 the wiring details and the arrangement of the several parts in general are shown to good advantage. The wiring of each section is complete in itself, all wires being concealed in a vertical groove, so that when the board is connected up no wires either on the front or back are visible. All of the connections are, of course, carefully soldered, and the wires insulated with the best quality of Para rubber. Fig. 4 gives a view of the back of the board.

In the construction of the drop magnet several novel features have been employed. It is of the tri-polar type, with the armature placed so as to obtain the greatest possible force. The coils are wound in even layers with silk-covered wire, and can be removed without taking out any screws. As the coils are not in series, there is no retardation or counter e. m. f. to affect the telephone current. Consequently, to change to a toll-line jack, for very long distance work, it is only necessary to replace the drop coil with one of higher resistance.

The night-bell connection is made in such a manner that there is no metal connection between the drop coil and the shutter, leaving the coils thoroughly insulated from each other, with no possible chance for leakage of current and consequent cross-talk.

It is the claim of the Victor Company that owing to the fewness and stability of parts, economy of maintenance and lasting qualities, purchasers of this board secure a saving of 50 per cent. in the equipment of an exchange, although the first cost is no higher than that of the best board on the market.

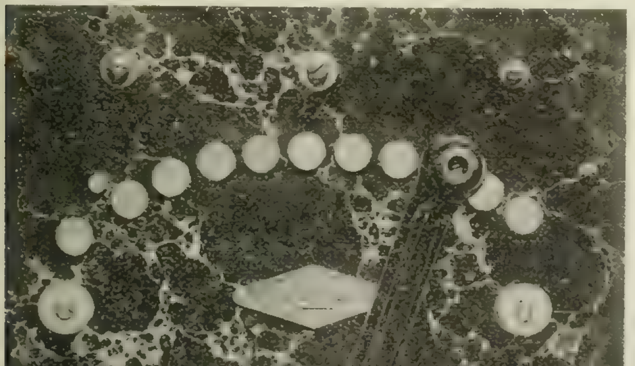
Electric Turntable.

In the article on the Erie Railroad Company's electrically driven turntable, published in the last issue of The Electrical World, an elusive typographical error made an excessive charge for current to operate the table. The monthly cost of current should have read $20, and not $200. The error was an obvious one to those familiar with such matters.

Speed-Regulating Rheostat.

The Chicago Rheostat Company's motor speed-regulating rheostat, which automatically releases the lever from any point, and cuts in the resistance when the circuit is interrupted, is illustrated herewith. The distinguishing feature is the method of clamping the lever. This is accomplished by means of a steel strap in contact with the rim of a disc on the lever, after the manner of a strap brake.

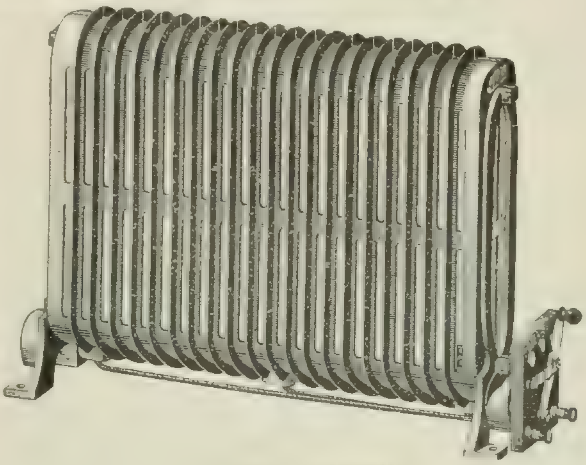
The details have been so worked out that the amount of current in the magnet necessary to clamp the lever is said to be much less than by any means heretofore employed. The lever is held so firmly in any position that no amount of jarring will dislodge it. It moves from point to point with great smoothness and with a total absence of jerky motion. The release is said to be positive and sure. There are no catches or notches to wear out, and a very simple take-up is employed for adjusting the tension of the strap.



Front of Speed-Regulating Rheostat

A Novel Form of Electric Heater.

The Western Electric Company is placing on the market an electric heater made in the shape of a small steam radiator, as illustrated in the accompanying cut. The apparatus is 14½ inches long, 3½ inches wide and stands 12½ inches high, being finished in black enamel and japan. It is made for two different degrees of heat—half capacity and full capacity. The current is regulated by means of a three-point switch, shown at the right in the illustration. In one position the current is entirely off; in the second position half of the heater is used, and in the third the full current is on. The switch, besides, indicates whether the current is off, on full or on half. The heater is made for 52 and 104 volts alternating, and also for [illegible] and [illegible] volts direct current.



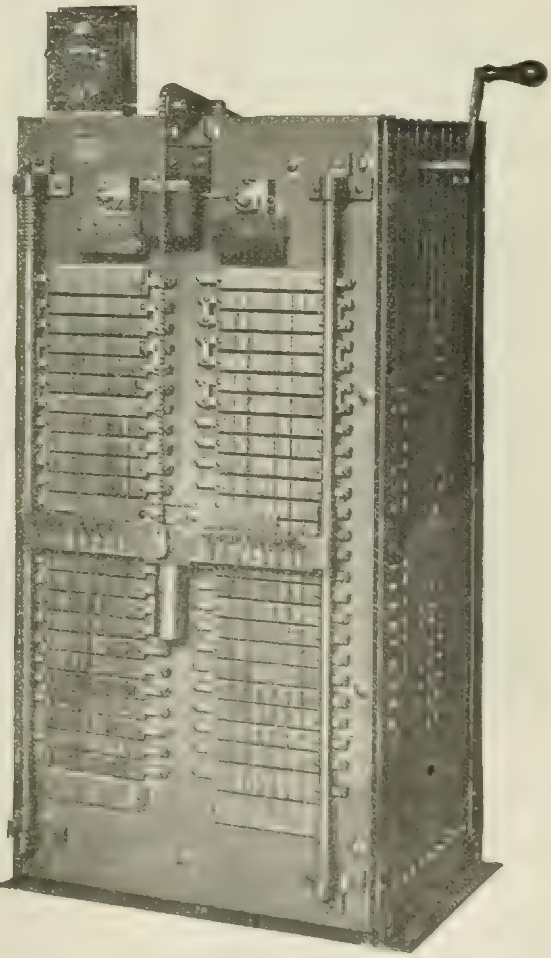
Electrical Radiator.

This heater will no doubt find a wide field of application in heating small offices, street railway waiting rooms, etc. It has the peculiar advantage of being instantly available, and the amount of heat can be regulated at will. No definite rule can be given to determine the amount of current necessary for heating a given space, though approximate estimates can be made by allowing from one to two watts for each cubic foot of air space to be heated, the latter amount being for well constructed buildings in cold weather.

A Large Motor-Starting Box.

The accompanying illustration shows a motor starter which is probably the largest—outside of water rheostats put up for temporary service—ever constructed.

The box is used with a 500-hp, 500-volt motor, and was made by the Cutler-Hammer Manufacturing Company, Chicago. The resistance is of wire coils attached directly without leads to the segments shown on the face. These segments are double, the surfaces, on which come the wear and tear and whatever sparking may occur, being of hard-rolled copper bolted to the segment



500-hp., 500-Volt Motor-Starting Box

[illegible] Travelling vertically over this double column of segments is the crosshead carrying the contact brushes and held in position by two rods at the sides acting as guides. The crosshead is raised by a chain and hand windlass, the crank of which is shown in the illustration, and carries switch blades, which in the uppermost position enter the clips, forming a good short-circuiting contact. The crosshead is supported in this position only by the magnet shown between the two sets of switch clips, this magnet being connected up as usual in a shunt circuit and acting as a low-voltage release. To overcome the binding of the switch blades and to start the crosshead downward springs are mounted on the upper ends of the guides and similar springs at their lower ends cushion the fall. For the sake of comparison a small 1¼-hp starting box is shown, mounted on the top of the larger one.

A Submarine Arc Lamp.

Messrs. I. E. Burdick and Franck G. Hall, Jr., students of electrical engineering at Sheffield Scientific School, Yale College, have jointly invented an arc lamp to be used in submarine work.

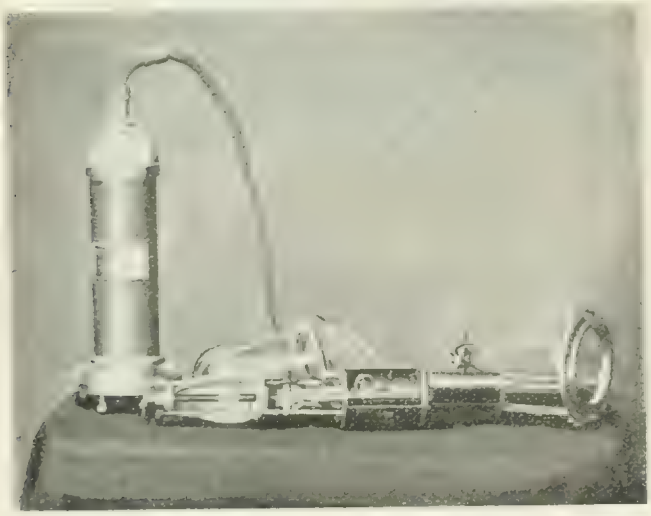
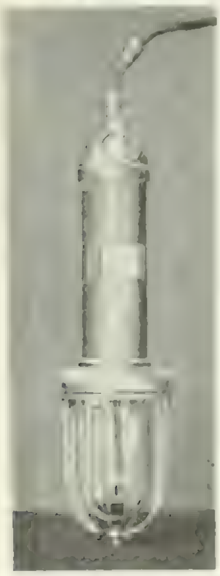
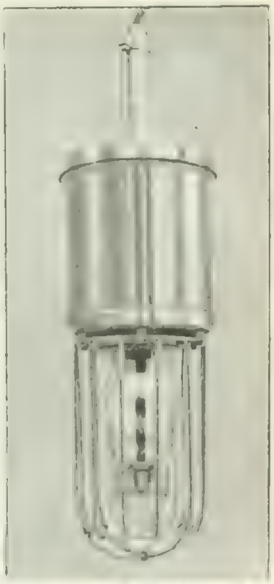


Fig. 2.—Lamp Dismantled.

These gentlemen were employed by the United States Government early last spring to conduct some electrical work in connection with the laying of mines in certain harbors on the Maine coast. At that time they conceived the idea [illegible] light under water for the examination of vessels' sides, wrecks, etc.





[illegible]

[illegible]

[illegible]

[illegible]

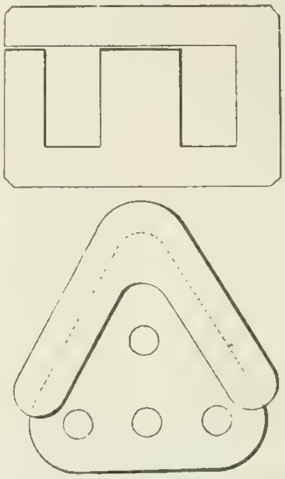
of air supply, of course, does not figure in the enclosed arc lamp, but the apparatus is provided with a valve for the release of the excess gases of combustion.

This lamp will no doubt be found very valuable and useful in laying and removing mines, disentangling cables, bridge pin construction, attaching hoisting chains to submerged guns and other movable parts of battleships; in wrecking, fishing, submarine photography in connection with Professor Dodge's aquescope, and for many other purposes in submarine work.

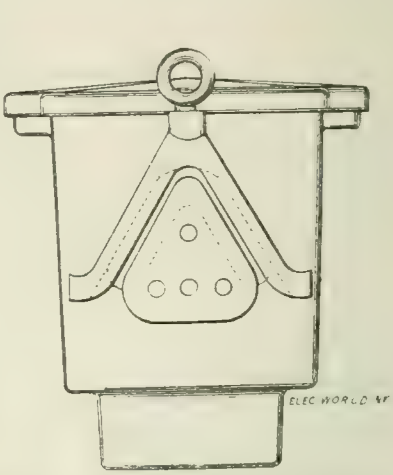
Improved Transformers.

A complete new line of transformers has just been brought out by the Royal Electric Company, Peoria, Ill. They are of the shell type, with a one-piece magnetic circuit of the usual E-shape split across one side and the tongue to allow ready stripping or assembling, as shown in the accompanying figure.

The transformers, which are designated Type E, are incased in water and oil-proof boxes. The casing is adapted for either dry or oil insulation, and gives a large surface for radiation. A very simple method of hanging these transformers has been devised by the company. The support consists of a small triangular plate having a projecting shoulder, and may be separately attached to the pole, cross arm or wall by lag screws. Upon the back of the transformer case is an inverted V-shaped channel or slot, which corresponds in shape to the plate. To place the transformer in position it is simply raised and slid over the projecting rim of the plate.

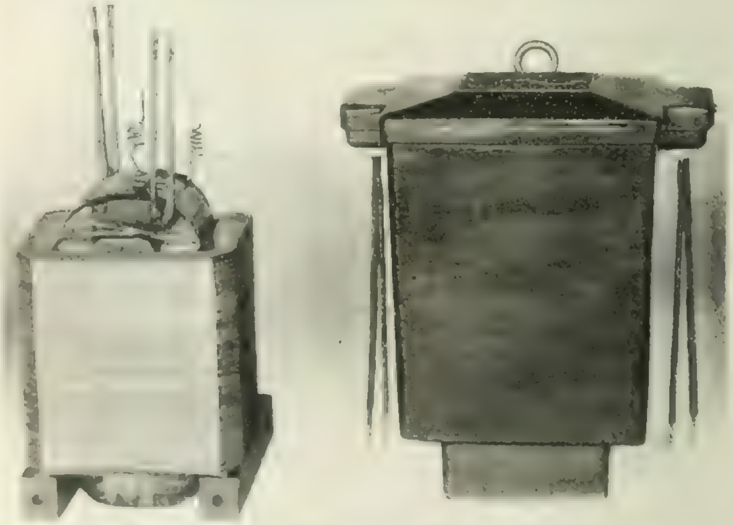


Core Stamping and Hanging Plate.



Transformer Supported on Hanging Plate.

No terminal plate is used within the transformer, and but two leads come from the secondary, the proper connection for 50 or 100 volts being effected within the case. To avoid the liability of mistakes one end of each of the two [illegible]



Assembled Coil and Perspective View of Transformer.

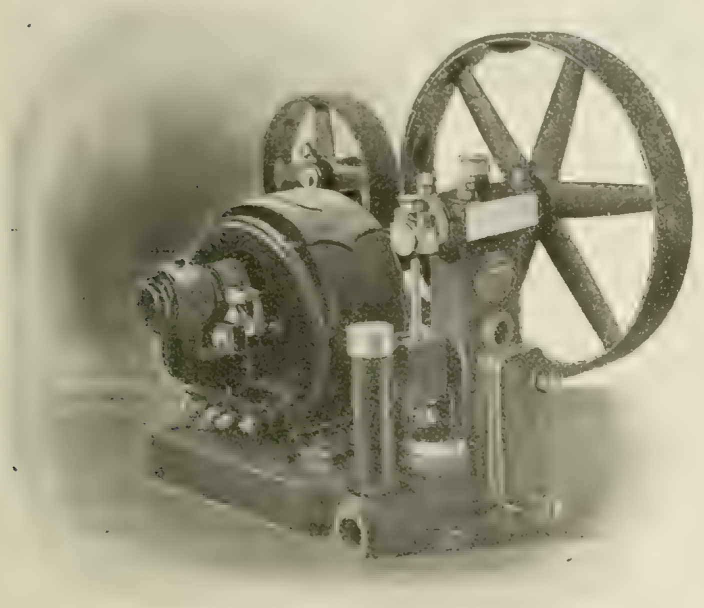
[illegible]

A Compact Pumping Combination.

[illegible]

[illegible]

in the position of the bearings, be run in any position. The magnetic circuit is of laminated, instead of cast iron, the armature of toothed laminations with coils made up and insulated before application. The motor is mounted upon the base of the pump, making the combination one of the most compact on the market. It is stopped and started by an automatic switch operated by a float on the water in the tank. These pump combinations are built for capacities of 200 and 500 gallons as required.

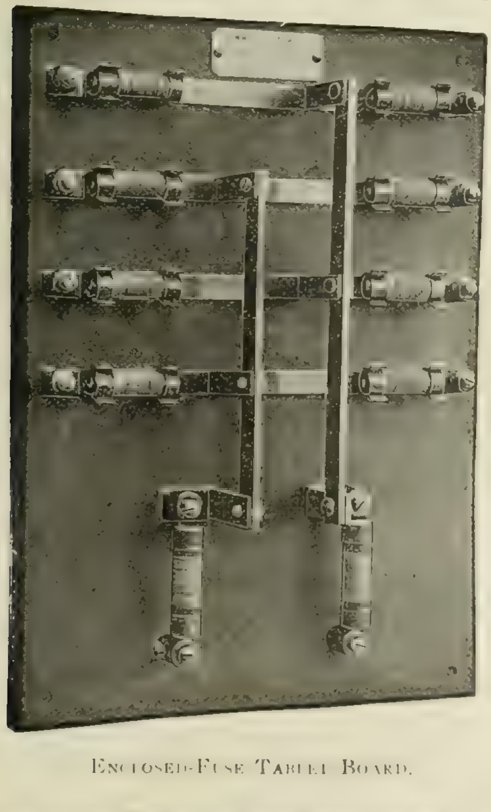


PUMP DRIVEN BY AN ELECTRIC MOTOR.

Shawmut Enclosed-Fuse Tablet Boards.

Electrical engineers have been looking for a line of tablet boards which would be compact and neat, and at the same time avoid all possible fire risk. To do this it was essential that fuses be made in such a manner that upon blowing there would be no arcing, flashing or undue heating which could set fire to inflammable material near by. The illustration shown represents the efforts of the Shawmut Fuse Wire Company, of Boston, Mass., to make a combination tablet and enclosed fuse board that would answer these conditions in the most satisfactory manner. To do this it was necessary to experiment largely in a new line; and the company now offers to the trade a board that can be manufactured at a very reasonable price and at the same time cover all the necessary conditions for its proper action.

The fuse blows within a fibre tube so closed that the gases and heated metal cannot escape. The ferrules make contact similar to the blade of a knife switch, thereby avoiding the use of tools when fuses are placed. This manner of replacing a fuse will be appreciated by those who have been obliged to place fuses in a small space with a large amount of bare metal in close proximity.



ENCLOSED-FUSE TABLET BOARD.

This device has been approved by the National Board of Fire Underwriters and the Shawmut Fuse Wire Company feels that it will be greatly appreciated by engineers and architects generally.

Receptacle and Midget Plug.

The accompanying illustrations show a receptacle and a plug and receptacle of improved form which no doubt will be favored by electrical workers. Not the least feature is the small size of both of these devices. The receptacle shown in Fig. 1 is made of one piece of cylindrical porcelain 1¾ inches in diameter by 1¾ inches deep. The plug is fusible. The only tool necessary to install this receptacle is a common auger-bit.

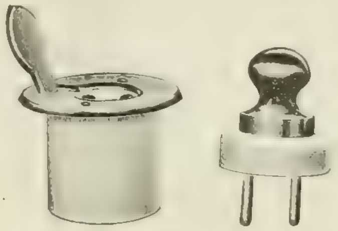


FIG. 1.

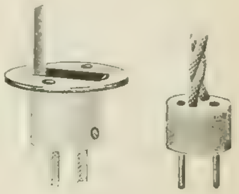


FIG. 2.

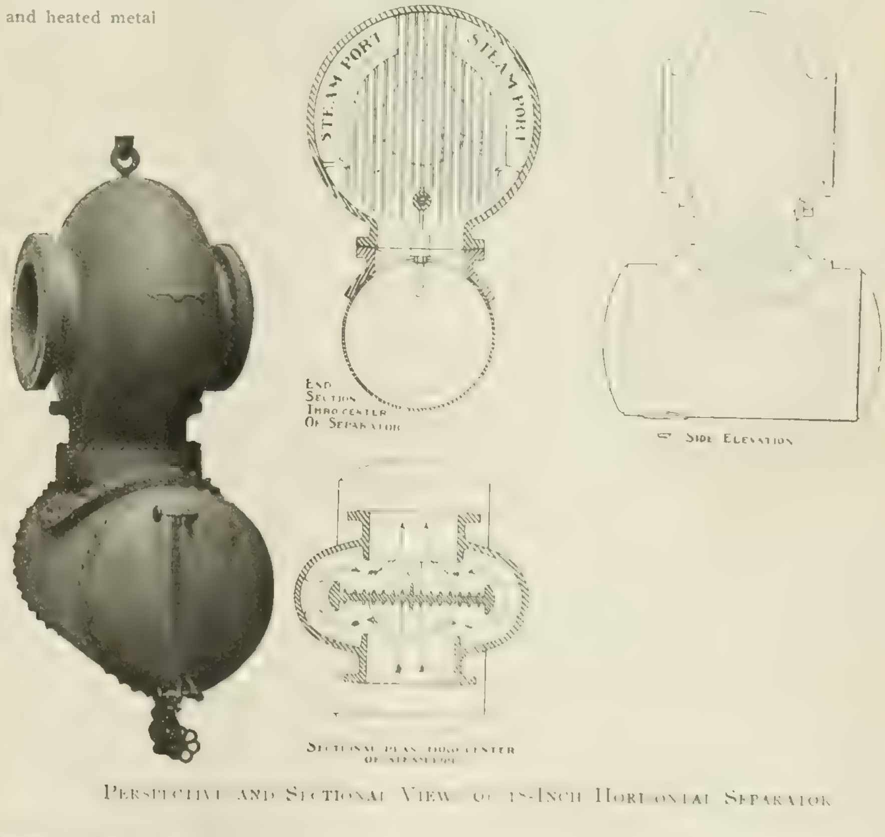
The "Midget" plug and receptacle shown in Fig. 2 is designed for use in confined spaces. It is made of porcelain throughout, except the face plates, and will carry a maximum of ten amperes, and is not fused. The face plates are furnished to match any finish of hardware.

These compact devices are made by the Anchor Electric Company, 71 Federal Street, Boston, Mass.

A Horizontal High-Pressure Separator.

The accompanying illustrations represent a special 18-inch horizontal high-pressure Cochrane separator, built by the Harrison Safety Boiler Works, Philadelphia, Pa., for the Cambria Iron Company, of Johnstown, Pa. On account of the limited space between the main steam pipe and the floor it was necessary to turn the well or receiver at right angles, thus giving the desired capacity without increasing the depth. The specifications calling for a separator adapted for an exceptionally high working pressure (250 pounds per square inch), a large factor of safety was adopted and the metals proportioned accordingly. The thickness of the metal in the shell forming the head of the separator was made 1¾ inches, with flanges 2½ inches thick. The well, 30 inches in diameter by 4 feet 9 inches long over heads, was made of flanged steel seven-sixteenths of an inch thick, with horizontal joint lap and triple riveted, the heads, nine-sixteenths of an inch thick, being dished to a 30-inch spherical radius. For the drip a 2½-inch reinforced tapped opening was provided; the cast-iron saddle was double riveted to the shell, and the same suitably bolted to the head proper.

In the use of an oblate spheroidal shape exceptional strength was given, with special protection at the juncture of the lower branch with the head on the short axis from expansion and contraction strains, by means of a stay tube cast in with the head. Through this stay tube is passed a 1 5-16-inch bolt fitted at each end with a close ended steel nut. The following are the principal dimensions of the separator: Greatest diameter across the head, 4 feet; distance from the bottom of the well to the top of the head, 7 feet; weight, 5400 pounds. The completed separator was hydraulically tested under a pressure of 400 pounds per square inch.

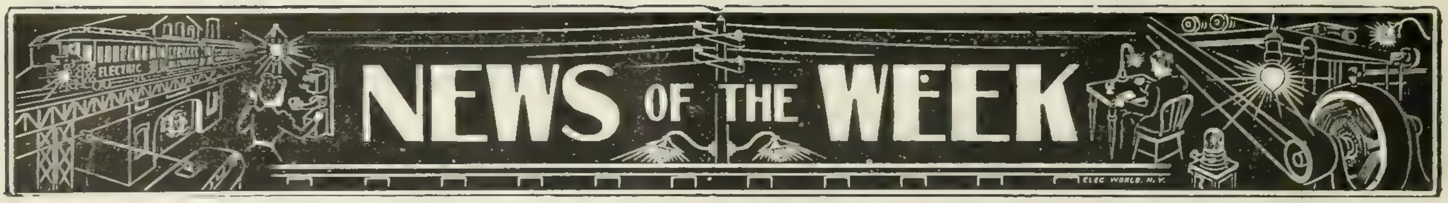


END SECTION THRO CENTER OF SEPARATOR

SIDE ELEVATION

SECTIONAL PLAN THRO CENTER OF SEPARATOR

PERSPECTIVE AND SECTIONAL VIEW OF 18-INCH HORIZONTAL SEPARATOR



Financial Intelligence.

THE EDISON ELECTRIC ILLUMINATING COMPANY, of Boston, report gross earnings during the six months ended June 30 last $488,964; operating expenses, $306,851; net earnings, $182,113.

THE BOSTON ELECTRIC LIGHT COMPANY.—In the last issue of THE ELECTRICAL WORLD it was stated that a regular quarterly dividend of 1½ per cent. had been declared, payable December 15. This date is erroneous. It should have read October 15.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY has furnished the New York Stock Exchange with a balance sheet dated July 31, 1898, which is as follows:

ASSETS.		LIABILITIES.	
Cash	[illegible]	Accounts payable	[illegible]
Bills receivable	[illegible]	Bills payable	2,714,894
Accounts receivable	2,157,795	Dividend scrip	194,560
Material in stock	[illegible]	U. S. Elec. Light Co. bonds	300,000
Sawyer-Man Elec. Co.	[illegible]	Collateral trust bonds	590,000
Real estate, etc.	[illegible]	Preferred stock	[illegible]
Machinery, tools, etc.	1,374,542	Assenting stock	8,227,475
Stocks and bonds	[illegible]	Common stock	146,700
Patents, charters, etc.	4,763,785	Surplus	2,191,322
Miscellaneous	[illegible]		
Total assets	[illegible]	Total liabilities	$18,051,384

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
9 Murray St., NEW YORK, October 17, 1898.

MR. WILLIAM SUTTON, president of the American Car Company, of St. Louis, is at present in New York on business. He and Mr. E. J. Lawless, the Eastern representative of the company, have lately been closing some nice orders for cars.

MR. HIRAM S. MAXIM, the well-known inventor, was arrested at Poughkeepsie last week on the charge of bigamy and abandonment, preferred by a woman calling herself Helen Maxim. The charge of bigamy has been withdrawn, but the abandonment proceedings will be prosecuted. An adjournment in the case was taken until Friday of this week. Mr. Maxim is under bail.

THERE HAVE BEEN no new developments in the plans of the New York Gas, Electric Light, Heat & Power Company, whose incorporation was noted in this column in last week's issue, and those indirectly interested are still guessing at what the new company proposes to do. One of the latest theories is that the new company, counting upon its close relations with city officials, will proceed to install a large plant in opposition to all of the old companies and then precipitate a fight on rates in order to rapidly extend its business, and finally secure control of the whole lighting situation, as was done in Brooklyn recently by the Kings County Electric Light & Power Company. In this connection it should be noted that President H. H. Vreeland, of the Metropolitan Street Railway Company, denies the report to the effect that his company intended to sell electric current in any form. He states that the Metropolitan Company is prohibited by its charter from doing anything of the kind. The week, therefore, closes without anything more definite being revealed than was given in the last issue.

[illegible] last week by the announcement of the incorporation of the People's Telephone Corporation at Albany last Wednesday, with a capital stock of $5,000,000. The following named gentlemen are the officers: President, Darwin R. James; vice-president, Elias S. A. Delima; secretary, Frank S. Gardner; treasurer, Silas B. Dutcher. The company will operate lines of telephone from this city to points within the United States and Canada. The directors are S. B. Dutcher, J. E. Nichols, E. S. A. Delima, Francis C. Travers, Frank Brainard, J. Fred [illegible] dividend on the common stock shall be declared, and the preferred stock is [illegible] and commercial value of the project. He said that while the plans of the company involve the use of principles now utilized and well understood by the electrical public, at the same time new methods and new devices would be employed. Assurance was also given that in the near future readers of THE ELECTRICAL WORLD would be furnished with full information regarding the system in all its details. It is stated that the new company will in a year compete actively with the Bell Company, and will make a charge for unlimited service in Manhattan of $100. This will include the right of free use of its public pay stations for 100 calls per annum per subscriber. The message service rates will be made $40 for 400 messages, and for a larger number of messages on the message schedule the rate will go as low as 4 cents per message. The residence message rate for service on private wires will be $30. To families living in apartment houses and flats an unlimited service connecting with all the other subscribers of the company will be given for $1 per month on group lines. The unlimited service for business places in Brooklyn will be $75 per year. Mr. Gardner states that the new company has all the needed rights to engage in active business. Members of the board of directors claim that with a capital of $5,000,000 the company can serve 40,000 subscribers.

NEW ENGLAND NOTES.

Branch Office of THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., October 15, 1898.

MR. FRANKLIN B. PLATT, secretary of the Ansonia Electrical Company, Ansonia, Conn., was a Boston visitor this week.

THE ANCHOR ELECTRIC COMPANY, Boston, has engaged the services of Mr. H. G. Issertel, formerly of the Walker Company, as traveling representative, with headquarters in New York City, where the Anchor Company will soon open an office.

THE AMERICAN ELECTRICAL WORKS, Providence, R. I., through the distribution this week of a group photograph of its 1898 clambake, will make particularly happy those of its friends who attended the event. There were over 300 persons present, this being the largest number at any of the company's bakes. The group photograph this year is the best ever distributed.

MR. SAMUEL H. COUCH, of Whitman & Couch, Boston, the well-known telephone manufacturers, was united in marriage at Roxbury, Mass., Tuesday evening, October 11, to Miss Elizabeth Coleman, of New York. Immediately after the marriage, which was private, only intimate friends being present, Mr. and Mrs. Couch departed on a brief wedding trip, and on their return will reside at No. 55 Humboldt Avenue, Roxbury. Mr. Couch has a large circle of friends in the telephone and electrical business, the congratulations and best wishes of whom, our own included, attend him and his bride for the fullness of happiness and prosperity.

THE TWENTIETH TRIENNIAL EXHIBITION OF THE MASSACHUSETTS CHARITABLE MECHANICS' ASSOCIATION was opened to the public on Monday evening last. There is quite a number of purely electrical exhibits and others of indirect interest to electrical people. A brief reference to these exhibits will no doubt be of interest at the present time, leaving a more detailed account for the future.

MR. J. H. WILDAY, 23 Duane Street, New York, illustrates the art of engraving by electricity.

THE EATON ELECTRIC MOTOR CARRIAGE COMPANY, Boston, Mass., exhibits an electric motor carriage.

THE ELECTRIC DISPLAY COMPANY, 27 School Street, Boston, makes an exhibit of electrical display advertising.

THE JOHN A. ROEBLING'S SONS COMPANY, Trenton, N. J., shows a sample board of electrical wires and cables.

MESSRS. WHITMAN & COUCH, 196 Summer Street, Boston, make an interesting exhibit of telephones and telephone appliances.

THE LOMBARD WATER WHEEL GOVERNOR COMPANY, Boston, exhibits a Lombard water wheel governor in practical operation.

THE HOLTZER-CABOT ELECTRIC COMPANY, Boston, Mass., makes a showing of a large variety of electrical apparatus, including several novelties.

THE POPE MANUFACTURING COMPANY, Hartford, Conn., exhibits a Columbia electric carriage. This is the first time this carriage has been seen in Boston.

THE MAXHAM ELECTRIC THIRD-RAIL COMPANY, 606 Tremont [illegible], Boston, [illegible] system which is particularly interesting to [illegible]

THE [illegible] ELECTRIC COMPANY, Cleveland, Ohio, is represented by [illegible] whose headquarters are at [illegible] Tremont Building, Boston.

THE SAMSON CORDAGE WORKS, Boston, make an interesting exhibit [illegible] including braided cord in a variety of [illegible] and colors.

THE RIDGWAY DYNAMO & ENGINE COMPANY, Ridgway, Pa., through its Boston agents, has an exhibit of a [illegible] dynamo directly connected to [illegible] engine.

[illegible] decorated parlor, which is [illegible] The current from the street mains of the Edison Electric Illuminating Company is used.

[illegible] illustrating some

of the successive stages of electrical development. These were prepared by Dr. Park Benjamin, Prof. F. B. Crocker and Mr. T. C. Martin.

THE STANDARD THERMOMETER & ELECTRIC COMPANY, Peabody, Mass., lights the gallery of the exhibition hall by its well known arc lamps. Its thermometers are also placed in various parts of the building.

THE DIESEL MOTOR, which is attracting so much attention in the mechanical world, is here exhibited for the first time in New England. This remarkable machine was described in THE ELECTRICAL WORLD of May 28, 1898.

THE RIKER ELECTRIC MOTOR COMPANY, Brooklyn, N. Y., has an exhibit of a line of automobiles. This company's delivery wagons are used in New York City by several leading houses, and others are building for prominent Boston houses.

THE INCANDESCENT ELECTRIC LIGHT MANIPULATOR COMPANY, Hyde Park, Mass., brings to public attention a device for the safe and convenient handling of incandescent lamps. It is designed to remove bulbs from their sockets in high and inaccessible situations.

THE BURTON ELECTRIC SMELTING COMPANY, 144 Lincoln Street, Boston, makes a practical demonstration of electric metal working and smelting. This exhibit consists of a direct-current welding, forging and brazing machine. A welding machine was illustrated and described in THE ELECTRICAL WORLD of August 27, 1898.

THE GENERAL ELECTRIC COMPANY'S exhibit consists of the 25-foot globe—a miniature representation of the earth—which formed so conspicuous a feature among the exhibits at the recent convention of the American Street Railway Association in this city. A description of this unique exhibit was given in THE ELECTRICAL WORLD of September 17, 1898.

THE NEW ENGLAND TELEPHONE & TELEGRAPH COMPANY has a unique and interesting display of apparatus which is intended to demonstrate the business and social use of the telephone. Through the courtesy of Mr. B. F. Keith connection will be made with the exhibition telephone system, and patrons of the fair will enjoy the privilege of listening to the distant performance.

THE UNITED STATES ELECTRICAL SUPPLY COMPANY, 141 East Twenty-fifth Street, New York, makes an extensive exhibit, including, besides its acetylene gas generator, a thermo-electric generator. The Clarke wireless telegraphy and the X-ray exhibits of this company form two of the principal attractions of the fair. By means of the wireless method of transmitting electric waves submarine torpedoes are exploded four times a day in an artificial lake placed on the stage.

THE EDISON ELECTRIC ILLUMINATING COMPANY, of Boston, occupies a space of about 2184 square feet, which is divided into three sections. The central section or archway is devoted to a display of ornamental incandescent lighting by means of miniature lamps. In one of the side sections are exhibited incandescent and arc lamps, a photometer and a prepayment meter, also the company's standard meters. In the third section is exemplified the application of electrical power to the running of direct-connected machinery and the use of electricity for cooking and heating.

PHILADELPHIA NOTES.

Branch Office of THE ELECTRICAL WORLD,
929 Chestnut Street.
PHILADELPHIA, Pa., October 17, 1898.

MESSRS. FRANK H. STEWART & CO., 35 North Seventh Street, have just brought out their 1899 catalogue of electric light supplies. The catalogue is very fully illustrated with cuts of goods of this class, and the line handled by Messrs. Stewart & Co. is a very complete one. All of the goods handled by the firm are of standard make and type.

MEETING OF THE FRANKLIN INSTITUTE.—At the stated meeting of the institute, which will be held on Wednesday evening of this week, Mr. Edward H. Johnson, vice-president and general manager of the Sprague Electric Company, New York, will read a paper on the Johnson-Lundell surface contact system of street railway. The paper will be fully illustrated.

BUFFALO AND NIAGARA FALLS NOTES.

BUFFALO, N. Y., October 15, 1898.

MR. P. H. GRIFFIN, proprietor of one of the largest car-wheel works in Buffalo, has a large interest in the new electrical plant soon to be erected at Shawinegan Falls, 19 miles from Three Rivers, Quebec.

THE GENERAL ELECTRIC COMPANY is engaged in drawing in the cable in the Niagara Street subways that will make the entire Niagara power line an underground system so far as Buffalo is concerned. As soon as all the cable is in position the city terminal house at the foot of Potomac Avenue will be discontinued and the new one at the city line put into use. The cable is of the same three-conductor pattern as the one now in use, and is about 13,000 feet long. The old pole line will be disconnected, but maintained as an emergency line.

THE ANNOUNCEMENT, made some months ago, of the establishment of an electric button factory at La Salle, on the line of the Niagara power current to Buffalo, is at last confirmed, though for a time it was supposed that the project had fallen through. On October 11 the contract for a four-story brick building, 40 by 100 feet, with two-story boiler and dry house attached, was let. The works will not be a branch of J. B. Shantz's factory in Berlin, Canada, as has been stated, nor of the one under management of J. H. Shantz & Son, in Buffalo, but will be a separate venture. The people interested in it are mainly the same, however. They will say very little as to the equipment of electrical apparatus, but admit that they expect to be running next spring.

THE DEPEW & LANCASTER POWER COMPANY is actively engaged in getting the right of way for the pole line to carry the Niagara current to these eastern suburbs of Buffalo. Considerable difficulty has been experienced and some of the land has been taken by commission. It is not the intention to build an independent line all the way to Niagara Falls, but to join the one to Buffalo, either in Tonawanda or south of it, thus avoiding a second set of poles from that point northward. A transformer station will be built in Depew as soon as the line is ready. The company is not prepared to announce any contracts for the use of the current, but says that there is a reasonable amount of assurance that there will be patrons in plenty as soon as the power is ready to deliver.

THE NEW Buffalo & Lockport trolley line is given a very high character by the management. The passenger cars make a mile a minute where it is permissible, which is sometimes necessary in order to make the time. The trip of 25 miles is made in 73 minutes, though half of the time is taken for running through Buffalo and Tonawanda. The electric freight engines are easily hauling thirty-five cars and performing all the work of the steam locomotives which they supplanted. Manager Van Horn states that the 800 horse-power that was put into the motors is not considered too much, though it is in excess of such motor engines generally. The road has this week taken formal possession of the Kenmore line from Buffalo to Tonawanda, and will change the route to that via Main Street, Buffalo, instead of following the Niagara Falls line of the company via Niagara Street. It is not expected that the time can be shortened by the change, but the city will in this way be covered better by the two lines, as they come together again in Tonawanda.

MILWAUKEE NOTES.

MILWAUKEE, WIS., October 13, 1898.

WINNEBAGO CITY, MINN., is contemplating the establishing of a city lighting plant.

THE OFFICERS of the Milwaukee Electric Railway & Light Company recently entertained the officers of the Chicago street railways. Messrs. Henry C. Payne, Charles F. Pfister, General Manager Biggs, Superintendent Mitten, Chief Electrician Rau and Comptroller Mackay were the hosts.

AN EXTENSIVE glue manufacturing plant is being erected near South Milwaukee for the United States Glue Company. All the machinery will be electrically driven. About 500 horse-power will be used. Mr. Philip Bossert, of the Pfister Vogel Leather Company, of this city, is drawing up plans and specifications for the electrical plant.

THE WISCONSIN TELEPHONE COMPANY announces to its patrons that a new branch exchange, located on the lake side, will shortly be opened. It will be known as the "Lake" Exchange. This branch, with those already in operation on the west, south and north sides, completes the chain of branches, established with a view to reducing distances and rates to the minimum as far as possible within the city limits. The reduction in rates to subscribers in the northeastern portion of the city amounts in the aggregate to sums ranging from $5 to $80 per year per subscriber. The residents of the Lake Park district will benefit greatly by the saving of 2 miles of distance charge.

ST. LOUIS NOTES.

ST. LOUIS, MO., October 14, 1898.

CHANGE OF POWER.—The Oliver Street line, part of the Lindell system, has a bill in the City Council to change its motive power from cable, which is now being used, to the overhead trolley system.

THE KINLOCH 'PHONE SERVICE.—The merry war of the telephone companies will soon be on if the management of the Kinloch Company fulfills its present expectations as to placing its system in operation. At the office it has been stated that the new system will positively be in operation before the end of the present month.

THE CIRCUIT COURT decided this week that, in the suit of L. M. Rumsey against the People's Railway Company, in which Rumsey asked that a receiver be appointed, as the interest on the third mortgage bonds has been defaulted, the road must be sold, and he instructed the attorneys at some length, in his verbal opinion, to draw up a decree of sale. He also stated that the charges made against Receiver L. M. Rumsey and the ex-president, Charles Green, whom it was claimed had done all they could to wreck the property, were not true. It is likely that the disposal will be made by auction to the highest bidder.

THE BILL granting the Lindell Railway Company the right to consolidate all its various lines and to connect them by tracks over intervening streets was reconsidered this week by the City Council, after it had been defeated at a former session, and passed. The bill amounts to the granting to the Lindell of a new franchise, running until 1942 over all its roads. The remuneration is to be $14,000 for each of the two first years, $28,000 for the next five, $32,000 for the next ten years, 3 per cent. of the gross earnings for the next ten years, 3½ per cent. for the next eight years and 4 per cent. for the remaining ten years. Transfers, which amount to a universal transfer system over that line, are to be given at various points. The bill will now go to the House of Delegates, where a similar one has been defeated during the past month.

PACIFIC COAST NOTES.

SAN FRANCISCO, Cal., October 9, 1898.

THE CITY OF FRESNO, CAL., is seriously considering the question of establishing a municipal electric lighting system.

THE ELECTRIC RAILWAY & MANUFACTURERS' SUPPLY COMPANY, of San Francisco, was recently incorporated. The directors are: William F. J. [illegible], Samuel H. [illegible], Frank [illegible] and Henry P. Howie. The capital stock is placed at $50,000.

THE SUNSET TELEPHONE & TELEGRAPH COMPANY has announced the completion of its Pacific States telephone lines, including the 400-mile gap between the Oregon and California systems, the line from Walla Walla, Wash., to Huntington, Ore., and one from Spokane, Wash., to the British line.

THE PORTLAND (Oregon) City Council has awarded to the Portland General Electric Company a contract for lighting the streets for a period of two years, from April 1, 1899, at the rate of $[illegible] a month per arc lamp and $1.50 a month per incandescent. Under the present contract with the same company the city lighting costs about $85,000 a year.

IT IS reported that a San Francisco syndicate, headed by H. E. Huntington, has acquired the San Mateo Street Railway and the street railway franchise covering many streets in Los Angeles, owned by J. C. Kays. The same gentlemen recently purchased the Los Angeles Railway Company's street railway lines. I. W. Hellman, of the syndicate, recently said that he did not think they would acquire the Santa Monica and Pasadena electric railways, which had been reported as sold.

THE CENTRAL LIGHT & POWER COMPANY, San Francisco, is installing two additional generators to be driven by a 750-hp triple-expansion, vertical, Union Iron Works engine. Two cooling towers are being installed by Charles C. Moore & Co. on the roof of the Parrott Building, in the basement of which the central station is located. The towers are placed 100 feet above the level of the street. Additional boilers and condensing apparatus will be installed. Siemens & Halske generators are used exclusively.

CANADIAN NOTES.

OTTAWA, ONT., October 15, 1898.

THE CITY ENGINEER of Toronto, Ont., has refused to draw up specifications for a 6000-hp municipal power plant, as ordered by the City Council, and has recommended that $1000 be appropriated to secure the services of an expert consulting electrical engineer who would draw the specifications.

A UNITED STATES COMPANY, which is going to develop the water power of the Jacques Cartier River, in the Province of Quebec, for electric light and power purposes for Quebec city, in opposition to the Montmorency Company, has acquired the chartered rights, as regards the city of Quebec, of the Standard Light & Power Company, of Montreal. The American company has a capital of $500.000, and its president is Mr. Emerson McMillan, of New York.

A LARGE POWER DEVELOPMENT.—Messrs. Barry, Ross & McRae, contractors, of Niagara Falls, Ont., have secured the contract for the construction of the central power house, for the development of 30,000 horse-power at Shawinegan Falls on the St. Maurice River, near Three Rivers, Que. This, it is said, will be the largest power development in Canada. The plans of the Shawinegan Company and other information concerning the enterprise were given in this correspondence in THE ELECTRICAL WORLD of September 10 last.

ALTHOUGH it is only a few years since the first electric railway was built in Canada, it is now possible to obtain in the Dominion all the materials necessary for the complete equipment of an electric road. In the case of the street railway recently completed at St. Thomas, Ont., with the exception of the overhead fixtures, the line was built and equipped with Canadian material, the total cost being $85.000. The rails were made at Hamilton, Ont., the engines at Amherst, N. S., dynamos and electrical equipment at Peterboro, Ont., and the cars at Ottawa.

THE WEST KOOTENAY POWER & LIGHT COMPANY, which is building a parallel line of wires between Rossland, B. C., and the generating plant at Bennington Falls, has the right of way cut, and poles on the ground for most of the distance. The right of way has been cut clear of everything for a width of 100 feet, and all the tall trees outside of that area, which, if they fell, would injure the line, have also been cut down. The insulators will be housed, so as to keep out the snow in winter. The idea in constructing the second line is that if one line goes down the other can be made use of and [illegible]

[illegible], Que., October 15, 1898.

THE ELECTRIC RAILWAY from Ridgetown to Rondeau Park, near Chatham, Ont., is one of the probabilities of the near future.

THE PETERBORO & ASHBURNHAM STREET RAILWAY has been sold to Arthur Stephenson, and it is probable that some improvements will be [illegible]

THE RATEPAYERS OF BARRIE, ONT., recently voted a by-law to raise $35,000 for the installation of a municipal electric light plant. Tenders for the [illegible]

A NEW incandescent electric lighting plant is to be installed at Campbellford, Ont., for which $8000 was recently voted by the ratepayers. The new plant will replace the one now in use.

THE HAMILTON, ONT., City Council has extended the franchise of the street railway company for fifteen years. As soon as financial arrangements are completed some improvements will be made in the system.

[illegible] favor of building an electric railway from Waverly to Dartmouth, N. S., thence to Musquodoboit Harbor. The promoters will hold a meeting in a short time.

[illegible] represented by Messrs. Carroll & Smith, has asked permission to distribute elec- [illegible]

ADVICES from St. Catharines, Ont., state that Messrs. Haines Brothers, of New York, who have secured control of the Niagara Central Railway, announce [illegible]

ENGLISH NOTES.

[illegible]

[illegible]

desirability of establishing a national physical laboratory for the testing and verification of instruments for physical investigation; for the construction and preservation of standards of measurement, and for the systematic determination of physical constants and numerical data useful for scientific and industrial purposes, and to report whether the work of such an institution, if established, could be associated with any testing or standardizing work already performed wholly or partly at the public cost." The committee was constituted as follows: Lord Rayleigh (chairman), Sir Courtenay Boyle, Sir Andrew Noble, Sir John Wolfe Barry, W. C. Roberts-Austen, Robert Chalmers, Prof. A. W. Rucker, Alexander Siemens and Prof. T. E. Thorpe. It will be seen that the majority of these gentlemen are Fellows of the Royal Society, and also that the engineering industries are represented on the committee as well as pure science. The report of the committee has just been issued. A number of witnesses were examined, a large proportion of whom were nominated by scientific and technical institutions. The committee visited the Physikalisch-technische Reichsanstalt, the Königliche Mechanisch-technische Versuchsanstalt and the Königliche Magnetische Institut in Germany, the work of which institutions is similar to that indicated in the above reference to the committee. The only English public institutions whose objects are at all similar to those required are the Standards Department of the Board of Trade and the Kew Observatory. The Standards Department of the Board of Trade was established to carry out the provisions of the Weights, Measures and Coinage act, and its chief duty is to preserve and restore, if required, standards of the various weights and measures. An important branch of this department is the Electrical Standards Laboratory, which was established in 1889. This branch has also done useful work in verifying electrical instruments for the measurement of current pressure, power, resistance, etc., but it does not certify meters for use in connection with electric supply. The Kew Observatory is a self-supporting institution, but owing to its restricted means the work done there is very limited. Besides being a meteorological station, a number of instruments, including watches, thermometers, sextants, barometers, etc., are verified, and it may be mentioned incidentally that the beneficial effect it has carried upon the watchmaking industry has been very noticeable. The committee now proposes that the Kew Observatory should be extended by adding new buildings at some distance from the present observatory. It proposes that the new institution should undertake work similar to that mentioned in the instructions to the committee, and that the Royal Society should be invited to control the proposed institution and nominate a governing body on which commercial interests would also be represented, the choice of members of this body not being confined to members of the Royal Society. The committee also proposes that the permanent secretary of the Board of Trade should be an ex officio member of the governing body. It is to be hoped that the Treasury will see that the recommendations of the committee are carried out in an adequate manner.

FRENCH NOTES.

(From Our Special Correspondent.)

PARIS, September 20, 1898.

THE ELECTRICAL BUILDING.—The operation of the great steam engines which will be exhibited in 1900 will require a pumping capacity which is estimated at 12,000 horse-power, equivalent to a delivery of water of about [illegible] gallons per second. It is a question whether this water, which will be brought from the Seine by means of a large pumping station, ought to be allowed to remain out of sight in the underground pipes, or ought not rather to be utilized before being passed to the machinery in furnishing sparkling fountains for the delight of the eye. It is the latter course which has been decided upon, and by the united efforts of M. Henard and M. Paulin, who have special charge of the water works, this building has been erected, where light and water have been so combined as to produce the most fairy-like effects. The fountain will be 34 metres high. The whole effect, I think, will be sufficiently attractive to draw to the Champs de Mars the visitors who would otherwise be detained at the Champs Elyseés and the Trocadéro by so many other objects of interest.

THE EXPOSITION OF 1900. The general committee of the Universal Exposition of 1900 has just drawn up the agreement regulating the cost and conditions of transportation of the exhibits to be sent or which have already been sent to the exposition. This agreement was drawn up by M. Alfred Picard, administrator of the government railroads, represented by M. Metzger, the director, and the directors of the six great companies, Messrs. Heurteau, Blagé, [illegible], [illegible], [illegible] and [illegible]. The document consists of four articles, of which the following is a brief résumé. The three first articles treat of the cost and conditions of the transportation of objects of art, of valuables, [illegible] etc. Carriages and rolling stock of the French railways and intended for exhibition at the exposition will be transported to Paris at a reduction of [illegible] per cent on the general tariff and on the special tariff applicable to the particular exhibit, and will be sent back at a reduction of 75 per cent. Article [illegible] of [illegible] tons and of objects whose [illegible] in proportion to their weight. Article 4 indicates the general conditions applicable to all exhibits sent, and [illegible] that [illegible] only to such articles as are [illegible] admitted to the exposition [illegible] will be addressed to the ex[illegible] and will be received by [illegible] or by an agent authorized [illegible] the return of the exhibits after the [illegible] for only six months, [illegible] the exposition is [illegible] closed.

TRACTION IN PARIS. [illegible] different [illegible] the self-propelling [illegible] cable traction [illegible] contact [illegible] The Paris General [illegible] traction on the Bastille [illegible] has petitioned for the [illegible] of its tramway lines. [illegible] over of the tramway [illegible] Metropolitan [illegible] for 220,000,000, thus making up a total of 31[illegible] for the improvement of the transportation facilities of Paris. My hope is that these millions may be expended before the exposition of 1900, so that the visitors from other countries may not be able to reproach the capital of the world for maintaining the worst service of all the capitals of the two hemispheres. The Omnibus Company is displaying the utmost parsimony and delay in its submission to the orders of the Government. Although it was required eighteen months ago to substitute electric for horse traction on its tramway lines, it has carefully selected the worst systems with which to make experiments. Just at present an investigation is going on with regard to the form of traction of the line extending from the Gare de l'Est to Montrouge. Those who have charge of the affair should require not only electric traction, which is the only form practicable for Paris, but also a reduction of fares. The Omnibus Company will make the enormous saving of 75 per cent., and the public ought to profit by it.

THE MUNICIPAL INSTITUTE OF ELECTROTHERAPEUTICS AT LA SALPETRIERE.—This is the name which is given to the independent service of electrotherapeutics at La Salpetrière since its recent installation in that portion of the institution which is especially devoted to it. An enormous isolated pavilion has been erected for the exclusive use of the electrotherapeutic service. This pavilion fronts directly on the Boulevard de l'Hòpital. On entering, the eye is caught at once by two large therapeutic tables. Let us call attention here to the fact that the electrotherapeutic table which was originated by Brenner (1868) was used in France for the first time at La Salpetrière. The model arranged by Dr. Vigouroux was, at the time, made the subject of detailed articles in the publications of the day. Next to these electrotherapeutic tables are placed the apparatus intended for the applications of static electricity, another branch of electrotherapeutics which is also being restored by the service at La Salpetrière. The static electricity apparatus fills nearly two-thirds of the hall. Most noticeable are two large Wimshurst machines, furnished each with two pairs of plates 1 metre in diameter. Each machine is placed at the head of a row of insulating platforms on which are eight stools, an arrangement which admits of electrifying sixteen patients at once. Here we may call attention to the fact that it was at La Salpetrière that the Wimshurst machine was first introduced into France and received the well-known shape used for medical purposes. Special precautions, arranged by the aid of some entirely new devices, neutralize the effect of the weather changes, which have always given so much bother heretofore, and assure a perfecly reliable operation of the electricity. Two extra machines of smaller dimensions than the principal one are kept in reserve and close at hand in case of accidents. The motive power is furnished by the district on the left bank. But as the company uses alternating current, it must for reasons easily understood be transferred. The Brown transformer is in the same hall. The plant was planned with a view to permit the use at will of either kind of current. The direct current is used for the motor which drives the electrical machines. A gramme laboratory machine and a powerful Ruhmkorff coil and a few other accessories complete, or rather will complete, this collection, for the Ruhmkorff coil is still to be set up.

General News.

THE TELEGRAPH AND TELEPHONE.

MOUNDSVILLE, W. VA.—The Panhandle Telephone Company has been organized here with an authorized capital of $50,000.

CHICAGO, ILL.—Corporation Counsel Thornton holds that the slot machine telephone as used by the Chicago Telephone Company is illegal.

PEORIA, ILL.—The Central Union Telephone Company is to at once practically rebuild its plant in Peoria, at a cost of $75,000 to $100,000, laying 82,000 feet of underground wiring.

MEDINA, OHIO.—The Medina Telephone Company, of Medina, has been organized with a capital stock of $20,000. Incorporators: Samuel B. Rawson, T. M. Brush, A. E. Lord and others.

BLOOMINGTON, ILL.—The Kankakee County Telephone Company will soon incorporate. F. G. Snow, recent manager of the Eastern Illinois Telephone Company, is the principal promoter.

URBANA, OHIO.—The Urbana Telephone Company has been incorporated with a capital stock of $30,000. The company will operate a telephone system in Urbana and between Urbana and Bellefontaine, Marysville, London, Troy, Sidney and Springfield. D. B. McDonald, E. L. Barber and J. S. Bailey are among the incorporators.

ANDERSON, IND.—The New Telephone Company, of Indianapolis, has been granted a franchise by the City Council. The company made a contract with the Overshimer Company, of Elwood, an independent organization, by which all patrons of the latter may use the New Company's toll lines. The New Company expects to have its exchange in operation in this city before January 1.

RALEIGH, N. C.—The Thomasville Telephone Company has been incorporated with a capital stock of $6000. F. S. Lambeth, J. W. Lambeth, C. A. Julian, J. F. Haden, W. E. Evans, R. W. Thomas, C. R. Thomas, W. M. Morton, A. Johnson, J. B. Boone and J. A. Green are the incorporators. The company purposes to erect a telephone system in the town of Thomasville and the surrounding county.

NORWALK, CONN.—Mr. James B. Morris, manager of the Norwalk branch of the Southern New England Telephone Company, secured a permit from the Norwalk City Council to extend the company's underground conduits from the city line to the Norwalk Hotel. The work will be commenced at once, and will probably be completed by December 1. The conduits are cement lined, each carrying one cable containing between 100 and 200 wires.

HARRISBURG, PA.—A charter has been issued to the Cumberland Valley Telephone & Telegraph Company, of Chambersburg, to erect and maintain lines in Franklin and Cumberland counties. The directors are D. K. Appenzellar, J. O. Skinner, Isaac Lesher, D. L. Grove, W. L. Minnich, E. M. Smith, H. B. McNulty, of Chambersburg, [illegible] wicks, of St. Thomas. The capital of the company is $50,000.

BAY CITY, MICH.—The Valley Telephone Company has filed a mortgage to Thomas Cranage, trustee, and covering an issue of bonds to the amount of $70,000, the proceeds of the bonds to be used in the work of completing the plant. The bonds will bear date September 1, 1898, and are to be paid in annual installments of $10,000, beginning September 1, 1901, with interest at 5 per cent. per annum. The telephone company is to continue to manage and operate the system in the valley until default is made in the payment of principal or interest of the bonds, the default to continue for ninety days.

HARTFORD, CONN.—The Southern New England Telephone Company has about completed the laying of a cable connecting Gull Island, where the Government fortifications are being built, with Goshen Point on the Connecticut shore. The work was undertaken a month ago, and the cable was laid under the supervision of General Superintendent E. B. Baker. It is 5 miles long. The Government in completing the Race fortifications has established communications with Washington or anywhere else by means of the cable just laid. It can be used either for telegraphic or telephonic purposes.

DENISON, TEX.—The Conway Telephone Company is now building a line from Tishomingo to Denison. The line is constructed as far as Emet, and will come down the Washita River from there to Linn, from Linn to Cumberland, Cliff, Grantham and small towns in that section, then across country to Mead and to Colbert and from Colbert to Denison. This is the same line that now runs from Tishomingo to Oakland and from Oakland to Ardmore. It will connect every town in the Chickasaw nation by telephone in the near future, and it is expected that it will be in operation into Denison by the middle of December or perhaps before that time.

GRAND RAPIDS, MICH.—The long delayed fight between the Bell and Citizens' telephone companies came to a head a few days ago when the agents of the American, Adams, United States and National express companies ordered the Citizens' 'phones out of their offices and refused to allow their employees to answer them when they rang. The Citizens' Company was asked to furnish the 'phones free of charge, and refused, and this is the result. The Bell Company is opening a bitter fight against the local concern, and it is expected to push the boycott movement into the railroad and telegraph offices. The Citizens' Company promptly hired a store near the express offices, put in 'phones and messenger service and gives patrons service to the express companies in that way.

NEW YORK, N. Y.—According to the annual report of the Western Union Telegraph Company for the year ended June 30 the number of miles of poles and cables operated by the company at that time was 189,847; miles of wire, 874,420; number of offices, 22,210. The number of messages handled during the year was 62,173,749. the average tolls per message being 30.1 cents. The average cost of a message was 24.7 cents. President Eckert explains in his report that the decrease of 767 miles of poles as compared with the previous year was caused by the abandonment of certain highway lines, which it would otherwise have been necessary to reconstruct at a large cost, and the transfer of the wires therefrom to newer poles on parallel railroad routes. The decrease in the average tolls received and the increase in the average cost per message are accounted for by the large number of Government and press messages consequent upon the war with Spain, transmitted during the latter part of the fiscal year, on both of which classes of messages the tolls are the lowest. The cost of construction of new property for the year was $1,117,651.

ELECTRIC LIGHT AND POWER.

BUSHNELL, ILL.—The Lewistown Electric Light Company has disposed of its stock for $5000 to a new company.

LEBANON, PA.—The Council will secure estimates on a municipal lighting plant. The present contract for electric lighting expires in June, 1899. George W. Hayes is city engineer.

MARSHALL, WIS.—The Marshall Electric Lighting & Power Company, with a capital stock of $2000, has been organized. Mr. W. H. Porter is president, A. D. Kelley secretary and treasurer.

AKRON, N. Y.—The village of Akron is contemplating a municipal electric lighting plant. The estimated cost of a plant with thirty arc and 600 incandescent lamps is $3000. At present the village is lighted by kerosene.

COXSACKIE, N. Y.—The new electric light plant in this place was put into practical operation recently. It contains one 80-arc light dynamo, one incandescent alternator of 1500-light capacity, both made by the Fort Wayne Electric Corporation.

PHILADELPHIA, PA.—The Cheltenham Electric Light, Heat & Power Company, Oak Lane, Philadelphia, is in the market for arc light machinery and appliances for about eighty lights. Mr. George U. G. Holman, manager of the company, can give further information.

WABASH, IND.—The Common Council of Columbia City has purchased the electric plant owned by a commercial corporation in that town for $21,000. The property is to be paid for in ten annual installments, and the city will not only operate the plant for street lighting, but will furnish domestic service.

PATCHOGUE, L. I., N. Y.—The Patchogue Electric Light Company will probably extend its lines to Blue Point, Bayport and Sayville. If the proposition goes through the company will erect a new brick power house on its lot adjoining the Patchogue River and install a new 1000-hp dynamo and add other improvements. It is expected to have the extension completed by December 1.

WILKESBARRE, PA.—A syndicate of local capitalists has secured an option upon and agreed to purchase a majority of the capital stock of the Wilkesbarre Electric Light Company at a price said to be $200 per share. Parties owning about three-fourths of the stock have already signed an agreement to sell their holdings at the price mentioned. It is understood that Abram Nesbitt will be president of the company under the new management.

[illegible], N. Y.—The firemen and oilers at the power house of the New York & Staten Island Electric Company, at Livingston, S. I., are out on a strike. Some wires have been cut, leaving the streets in sections of the island in darkness for the time being. Men were sent out at once to make repairs. The electric lighting service, however, is somewhat crippled, although some of it has been restored.

THE ELECTRIC RAILWAY.

TRENTON, N. J.—The trolley line between Trenton and Bordentown is now complete.

NYACK, N. Y.—It is probable that active work of construction on the Nyack trolley road will begin on or about October 20, and it will then proceed until the road is completed and in running order.

BOULDER, COL.—Boulder is to have an electric street railway. The City Council has granted a franchise to a company on condition that it get the consent of half the property owners whose property fronts on the proposed line, and also enter into bonds to complete and operate the road to the Chautauqua grounds by June next.

DETROIT, MICH.—The long-standing dispute over the granting of a franchise for a railway through Highland Park village was terminated when the Village Council, by a unanimous vote, granted a thirty-year franchise to the Citizens' Railway Company, of Detroit, to extend its tracks north from the Highland Park Hotel to the village limits at the Six-Mile road, a distance of half a mile.

WASHINGTON, D. C.—Consul Liefeld at Freiburg, Germany, writes to the State Department that a good deal of work is at present being done in that country in the line of electric railways. In a recent Berlin paper the claim was made that there were 707 miles of electric road in Germany to 715 miles in all the rest of Europe, and that in Germany there were 2492 electric cars, against 2021 in all the other countries of Europe.

NEWBURYPORT, MASS.—The Citizens Electric Street Railway Company has been organized to build and operate an electric railway in this city and between this city and Amesbury. The line will be 14 miles in length. The capital stock of the company is $150,000. Directors, Charles Goss, Amesbury, Mass.; James F. Shaw, H. I. Bartlett, F. L. Atkinson and A. C. Titcomb, Newburyport, Mass.; A. D. Bosson, Chelsea, Mass., and W. B. Ferguson, Malden, Mass.

OAKLAND, CAL.—By the bursting of three large cast-iron fly-wheel pulleys in the power station of the Piedmont electric road at Twenty-fourth Street and Oakland Avenue, in this city, a portion of the plant was destroyed. Large pieces of iron were hurled in all directions. One of the pulleys was 9 feet in diameter and the others 7 feet. The shaft was making 250 r. p. m. at the time of the accident, and the heavy steel shaft was twisted off. The damage to the station amounted to about $2000.

MOLINE, ILL.—A deal of considerable magnitude and of great importance to Moline, Davenport and Rock Island has been made public. It is the purchase by local capitalists of a controlling interest—something over $300,000—in the stock of the Tri-City Railroad Company from the Chicago men who organized and capitalized it. The company owns and operates a complete system of 41 miles of electric lines in the three cities, including a line across the Mississippi River. The capital stock is $400,000, with bonds which increase [illegible]

ROCKVILLE, CONN.—The recent report of the Hartford, Manchester & Rockville Tramway Company shows the successful operation of one of the long-distance electric railways of the State. The line from Hartford to Rockville is about 17 miles long. When it was opened, nine months ago, the opinion was ventured by railroad men and capitalists that it would never pay. Through the efforts of Mr. M. S. Chapman, the president, who had entire confidence in the enterprise, the reverse results are recorded, and the company, [illegible] $57,015, the operating expenses $38,778.

[illegible] the Brockton & Whitman Street Railway Company. The Bridgewater, Whit[illegible] Rockland to Brockton, competing with the Rockland & Abington Company. The new company intends to construct a line to Brockton from that part of Whitman known as Auburnville. In order to make quick time through the woods, the company has secured land over which to run the road, and thus will be allowed to construct in such a manner as to allow the limit of speed. The road is to [illegible]

LEGAL NOTE.

[illegible]

PERSONAL NOTES.

MR. GEORGE A. RICKER, chief engineer of the Buffalo Traction, Gorge & Buffalo Valley trolley lines, is in Colorado acting as consulting engineer of some extensive irrigation enterprises there.

MR. MAXWELL S. COOLEY, of Dannemora, N. Y., was married on October 17 to Miss Grace C. Bogart, of Elmira. Mr. Cooley is the electrician of Clinton Prison, and is a graduate of Cornell. His many friends wish him a long, happy and prosperous life.

DR. CARY T. HUTCHINSON has been chosen to fill temporarily the position of director of the course of electrical engineering at Johns Hopkins University in Baltimore. This position was held by Dr. Louis Duncan, who has been granted sick leave for a year.

EDUCATIONAL NOTES.

ELECTRICAL ENGINEERING COURSES BY MAIL.—The electrical courses of the United Correspondence Schools, 156 Fifth Avenue, New York City, it is stated, continue to give satisfaction. The scope of these courses is such as to practically cover the electrical field and furnish a course which will suit the requirements of anyone desiring to perfect himself either in some particular branch of electrical engineering or to increase his general information. The courses include complete electrical engineering, complete station engineering, electrical station engineering, electric lighting, electric railway, telegraph, telephone and electroplating courses. Mechanical drawing and the design of dynamos and motors are also taught in connection with the abovenamed courses, the tuition fees for which are so low as to be within the reach of all. These fees include the cost of specially prepared text books, examinations and drawing plates. The schools will send a copy of their circular free to any one interested in any one of the subjects taught.

THE AMERICAN SCHOOL OF CORRESPONDENCE, of Boston, has, it is stated, been most successful in imparting to engineers and mechanics a thorough knowledge of the theory and practice of their profession by means of its thoroughly up-to-date system of instruction by correspondence. Its courses are limited strictly to steam, electrical and mechanical engineering, and, as these courses have been prepared by well-known educators and experts they are complete, accurate and thoroughly abreast of the times. The success and popularity of this institution in fitting students for better positions is the direct result of the school's policy of concentration of energy, specialized courses and thorough instruction under expert supervision. The school is chartered by the Commonwealth of Massachusetts, and, as its chief aim is to benefit the ambitious workman, the tuition is placed very low in order that every mechanic may secure the technical knowledge necessary for advancement in his profession. The school will send a handbook to any address on request.

THE ELECTRICAL ENGINEER INSTITUTE OF CORRESPONDENCE INSTRUCTION.—The managers of this institution are energetically reaching out after pupils. Three of its representatives recently attended a meeting in Newark of exchange managers, switchboard men, linemen, etc., of the New York & New Jersey Telephone Company, from many of the New Jersey cities in this vicinity, at which the plans, purposes and methods of the institute were set forth. It is stated that at the close of the meeting a large number of enrollments of students, chiefly for the special course in telephony, was entered. A series of technical lectures by eminent electricians is in contemplation to be given during the coming winter in Brooklyn, Jersey City and Newark, to harmonize with or make additionally beneficial the institute's results. It is stated that the work of the institute is much appreciated by the officers of the New York & New Jersey Telephone Company, and that this encouragement led the institute management to decide upon giving the lectures as above noted.

Trade and Industrial Notes.

THE METROPOLITAN ELECTRICAL SUPPLY COMPANY, Chicago, Ill., has been formed with a capital stock of $15,000. The incorporators are William E. McKinlock and George Dickinson.

MESSRS. A. C. POWELL & SON, one of the well-known machinery houses of Syracuse, N. Y., will soon add to its business a full line of direct current dynamos and motors, both for direct and belt connection.

THE OHIO BRASS COMPANY, Mansfield, Ohio, has opened a branch office in New York at [illegible] Cortlandt Street. Mr. R. A. Byrns, formerly of the Walker Company, [illegible] and will represent in this section the well known specialties manufactured by the Ohio Brass Company.

THE GENERAL Eastern office of the Siemens & Halske Electric Company, of America, has been removed to the Land Title Building, Philadelphia, Pa. The company's New York office for local business (Metropolitan district) is [illegible] Cable Building, [illegible] Broadway, New York City.

MESSRS. HUEBEL & MANGER, 286 Graham Street, Brooklyn, N. Y., [illegible]

[illegible]

[illegible]

[illegible]

the Central Construction Company, and have taken offices in 243 Main Street, Buffalo. This company is prepared to do all kinds of mechanical and electrical construction work, including the installation of engines and boilers and complete electric plants.

"DEPRECIATION OF CANDLE POWER OF WELSBACH MANTLES" is the title of a small pamphlet just issued by the General Electric Company. It gives the result of interesting tests made both in mantles and electric incandescent lamps, and contains information of use to every electric light station manager, as well as to the general public. A copy of it will on application be sent by the General Electric Company to anyone interested.

THE BROWN & SHARPE MANUFACTURING COMPANY, Providence, R. I., recently installed a Rice & Sargent compound condensing engine of 350 indicated horse-power in the main machine shop. The new engine displaces a pair of non-condensing simple engines of the Corliss type, and it is stated that the change will effect a saving of 10 tons of coal a week. The gain in economy illustrates the great advance made in steam engineering during the past twenty years.

THE WHITING FOUNDRY EQUIPMENT COMPANY, Harvey, Ill., has just issued its new general catalogue descriptive of its electric traveling cranes and hoists suitable for central stations and electrical repair shop work, together with its labor-saving devices of interest to the electrical industries generally. The catalogue is gotten up in a most attractive and instructive manner, and should be on file in the office of every one interested in this class of apparatus.

"PEGAMOID" aluminum paint is recommended by the American Pegamoid Company, 346 Broadway, New York, for qualities which are valuable in the electrical industries. It dries quickly and is untarnishable, washable, water, oil, grease and weather proof. It is stated to be excellent for protecting and decorating dynamos, motors, arc lamps, sockets, brackets and all kinds of metal work. It possesses the important property of being very adhesive to the article to which it is applied, and electrical manufacturers will do well to look into its merits.

OF THE MANY ELECTRICAL SIGNS erected for the Knights Templar conclave, which was held in Pittsburg last week, some of the most elaborate were built complete by Doubleday, Hill & Co., of Pittsburg, and for many others the same firm supplied the material. Among the former was a large sign 36 feet in length erected for Weyman & Co., consisting of two waving flags and a handsome centre piece. This required 1200 8-cp lamps. In the window of the headquarters of Doubleday, Hill & Co. there was also a handsome shrine emblem, consisting of a sword, crescent and Maltese cross.

A 30-TON ELECTRIC CRANE, having a span of 46 feet, will be installed in the extension of the foundry of the Benjamin Atha & Illingsworth Company at Harrison, N. J. The Berlin Iron Bridge Company, East Berlin, Conn., is erecting this extension, which will be 51 feet wide and 152 feet long, the framework being of steel throughout. The sides are covered with corrugated iron on steel purlins, and are arranged for suitable doors and windows. The electric crane will be supported on the side columns. The roof construction is of steel trusses and purlins arranged with openings in the roof for skylights.

CONDUIT INSTALLATION.—A contract has been awarded by the Narragansett Electric Lighting Company, Providence, R. I., to the Standard Fireproofing Company, New York, for the conduit for the installation of an underground system in the city of Providence. The Potomac Terra Cotta Company, Washington, D. C., has furnished about 100,000 feet of the conduit. This, it is stated, is the first terra cotta conduit to be laid in New England, and as this particular make of conduit has given much satisfaction in other sections it will probably lead to other big shipments to New England territory in the near future.

THE ELECTRICAL TRADES SOCIETIES of the different cities met in convention at the Burnet House, Cincinnati, October 7, and formed a national credit association, adopting a constitution and by-laws governing its business policy. The board of managers consists of one member from each local society, and it is the purpose of the national society to issue monthly lists of delinquents and furnish such other information as may be of interest to its members. As the association grows stronger it is purposed to establish a credit bureau by which it hopes to be able to keep members thoroughly informed regarding buyers of electrical goods.

THE CABINET MANUFACTURING & SUPPLY COMPANY, 244 The Arcade, Cleveland, Ohio, has succeeded to the business of the Cabinet Manufacturing Company, of Steubenville, Ohio. The company is prepared to furnish telephone woodwork and various kinds of cabinets of first-class workmanship at reasonable prices. Mr. M. T. James, a well-known business man who was the originator of the Cabinet Manufacturing Company, is secretary and treasurer of the Cabinet Manufacturing & Supply Company. The quality of the work turned out by the company is thus guaranteed. Manufacturers of telephones and others interested will find Mr. James in every way worthy of their confidence.

THE VICTOR TELEPHONE MANUFACTURING COMPANY, Chicago, is enjoying a very active business. Among its recent shipments was an exchange equipment of a capacity of 200 'phones to Mitchell, S. Dak. This included switchboard, telephones, cross-connecting boards, lightning arresters, etc. The company is engaged just now, besides other work, in filling an order for an exchange equipment for Paxton, Ill. This exchange will have a 200-'phone capacity. A switchboard of 400-drop capacity for Champlain, Ill., and a complete outfit of 100 capacity, including all central station apparatus and 'phones, for Rantoul, Ill., are also going through the Victor Company's factory. In addition to the above the company is engaged on a large amount of other telephone work for early delivery.

THE MASON VITRIFIED SALT-GLAZED TERRA COTTA CONDUIT made by the Potomac Terra Cotta Company, Washington, D. C., does not absorb water and is indestructible by the elements when properly laid. These conduits are salt-glazed inside, as well as out, and offer little or no resistance by friction in drawing in cables. The standard length is 30 inches, and they are made in two and four-way patterns, with ducts of 3 inches and 3¼ inches in diameter, suitable to carry the largest sized cables. Iron dowels secure perfect registration of the ducts and prevent displacement. The Mason ducts are extensively used in Washington by the Postal Telegraph Company, the Chesapeake & Potomac Telephone Company, the United States Electric Light Company and the Potomac Electric Power Company.

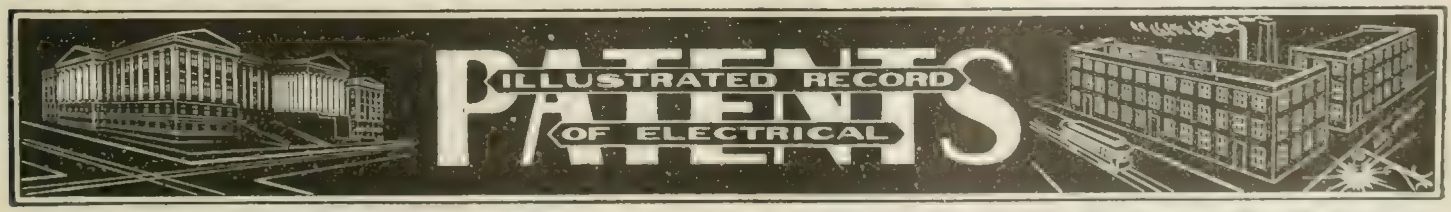
WATER WHEEL GOVERNORS.—The Lombard Water Wheel Governor Company, Boston, Mass., has just issued a catalogue in which is given a general description of the water wheel governors manufactured by it, together with a few speed diagrams, showing the degree of regulation which they have produced under various conditions in actual practice. It also contains copies of a few letters from those who are using the company's governors, setting forth their experience with and opinion of them. These governors are so designed that they fully compensate for the momentum and inertia effects in the moving water column, and the fly wheel effects in the rotative parts, so that they prevent the water wheels to which they are attached from racing. They are dead beat and move the water wheel gates by one prompt motion to the correct position for every change of load. The various types of governors are well illustrated, as are also several prominent installations. The catalogue embraces in condensed form such data taken from actual practice as will be of most value to those interested in the speed regulation of water wheels and steam engines. The Lombard Company makes governors for steam engines as well.

THE HARRISON SAFETY BOILER WORKS, Philadelphia, Pa., reports a long list of recent sales of Cochrane feed water heaters and purifiers, including the following: Schoenberger Steel Company, Pittsburg, Pa., two 2500 horse-power; Sheffield Electric Company, Sheffield, Ill., one 100 horse-power; the Lane & Bodley Company, Cincinnati, Ohio, two 200 horse-power and one 300 horse-power; Clinton Cement Company, Pittsburg, Pa., one 300 horse-power; Pennsylvania Manufacturing Light & Power Company, Philadelphia, one 2000 horse-power; Washington Coal & Coke Company, Star Junction, Pa., one 500 horse-power; Pennsylvania Railroad Company, Broad Street Station plant, Philadelphia, one 2000 horse-power special; Charles Erith & Co., London, England, one 100 horse-power. The following is a partial list of recent sales of Cochrane separators made by the same company: Philadelphia (Pa.) Engineering Works, one 8-inch, two 6-inch and one 3½-inch horizontal; De la Vergne Refrigerating Machine Company, New York City, one 6-inch oil ammonia separator; F. R. Dravo & Co., Pittsburg, Pa., one 4½-inch horizontal; Massachusetts Institute of Technology, Boston, Mass., 8-inch horizontal; United Gas Improvement Company, Philadelphia, Pa., one 6-inch, one 8-inch and three 5-inch horizontals; Arizona Copper Company, Ltd., Clifton, Ariz., one 5-inch horizontal; Spring Garden Institute, Philadelphia, one 7-inch horizontal; Fraser & Chalmers, Chicago, one 6-inch horizontal and one 8-inch vertical; Charles Erith & Co., London, England, one 6-inch horizontal; Cleveland (Ohio) Rolling Mill Company, six 8-inch, one 5-inch and one 4-inch vertical; East Jersey Water Works, Little Falls, N. J., two 8-inch vertical; Denver Engineering Works, Denver, Col., one 3½-inch and two 4½-inch horizontal; Cambria Iron Company, Johnstown, Pa., two 16-inch horizontal and one 6-inch horizontal; Oliver-Snyder Steel Company, Edith Furnace, Allegheny County, Pa., one 6-inch horizontal; Jordan, Marsh & Co., Boston, Mass., 5-inch vertical; Gloucester (Mass.) Water Works, 5-inch horizontal; Filer & Stowell Company, Milwaukee, Wis., one 10-inch horizontal; Brooklyn, N. Y., Post Office, one 6-inch vertical and one 6-inch horizontal.

Business Notices.

THE ILLUSTRATIONS in this issue were made by the Photo-Engraving Company, 9-15 Murray Street, New York City.

THE WAR IS OVER, and now our thoughts are all of peace and home. There are, too often, people to be found who have no home, and it is to them these few words are addressed. If you really want a home you can easily get one, but you should act at once before the relapse from the war puts prices on the advance. In Marinette County, Wisconsin, the very finest farming land is to be had now at a most modest figure. Excellent home markets are at hand to take whatever the farmer raises, and good prices are given. These lands are on the Chicago, Milwaukee & St. Paul Railway, and full information concerning them will cheerfully be furnished by C. E. Rollins, Immigration Agent, [illegible] La Salle Street, Chicago.



UNITED STATES PATENTS ISSUED OCTOBER 11, 1898.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

[illegible] CONDUIT OUTLET INSULATOR. F. W. Jackson, of Boston, Mass. App. filed June 25, 1898. An outlet insulator for conduits comprising a hollow metallic member having [illegible] [illegible] threaded and the other end [illegible]

[illegible] LIGHTNING ARRESTER. [illegible] filed Jan. 15, 1898. In a system of distribution, the combination of a lightning arrester and a coil having portions reversely wound in close proximity to each other, said coil being placed between the lightning arrester and the [illegible]

[illegible] ELECTRIC SWITCH. [illegible]

[illegible] of insulating material, contacts mounted thereon, an operating mechanism having a switch plate in operative relation to said contacts, said base being cup-shaped and having in its outer walls open grooves leading from the bottom of said base to said contacts, substantially as described.

[illegible] TROLLEY ARM; E. R. Stepp, of Jersey City, N. J. App. filed March 15, 1894. The combination, with a trolley arm and an elongated roller pivoted therein as a trolley wheel, of guides located at opposite sides of the trolley arm, the said guides having inclined surfaces leading upward and inward to the peripheral surface of the roller at its ends, the said guides being arranged in longitudinal alignment with the said roller and with each other, as and for the purpose specified.

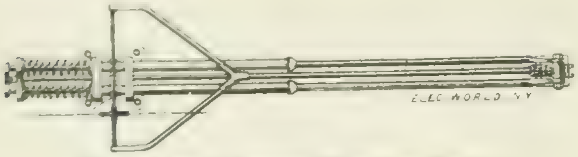
612,068. ELECTRIC RAILWAY; F. D. Sweet, of Elyria, Ohio. App. filed Nov. 22, 1897. In an electric railway, a bar suspended from the under side of the truck and through which the electric current is made to pass, a series of loosely pivoted strips pivoted at their upper ends upon the bar and which are free to swing back and forth thereon, and means located below the pivots for limiting the amount of movement which the strips shall have, combined with boxes arranged along the track and with which the strips make connection as they pass over them.

612,122. ELECTRICAL CONVERTER; F. Schwedtmann, of St. Louis, Mo. App. filed Aug. 28, 1897. In a converter, a suitable casing, a main chamber in said casing, a core in said chamber, supporting frames holding said core by means of projections engaging with the edges thereof, and side chambers into which the coils of said core project through openings in said supporting frames.

612,123. ELECTRICAL CONNECTOR; F. Schwedtmann, of St. Louis, Mo. App. filed Nov. 11, 1897. An electrical connector, consisting of an inner and an outer member, having smooth contact surfaces, one of said members being tubular and slit along a portion of its length to form a plurality of tongues or strips and an annular spring for forcing said tongues or strips against the other member, said annular spring having its axis coincident with the axis of said tubular member.

612,132. ELECTRIC TROLLEY DEVICE; C. L. Jeffrey, of Johnstown, Pa. App. filed Jan. 12, 1898. In an electric trolley device, normally free to move in a vertical plane, a lock for preventing said movement, said lock being actuated by the lateral movement of the trolley device when the same is in a predetermined vertical position.

612,139. CASING FOR ELECTRIC CAR LIGHTING APPARATUS; W. F. Richards, of Buffalo, N. Y. App. filed Nov. 26, 1897. The combination with a car body, a car axle and the truck frame, of a dynamo supported by the car body and capable of moving toward and from said axle, driving mechanism for transmitting motion from said car to the dynamo, and a casing enclosing said driving mechanism, and composed of a front section mounted with its front portion on said axle, so as to vibrate vertically therewith, and hinged at its upper rear end to the truck frame, and a rear [illegible]



No. 612,132.—Electric Trolley Device.

[illegible]

[illegible] ELECTRIC SYSTEM OF DISTRIBUTION [illegible]

[illegible]

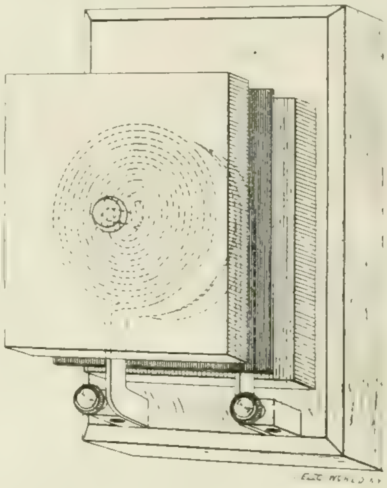
[illegible]

[illegible]

[illegible]

ber, and adapted to bear against said sets of resistances and clamp same against another member of same frame, substantially as described.

612,219. TELEPHONE CENTRAL STATION APPARATUS; J. H. West, of Berlin, Germany. App. filed July 8, 1896. The combination of telephone lines, spring jacks therefor at several switchboards to which the lines are connected, an annunciator for each line and normally connected therein, a visual indicating signal for each line, one terminal of each indicating signal being normally connected to a source of electricity, the other terminal being connected to two circuit controlling devices, one controlled by the operation of the annunciator, the other forming a part of the spring jack, being controlled by insertion of a plug in said jack.



No. 612,015.—Lightning Arrester.

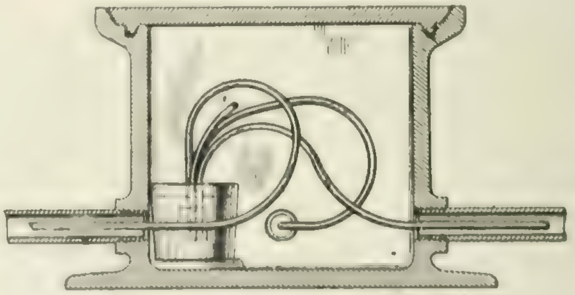
612,231. ELECTRIC TRACTION APPARATUS; R. Demeuse, of Brussels, Belgium. App. filed July 23, 1897. The combination with the electromagnets and their armature, of wedge blocks arranged on opposite sides of said armature, depending hinged and spring-pressed flaps to receive the wedge located on the upper side of the armature, and upwardly extending springs to embrace the wedge located on the under side of said armature.

612,255. TROLLEY POLE; V. A. Mason, of Austin, Tex. App. filed April 20, 1898. A trolley pole, comprising the butt section, the hollow wheel section hinged at one edge of its end to the butt section and the spring arranged within the hollow wheel section, secured at one end in connection with the wheel section and at its other end in connection with the butt section and operating by a contracting tension to tilt the wheel section on its pivotal connection with the butt section, substantially as described.

612,326. ELECTRIC BATTERY; M. E. Fuld, of Baltimore, Md. App. filed Aug. 4, 1897. The combination with the cells of an electric battery, of cell cases enclosing said cells, said cell cases being provided with recesses in their upper edges, caps enclosing the upper ends of said cell cases and extending into said recesses, enlarged supporting terminals screwed into said caps, a cell support and removable devices securing the said terminals to the cell support, substantially as described.

612,344. UNGERGROUND ELECTRIC RAILWAY; C. W. Jenkins, of Richmond, Va. App. filed Oct. 28, 1897. A conduit for electric railways provided with transverse insulating beams for the insulators and the insulators supported by and arranged alongside the beams, substantially as described.

[illegible] TROLLEY WHEEL SUPPORT; L. Lane, of Johnstown, Pa. App.



No. 612,1[illegible].—Electric System of Distribution.

[illegible]

The Electrical World.

VOL. XXXII. NEW YORK, OCTOBER 29, 1898. No. 18.

PUBLISHED EVERY SATURDAY BY

THE W. J. JOHNSTON COMPANY,

9 Murray Street, New York.

Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York.

New England Office, 620 Atlantic Ave., Boston.
Western Office, 936 Monadnock Block, Chicago.
Philadelphia Office, 929 Chestnut Street.

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THE ELECTRICAL WORLD,

9 Murray Street, New York.

VOL. XXXII. NEW YORK, OCTOBER 29, 1893. No. 18.

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SUBMARINE CONDUITS.

From the early days of the telegraph industry it has been customary to carry electrical lines under rivers by means of iron-armored cables generally also lead-covered. Since the development in this country of draw-in conduit systems for subterranean work, the advantages of this plan have become more and more apparent for river crossings not too long for the drawing in of cables, that is, less than 800 or 1000 feet in length, and during the last two years several such conduits have been put in. A description of two such installations of conduits lately constructed in Boston may be found on another page of this issue. The advantages of this system over cables simply sunk into the river bottom are numerous. For telephone and telegraph service armored cables are rarely made in sizes larger than those carrying fifteen pairs of conductors, and the sheathing and armoring of six such cables, as compared with the lead covering of one one-hundred-pair cable, is very expensive, so that when several hundred pairs cross at one point the saving is a large one. Outside of the question of cost the conduit gives a solid structure deep enough in the mud to be sheltered from anchors, etc., and sufficiently solid to resist almost any probable mechanical disturbance. If not dependent for life on metal the depreciation of that part of it below low-water line is extremely small.

Of the two conduits described on another page one contains iron-pipe ducts protected carefully against corrosion on the outer sides and intended to be kept dry inside, or, if this cannot be accomplished, to be filled with a heavy oil. The other abandons the use of iron altogether and depends on wooden ducts which will not corrode and give a smooth surface for drawing, the only criticism against them not applying to the other being that ice is more likely to affect the cables and perhaps crush and split the lead sheathing, the iron in the other case being intended to prevent this. A combination of the merits of the two might be obtained by using a wooden duct with a strong iron lining at and near the water line where only it is affected by ice and where the iron after corrosion may be readily renewed.

SPECIAL TRACKWORK FOR ELECTRIC RAILWAYS.

Perhaps the greatest source of trouble and rapid depreciation of an electric railway equipment has been the pounding of the rolling stock on uneven rail surfaces. The conditions of street traffic are such as to require a rigid roadbed, which acts as an anvil, giving at every inequality in the surface a blow that not only increases the inequality but flattens the wheel tread, sharpens the flange, destroys the gear teeth, distorts the journals, loosens the truck bolts, disintegrates the insulation, causes sparking at the commutator, sags the side frames, rattles the windows, makes the riding uncomfortable and disagreeable, necessitates the slowing down of the cars, and thus lengthens the schedule, and last, but not least, reduces dividends.

Now that the joint problem bids fair to be satisfactorily solved, one other source of this pounding which, though not as frequent, is more severe, needs attention. This source is the switches and frogs of turnouts and crossings. In the evolution of the heavy girder rail from the old strap rail of the horse car lines, the surface of the special work has remained as it was, and the smooth-riding fittings of steam railroad practice have not been imitated. It seems to be the general opinion that the special conditions of mud, slush, etc., prohibit the use of such fittings, although the practice of cable roads in the use of elaborate fixtures below the surface should prove the contrary. The old tongue switch on one rail, with the permissive mate on the other, take the place of the finely pointed double split switch of steam railroad practice. An attempt is made to transfer the weight on the wheel from the tread and head of the rail to the flange and groove in passing such mates and frogs, but with what success the passenger can readily tell. The pounding is so severe that extra hard pieces of steel are now inset at these points, with even worse results to the rolling equipment.

Underground switch-operating rods connected to levers are now quite commonly used, and there is no reason why the switch cannot be made positive on both rails as well as one. Spring switches are also often used, in spite of the ice and mud, and spring rail and frogs might be built on the same general designs that would be of great value in rarely used turnouts and crossings on heavily traveled lines. With the heavy cars, high speed and short headway of some of the larger lines any improvements in this respect would mean a great gain, and if the desired result could be accomplished in no other way it might almost pay to go to the extreme of constructing a subterranean chamber and supporting all special work on springs to avoid the severe pounding and banging of the cars at these points.

ADJUSTING FOR MINIMUM CURRENT.

In the running of synchronous motors and rotary converters on alternating-current combined light and power systems, a most crude and primitive practice prevails as to the adjustment of the field magnetization. As is well known, any synchronous machine will run with an extremely wide range of current in the shunt field coils, in fact, it is often impossible to break down the machine by any change whatever; but slight changes do have a great effect on the wattless currents introduced into the system, and these wattless currents have a most disturbing effect on the regulation, which is often fatal to the use of incandescent lights on the same mains. The adjustment is generally made for minimum alternating current, since with minimum current there must be unity power factor—that is, no wattless currents.

In principle this would be commendable if by any means the point of minimum current could be determined with any degree of accuracy. The combination of the minimum or energy currents with the wattless currents being a vectorial one, a very slight variation from the minimum means a heavy introduction of lagging or leading currents; for example, an increase above the minimum of 5 per cent. means either a lagging or a leading current with a magnitude over one-third of that of the total energy current itself. In one case this lagging current causes an inductive drop of voltage in the dynamos, lines and transformers generally much greater than the ohmic drop; in the other case it causes an inductive rise, [illegible] than that generated by the dynamo. This close adjustment of the ammeter indication to an unknown minimum must be obtained with often a variable load, which keeps the needle swinging, and almost [illegible] machine caused by the slight speed variations of the generator during the rotation, which precludes absolutely anything more than a [illegible] though one even more indirect, would be to adjust the rotary field until its effect on the line-drop is such as to give a proper voltage, [illegible] will give accurate indications of the conditions wanted. In this respect the induction motor has an advantage over the synchronous motor, in that its wattless currents, although lagging, are always [illegible]

GOVERNING THE SPEED OF ALTERNATING GENERATORS.

The maintenance of close regulation on alternating-current circuits is a much more difficult matter than on direct-current systems, since in the latter case the dynamos may be and generally are compounded not only to make up by the increased field strength for the drop in speed and the internal fall of voltage on increased load, but may be over-compounded to cover also the line drop. With alternating-current machines of the sizes now coming into use the compound winding is impracticable, and users of such machines are becoming more and more insistent on a close voltage regulation that gives the manufacturing designers no little trouble. Even with a 5 per cent. regulation between no load and full load, non-inductive, the drop at the lamps in case of a change of load is considerable. With a 2 per cent. drop in speed, 5 per cent. drop in the generator, a few more per cent. in the lines, transformers and secondaries, the amount to be made up by a readjustment of the field rheostat is large, but with the increasing use of alternating-current motors the problem is rendered more difficult by the inductive drop, which may double or more than double the ohmic drop in machines, lines and transformers. This load being a fluctuating one, especially with such machines as elevator motors, calls for some cure more prompt than the manipulation of the rheostat by the switchboard attendant.

A closer regulation than 5 per cent. even on non-inductive load is a difficult thing to get on alternators, as even this requires a carefully distributed winding, which means an added expense for insulation, and a large ratio of field to armature ampere-turns, which means a machine much more expensive and with much greater iron losses for a given output than one in which the rated load is determined only by the heating limit.

The best place for the solution of the regulation difficulty is in the engine governor, if it can be there effected. It has been customary to consider that the ultimate perfection of the governor mechanism is attained when the governor gives as high a speed with full load as with no load, but there is apparently no insuperable reason why a governor should not be designed that would give a speed higher with increased load and sufficiently so to overcome all other drops, even with a cheaply built generator. Relay governors are now successfully applied to large steam engines, and the relay governor is readily capable of differential attachments which shall bring into the determination of the speed any desired influence. A combination of a relay governor with weights so arranged as to give also the inertia effect and a mechanism designed to influence the speed by the position of the valve mechanism itself, so as to give a rise of speed between no load and full load of say 15 per cent., would give a very nicely compounded alternator. If the governor were influenced electrically by the output of the machine it might be so arranged as to give a rise on inductive load greater than on non-inductive loads and so eliminate the increased drop due to inductance, but this is perhaps too much of a refinement for serious consideration at the present time. The paralleling of alternators so governed would be undoubtedly a problem, but not an inherently insoluble one.

Long Distance Telephony on the Pacific Coast.

The long-distance telephone line between San Francisco, Cal., and Portland, Ore., was completed on October 13. Through lines [illegible] by way of Walla Walla were completed the previous week. All of these lines are of 435-pound copper wire. Speech has been carried on between San Francisco and Spo[illegible] a distance of [illegible] miles of the wire run. On October 16 the first public test and official opening was made of the line between San Francisco and Portland, with the usual musical selec[illegible], and the next day a public exhibition was given, with twenty [illegible] in the [illegible] Building at the Portland end of the line [illegible] exchanging compliments and con[illegible]

Electric Lighting in the Chicago Peace Jubilee.

ELECTRICITY played a shining part in the national peace jubilee at Chicago during the week beginning October 16. Of the decorations which the city put on for the occasion incandescent lights formed the most important and striking feature.

By day the hundreds of miles of bunting spread over the buildings and fluttering in the streets considerably outdid the rows and festoons and pieces formed by the lamps, though even then the continued foggy weather gave a chance for many of the merchants to burn their lights through the daylight hours. But at night-time, when grimy Chicago was transformed into a bower of fairyland, the electric lamp was supreme, as may be imagined on reference to the illustrations on page 441.

Fifty thousand extra incandescent lamps, at the lowest estimate, were burned in the streets of Chicago during the peace jubilee. They made the nights in the downtown districts brighter than the foggy days. A large number of these lights, distributed evenly throughout the business centre, were put up by the jubilee committee. The rest were installed by the business houses, office buildings and individuals. Together they made Chicago, already reputed to be second only to Paris in the brilliancy of its night displays, take rank for a few days as the most gorgeously illuminated city in the world.

The lighting and decoration scheme undertaken by the jubilee committee was a novelty. So far as known to the managers, nothing like it had ever hitherto been attempted, with the exception of the recent Queen's Jubilee in London, where a conspicuous failure was made. The plan decided upon was the startling idea of making for the downtown districts a roof of flags by day and of light by night. The jubilee committee decided to make its roof of flags and lights by stringing rows of both at regular intervals across the streets. The flags were hung on stout ropes, six to ten on each. The lights were swung in graceful festoons from above the centre of the roadways to the buildings on either side. They formed at night the drooping curves of a tent roof, and by day harmonized well with the straighter lines of the bunting canopy. The entire downtown district, with the exception of small portions of the cross streets, was roofed in this manner. Over three miles of streets were decorated, and upward of 10,000 16-cp incandescent lights employed. The work was turned over entirely to the Chicago Edison Company, with directions to install the lamps and run them during jubilee week. Under the supervision of Mr. J. H. Goehst, superintendent of construction, and Assistant Superintendent H. E. Niesz the work was completed in the marvelously short time of two weeks after the signing of the contract. Over 100 men were employed on the task. Taking into consideration the extra construction done on the arches, the Chicago Edison Company surely established a record for rapid work.

After the general form of the illumination was decided upon by the jubilee committee all wiring details were left to the Edison Company. With a rush job of such magnitude it was evident that ordinary methods had to be modified to a considerable extent. The requisite number of waterproof sockets or small street hoods of any kind could not be obtained in a hurry, and special devices had to be employed instead. After a day spent in experimenting, the following form of construction, used throughout the work, was followed:

Small cups 4½ inches across and 2 inches deep, made of tinned sheet iron of the variety commonly known as "tin," were made specially in large quantities by a big hardware firm. A hole was punched in the bottom of each cup. Ordinary keyless sockets of the standard Edison type were fitted each with two pieces of rubber-covered wire about 8 inches long. Through the holes punched in the cups the wires were drawn, pulling the sockets tight up against the bottoms. A small amount of tape, compound and waterproof paint on the outside finished the job, making the cups into serviceable street hoods, which answered equally well for reflectors. These were turned out at the rate of several thousand a day. They cost to make about 2 or 3 cents apiece, and in many cases were retailed to merchants who wanted to decorate with strings of lights at 18 cents apiece. When their present period of usefulness is over the sockets will be taken back again by the Edison Company.

Each festoon was supported above the centre of the street by an insulator hung from two strands of No. 4 B. & S. galvanized iron wire, stretched from building to building. One strand would ordinarily have been sufficient, but Mr. Goehst elected to take no chances of breakages. The festoons themselves were each composed of two strands of No. 6 B. & S. rubber-covered wire, on which the socket wires were spliced at intervals of a few inches. All the construction was made with high-grade rubber-covered wire of the several varieties which the company had on hand or could secure in a hurry. In the London jubilee, where the lighting failed just when most needed, ordinary weatherproof wire was used. The result, after the first heavy rain, was a succession of grounds that ruined the display. Wishing to avoid this trouble, Mr. Goehst insisted on the use of high-grade, rubber-covered wire everywhere, and the outcome fully justified his action.

From 80 to 120 lights, according to the width of the street, were hung on each festoon. Four festoons were put up in each block. Forty-five feet was the average height above the street, although the arches and other decorations at times made variations necessary. Standard 113-volt 16-cp uncolored Edison lamps were used. Every two festoons were put on a small knife switch, which was placed in a waterproof box on the front of the building near the pavement. Taps were made on the street mains of the Edison Company, and not in any case on the building wires. The lights were equally balanced on both sides of the three-wire direct-current system. As some of the runs were long and had a number of lights on them, wire as large as No. 0000 B. & S. was used. Altogether about 20 miles of wire was installed, varying in size from No. 0000 to 14 B. & S.

A neat scheme was adopted in many cases to hold the ends of the festoon wires without damaging the woodwork of the buildings. As over 200 permissions were obtained for the use of windows, assurances had to be given that the wood work would not be injured and that the windows would be left shut. So pieces of 4 by 4 pine scantlings were sawed, of lengths a little greater than the widths of the windows. The scantlings were wrapped with cloths, so as not to scratch even a varnished surface, and the ends of the festoon wires were made fast to them. The weight of the festoons was sufficient to hold these pieces of 4 by 4 in place on the inside of the windows, while the sashes could be closed, except for a small crack at the bottom. This scheme was found perfectly satisfactory where great care had to be used. In other places ordinary porcelain insulators and cleats were employed.

The entire cost of the festooning work is estimated at about $20,000. The Edison Company has agreed to take back the material employed, so that the final expense is not yet known. The city waived its usual inspection fee of 10 cents a light, helping to materially reduce the cost to the jubilee committee. Throughout the work there was not a workman or citizen hurt, and not a mishap of any kind. Although the lights have gone through a week of wind and rain storms so severe that five ornamental arches were destroyed and much of the decorations ruined, yet no trouble of any consequence has been reported. This fact is unquestionably due to the use of high-grade rubber-covered wire and the best of wiring methods.

The lights were turned on every evening at 6:30 o'clock, and extinguished at 11:30 o'clock. Patrolmen did the work, walking from switchbox to switchbox, until all the festoons were reached. The system of decorative light took about 2500 amperes at 220 volts, supplied by the Edison central station. So pleased are the merchants and business men with the festoon lights that a movement was put on foot to continue the nightly illuminations of the city for thirty days more, and the project will doubtless be carried out before this article is read. In fact, there is a strong possibility that some form of permanent lighting by festoons will be kept by the State street merchants.

Next to the festoon lighting the electrical feature of the peace jubilee was the municipal arch, donated to the city by the Western Electric Company, the General Electric Company and the Chicago Edison Company. This structure was built at the corner of La Salle and Washington Streets, near the City Hall. By day it proved to be the best designed and most handsomely decorated of the whole sixteen arches built for the jubilee, while at night its splendor was worth going miles to see.

The municipal arch was designed by John E. Youngberg, an architect of Chicago. Its principal parts were made in various carpenter and paint shops of the city. The entire structure was erected by the Chicago Edison Company, which also did the electric wiring on it. Seven days and nights were required for the work. The arch is 45 feet high and 50 feet wide. It is designed in pure classic style, painted ivory-white and decorated with appropriate portraits and inscriptions. The principal lines of the structure are picked out by uncolored 16-cp lamps, which, in connection with the white color of the arch, make a most beautiful night effect.

The wiring of the municipal arch was pronounced by President Samuel Insull, of the Chicago Edison Company, to be one of the most perfect pieces of work he ever saw. It was done entirely on the hollow inside of the structure. The lights are 1200 in number, set in porcelain wall sockets arranged 15 inches apart on strips of wood, which last were fastened to the arch in 8, 10 and 12 foot lengths. The entire 1200 lights were put in place, wired up and connected in twenty-four hours. Simplex wire was used, donated for the purpose by Mr. H. R. Hixson. The arch is connected with the city hall plant, which furnishes the current, by a 300-foot overhead line, consisting of three No. 0000 B. & S. cables. All the lights are on one 1000-ampere knife switch in the city hall engine room.

The street railway companies of the city decorated for the jubilee with flags and colored lights. Several thousand 16-cp lamps were colored red and blue with collodion for them by the Chicago Edison Company. These, with a proportionate number of clear lamps, were put in the electric cars in place of the regular bulbs. The effect was pretty, but rather dim for good street-car illumination. After the jubilee these colored lamps were dipped in wood alcohol at the expense of a few dollars, and cleaned off for ordinary use.

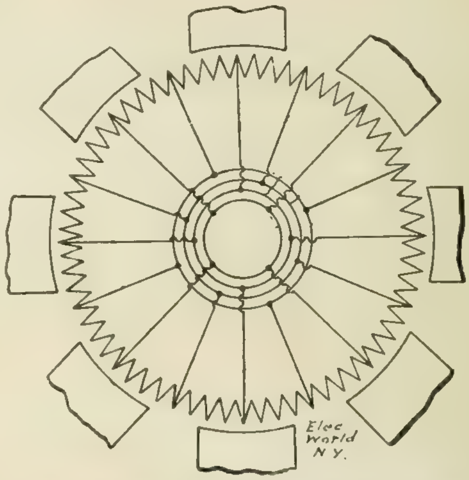
The private lighting displays brought out for the jubilee were many and varied. They took the form principally of signs, shields and strings of lights festooning the fronts of buildings. The great retail merchants of State Street led in this illumination, using thousands of incandescent and many arc lights along the thoroughfare. The newspaper offices and the theatres well seconded their efforts.

Taken all together, the cost of the lighting for the peace jubilee is estimated to be between $30,000 and $40,000. This sum is by far the greatest single item spent by the city in its rejoicing In this respect the celebration just closed differs from all preceding affairs of the kind. It is significant of the progress of the age that the most important part played in an affair of this nature was taken by electricity.

Balancing the Distribution of Current in Parallel-Wound Armatures.

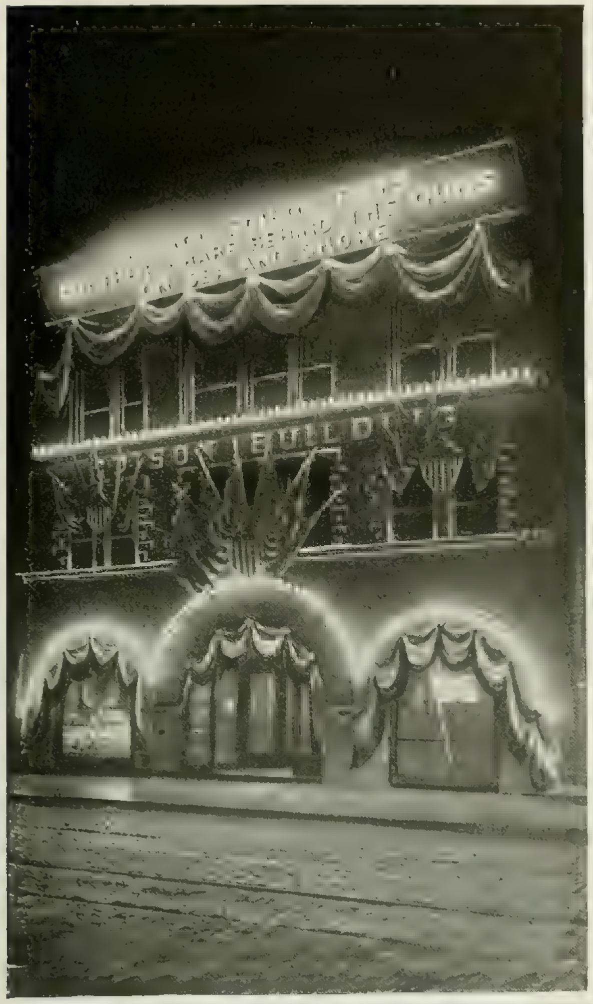
In the armatures of multipolar direct-current dynamos the circuits of which are of the parallel or lap-wound type there is obviously an opportunity for the current generated to be unequally distributed between the windings under various poles. If, for example, one pole, for any reason, is somewhat stronger than the others, giving a higher electromotive force between the adjacent brushholders, each of which is connected directly with all other brushholders of the same polarity, thus throwing the windings under all the poles in parallel with each other, the winding with the higher electromotive force will generate more than its share of the total current. As these local circuits are of extremely low resistance a very slight difference in the electromotive forces will not only unbalance the distribution but even tend to make those of higher pressure force current back through those of lower pressure, thus causing a continual C^2R loss even when there is no load on the external circuit. While the reaction of such increased current tends to crowd into one horn the lines of force issuing from the [illegible] viously aided if the brushes are given any considerable lead, yet, if [illegible] the pole will be still further weakened, the action becoming cumu- [illegible] on all the other sections. The initial inequality in flux may be due to any one of several causes—eccentricity of the armature, faults in the castings, poor joints in a bolted-up laminated field, inequalities or partial short circuits in the field winding, differences in the adjustment of the lead of the brushes, etc. An extremely simple and ingenious method of overcoming this difficulty is that described by Mr. B. G. Lamme in United States patent No. 573,009, issued December 15, 1896.

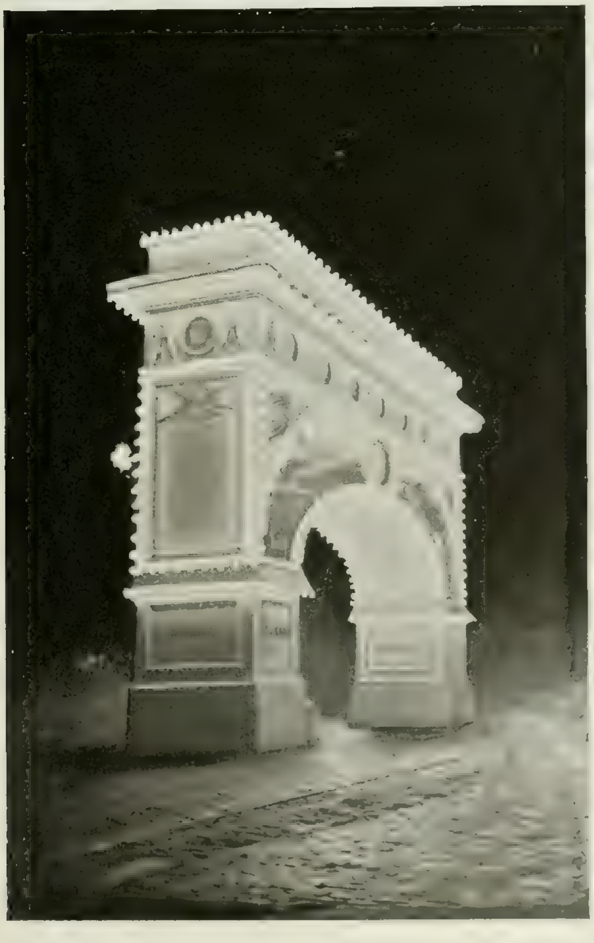
As is well known, two or more synchronous alternating-current machines, when run in multiple with each other, mutually adjust each other's field excitation to the same voltage output. Two such machines must maintain synchronism with each other or become mutually short-circuited, and, if the current in the field windings of one is much greater than that of the other, the tendency is for the one with the greater magnetization to generate current and deliver it to the other, driving it as a motor. The other, however, cannot speed up, and the electrical conditions are balanced by an interchange of wattless currents, the reaction of which weakens the field flux of the more strongly excited machine and strengthens that of the more weakly excited machine, until the two, if directly connected together, deliver the same terminal voltage. The windings of any direct-current generator are the seat of alternating electromotive forces, and if provided with collecting rings, such as those of a rotary converter, will give or take alternating currents. The windings passing at any instant under the various poles of a multipolar generator may be considered as alternating-current armatures, which by internally cross-connecting points situated at an angular distance of two-pole angles, and hence of normally the same potential, may be thrown in multiple with each other and be made thereby to automatically balance the field flux of their respective poles, just as do the armatures of independent alternating-current generators in parallel. This is very simply accomplished in large multipolar generators made by the Westinghouse Company by several rings, which may be seen under the leads to the commutator, tapped off to the several points of equal potential. If two such rings are used the balancing effect is the same as would be exerted between a group of single-phase alternators, the wattless current flowing exerting an intermittent or pulsating reactive effect on the poles. By putting in three rings or more the effect may be rendered more steady and similar to that in multiphase machinery.



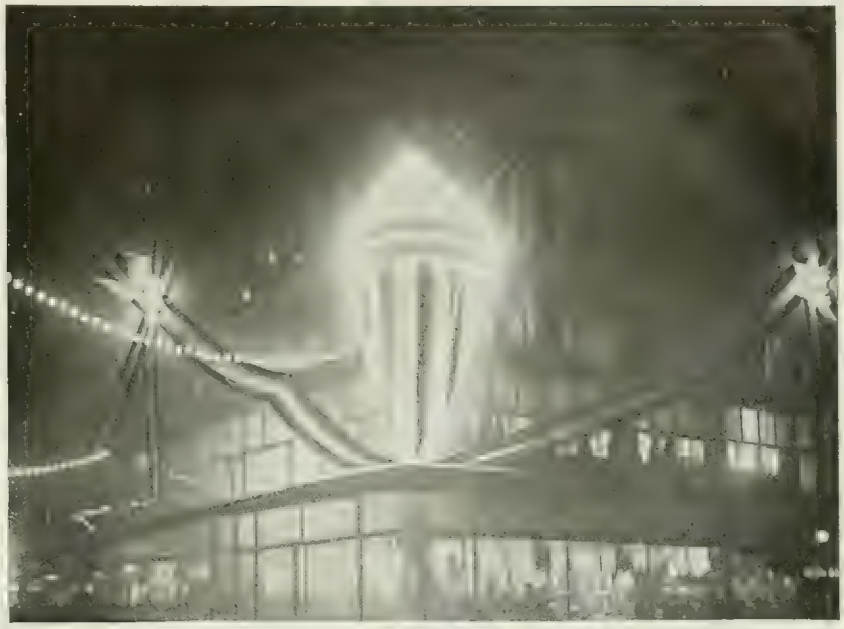
Cross Connections of Armature Winding.

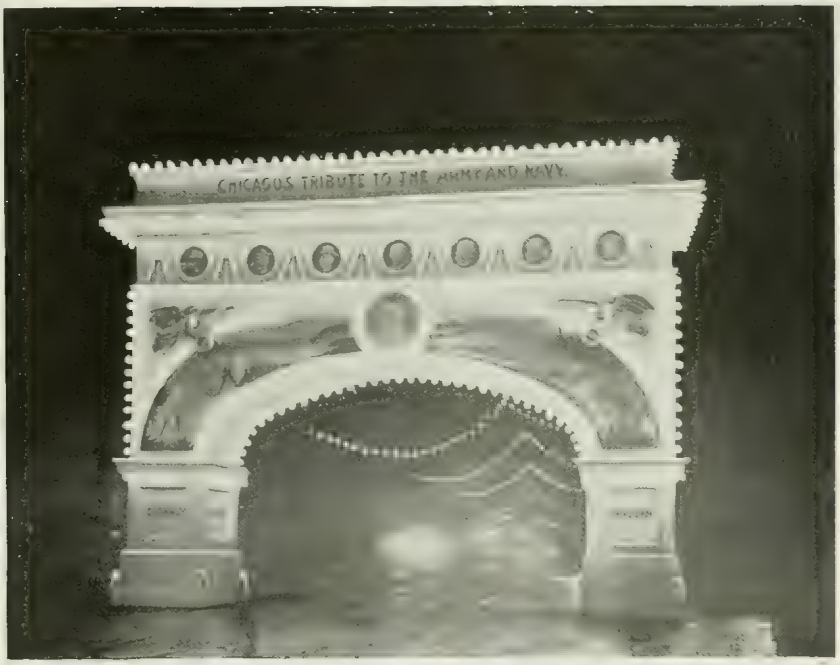
The same principle may be applied in other ways to direct-current machines. For example, if two compound-wound generators, the armatures of which are subject to the same number of reversals per second, be connected together by collector rings and leads, the field magnets of the two will be rendered always of the same strength even were there no equalizer bus between the series winding and the armature, and the direct-current output would therefore be equally divided. Even were the energy input delivered by their respective driving engines to vary, the direct-current power output would be unaffected, the generator whose engine was doing the [illegible] delivering a part of it through the alternating current circuits to the other machine, which would act as a rotary by transforming to direct current and equalizing the output to the direct current lines.





The Adams Street Edison Station.
The Arch Presented by the Western Electric Company, the Chicago Edison Company, and the General Electric Company.

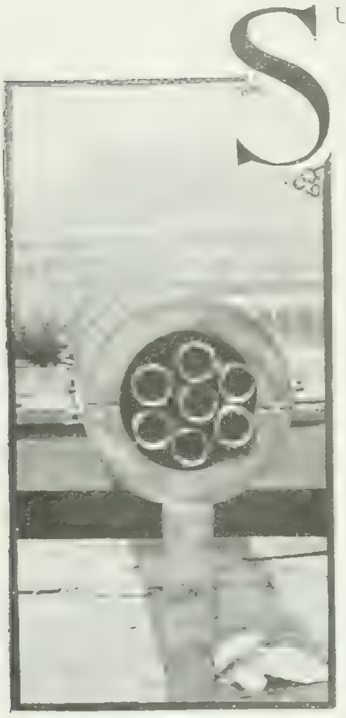




Mandel Brothers' Shield at Night.
Another View of the Municipal Arch.
State Street at Night.

Some Electric Lighting Effects at the Chicago Peace Jubilee.

Two Draw-In Conduits Under Boston Rivers.

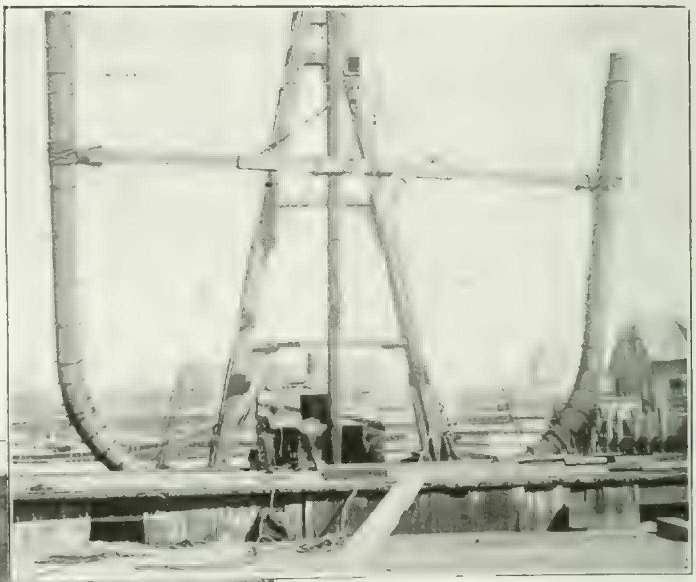


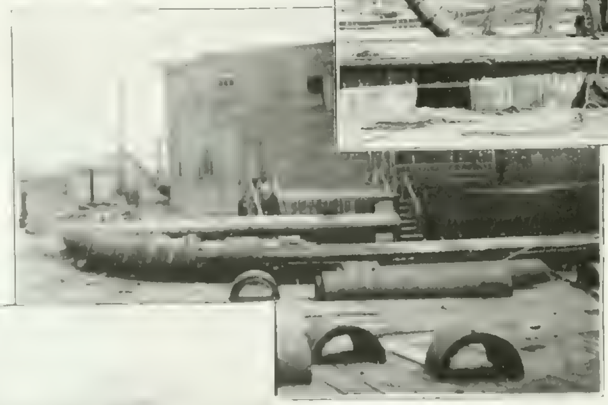
SUBMARINE conduits suited for drawing in electric lighting, traction, telegraph and telephone cables under narrow rivers are rapidly being accepted as a great improvement over simple armored cables lowered into the stream. But very few such conduits have been constructed in this country up to date, and these differ widely from each other; descriptions of two in New York city have previously appeared in these columns,* and the details of two lately built in Boston are given below.

The one illustrated by several views on this page was constructed by the Union Telegraph & Telephone Company under the Charles River, between Boston and Charlestown, beside the Warren bridge. It was built under the direction of Mr. G. H. Dresser, superintendent of the engineering department, to whom thanks are due for the following details and the accompanying illustrations. The conduit, as shown in cross-section in the initial letter, consists fundamentally of seven [illegible] in internal diameter and ¼ inch thick, with tight screw couplings, each pipe being covered to prevent corrosion with alternate layers of Bermuda asphalt and cheesecloth to a depth of three-sixteenths of an inch. The seven pipes are maintained in a proper relative position by wooden diaphragms from 2 [illegible] diameter and about 4 inches thick, with holes for the pipes and split into four pieces to allow assembling.

[illegible] shell with a thickness of 4 inches [illegible] inches, the shell being a regular [illegible] lengthwise into two sections, which [illegible] with bolts and nuts. These iron parts will have a short life compared with the intended life of the conduit, but when imbedded firmly in the clay the latter will be properly held together without the hoops. The conduit is in the form of a large U or inverted siphon, with about 48 feet between risers and a length of about 126 feet over all. It was assembled on the draw pier, and, with a heavy beam across the upper end of the U and many stays and ties, was lifted onto a lighter, as shown in one of the illustrations, and lowered into the stream. A trench about 5½ feet deep had previously been dredged in the clay and rock bottom, the rocks being removed by divers. Into this trench the U was sunk until the upper surface of the horizontal section was 4 feet below the level of the bottom of the channel and the trench was then filled flush. It was sunk during the month of September, 1898, being the first submarine conduit in Boston.

Lead-covered cables have been drawn into the ducts, and it is the intention to keep their interior dry. If moisture cannot be kept out, they will be filled with a heavy oil to prevent corrosion. Two similar conduits are to be put in by the same company, one under the Fort Point Channel and the other under the Mystic River.





[illegible]

The other conduit illustrated by the reproductions on the following page is a much larger one, and of a radically new type of construction. It belongs to the Boston Electric Light Company, which has now in course of erection a splendid new generating station in South Boston, to take the place of its four older stations in other parts of the city. It may be remembered that President F. A. Gilbert and Assistant General Manager Sidney Hosmer, of this company, before the erection of this station was undertaken, visited Europe, inspecting the latest alternating-current practice there, and they have laid out a very perfect system, a more complete description of which will appear later in these columns. The transmitting system from the new station into the city consists of two double conduits, one of which crosses Fort Point Channel near the Congress Street bridge. Each of these double conduits carries twenty-four ducts in four layers of six ducts each, they being double in the sense that the twelve ducts on one side of a vertical plane through the centre of the conduit run through manholes entirely distinct from the twelve on the other side, so that in case of a manhole explosion or heavy burn-out the whole line will not be interrupted. The line passes under two bodies of water and will have two [illegible] conduits, a description of one of which, that under the Fort Point Channel, will answer, except in the matter of length, for both.

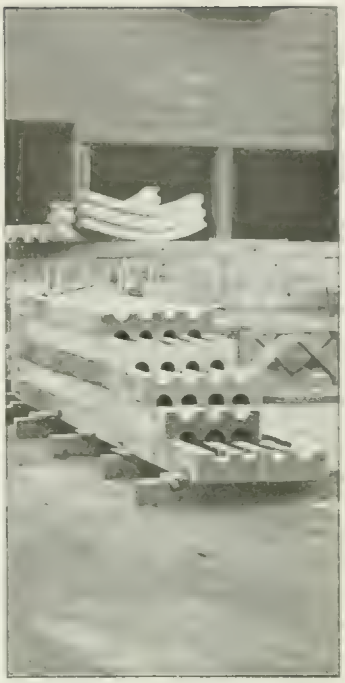
[illegible]

[illegible]

tance of 12 feet—6 feet each side of the mud line—are of oak. This is for the purpose of avoiding the attacks of insects, which, experience has shown, are only made at these points. The timbers are fastened together at frequent intervals by ⅞-inch galvanized iron bolts with nuts and washers, and also with kiln-dried soft-pine dowel pins, the former being expected to have a limited life and the latter to be more permanent. The swelling of the latter on reaching the water will render them very tight. These bolts and pins are passed through horizontally and vertically at intervals, making, with the staggered joints of the timbers, a very substantial construction. The bolt holes are counter-bored on one side of the conduit, in order to give a smooth surface for the launching, which was done from sliding ways. The length of the 6-inch timbers varies from 4 feet on the curves to 20 feet on the straight run. The work was in charge of Mr. C. L. Melvin, superintendent of woodwork for the company, from whom many of these details were obtained, under the general direction of Mr. David Harrington, who is in charge of the underground part of the distributing system, and was done at the wood works of the company, which are on the shore close to the point where the conduit was sunk. The sections were grooved by a straight buzz planer, the curved sections being made up by the same planer with the simple addition of a curved guide, against which they were run.

They were assembled in the yard complete, except for the dowel pins, and the ducts were tested by means of a 3¼-inch plunger attached to a bamboo rod for the curved runs, any sticking being remedied by taking down the structure and gouging out the ducts. At the joints each duct is flared out slightly to prevent a shoulder occurring to catch the piping. After the ducts were thus carefully rendered of a uniform minimum cross-section, each of the six sections of the conduit was assembled, fitted with dowel pins and taken on rollers to the launching ways, a view of which, with one of the straight sections just leaving the ways, is shown herewith. The conduit is quite heavy, weighing in air a ton for about every 8½ feet, making for the whole length a weight of about 40 tons. The launching ways were heavily lubricated with axle grease, and the back end was tilted up with jacks until the section slid off into the water. Each section was fitted with a stepped joint, with steps each 2 feet in length for attaching it to the next. These were joined in the water and the whole sunk with weights, its normal flotation being about 50 per cent.

The conduit starts at each end in a sort of cable house, running down vertically through the floor, and to a depth of about 43 feet, the horizontal distance between the two vertical lengths being 205 feet, the vertical runs being connected with the horizontal bottom section by means of curves with a 10-foot radius. The leads will come into these terminal houses through ordinary subterranean conduits of cement-lined pipe in concrete, and be there spliced. In the clay bottom a trench was dredged to a depth of 7 feet to receive the conduit. The conduit, when floating on water, was sunk by raising the two ends by lighters and loading the long centre tangent by weights until its tendency to float was overcome. The work has but recently been carried out, and is not yet finished. The majority of the ducts will be filled each by a number of small ¾-inch lead-covered cables.



For the illustrations and much of the information concerning this conduit thanks are due Mr. P. F. Dolan, electrical engineer and chief inspector of underground work to the wire department of the city of Boston.

A Trial of Sectional Conductor Traction in England.

A practical trial of electric traction in the streets with the so-called closed-conduit system of current supply, but more properly termed a sectional-conductor system, has been on trial in Leeds. One mile and a half of track has been laid in a hilly suburb of the city, with underground switches supplying current to the car through phosphor-bronze buttons in the streets and skates carried by the car. It is said that the tests proved the system to be very satisfactory.

Tramways in Gothenburg.

A consular report states that a committee appointed by the city government of Gothenburg has recommended that the city shall build electric power stations and four electric railway lines with overhead construction to be used by the present tramway company, on the payment of certain dues, etc., amounting to about $42,000 per year and 12 per cent. of the gross receipts over and above $107,000 per annum. The company is to provide the rolling material, and the city will take over the rolling stock by purchase and undertake the management after twenty years. The estimate of the Siemens & Halske Company is that the total cost of construction, including the sites and buildings, will amount to about $500,000.

Views of Boston Electric Light Company's Conduit Under Construction.

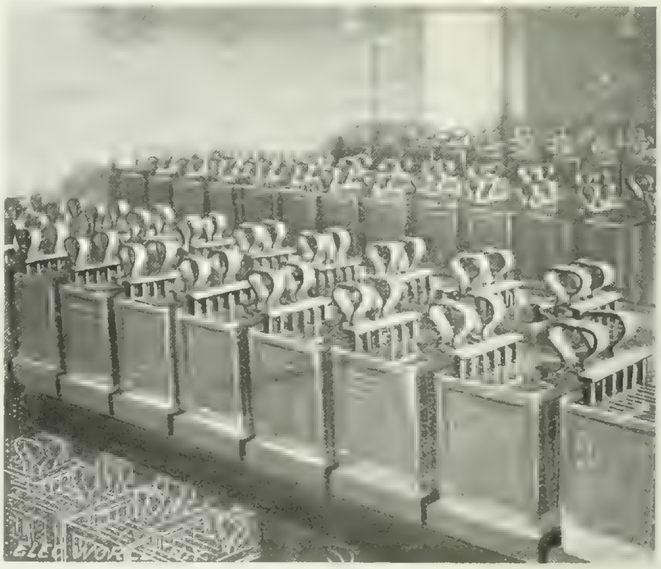
The Storage Battery Auxiliary of the Brunswick Traction Company.

MANAGERS of street railways operating in sparsely settled communities, with lines necessarily long to serve the scattered population, and perhaps desiring to extend their systems to neighboring towns, are often perplexed by the problem of the distribution of power. The distances soon become too great for economy at 500 volts; small separate power stations are out of the question, owing to the low economy in every way, and if, as is often the case, the lines are single-track, with only an occasional service, perhaps thirty minutes' headway, even high-tension power transmission and sub-stations with running machinery are out of the question, owing to the high cost of attendance of such stations per car-mile run on the limited trackage that they can reach. Managers of such roads will find one solution of this difficult problem in the installation described below.

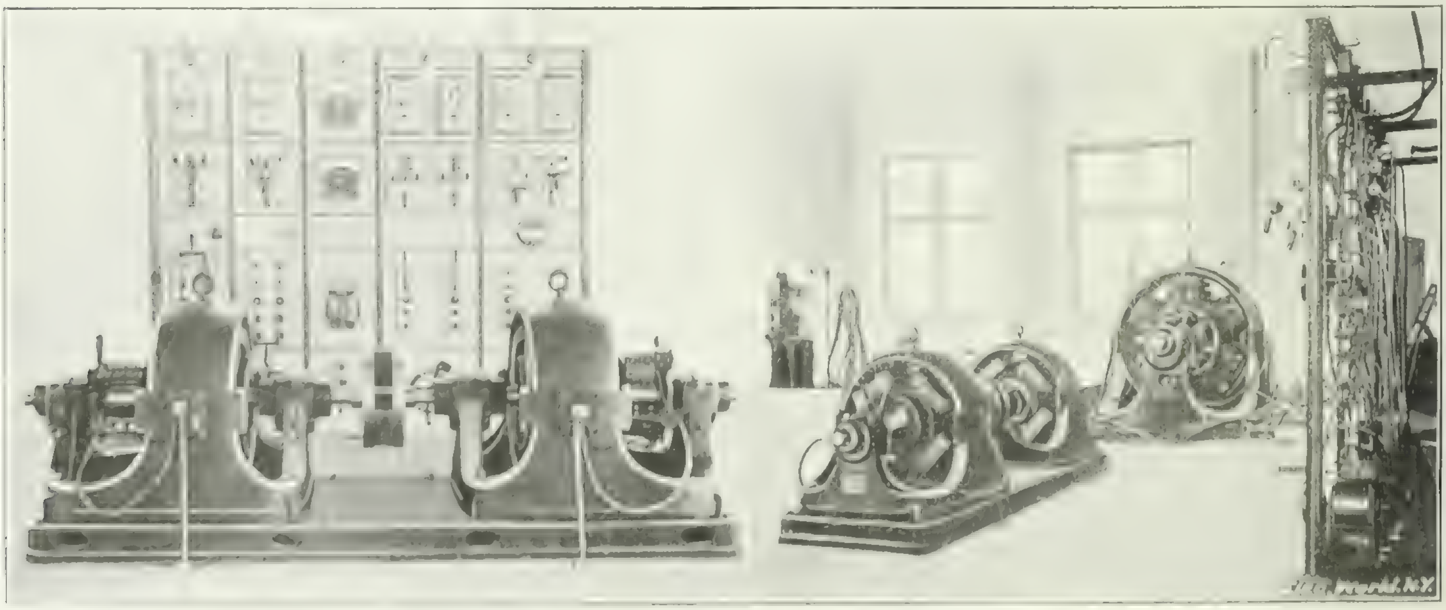
The Brunswick Traction Company operates lines in New Jersey, connecting among other towns New Brunswick, Metuchen and Bound Brook, the total mileage of track being 51 miles. The power station is situated about 3½ miles east of New Brunswick on a line running out toward South Amboy, this point being distant about 11½ miles as the copper runs, from the terminus of the line in Metuchen. The maintenance of a reasonably constant potential without an excessive cost of copper on such a long feeder, especially with the high load peaks of an excursion business (the line passing through a picturesque wooden and farming district), is obviously a serious problem, and a solution is sought in this case by the use of a storage-battery sub-station situated about 3 miles from the Metuchen end of the line and therefore about 8½ miles from the power house.

This battery has now been in service about two months. It consists of 258 cells of chloride accumulators, furnished by the Electric Storage Battery Company, with a nominal output of 100 ampere hours at a 45-minute rate. The cells are of glass mounted on sand in wooden trays, the latter being in turn supported on glass insulators on wooden frames heavily painted with acid-proof paint. To give flexibility the cell terminals are connected by inverted U-shaped lead loops, the halves being burned together at the top [illegible] [illegible] practically along- [illegible] the other [illegible] [illegible] each [illegible] The battery occupies the one room on the ground floor of a small dwelling, which is otherwise occupied by the family of one of the road's motormen. The wife of the motorman, in addition to her domestic work, serves as a battery attendant, her duty in this line consisting of throwing in the circuit breaker whenever it is opened by an excess charge or discharge.

The switchboard of the sub-station is located in one of the front rooms of the house and consists of a slate panel fitted with a Weston round-type voltmeter and a central-zero ammeter with an I T E circuit breaker and two quick-break single-pole single-throw switches and a three-point voltmeter switch. The battery is connected straight across between the overhead system and the ground, the feeder coming from the direction of the power station being tapped off to the trolley wire for some little distance back. This incoming feeder and that running out in the opposite direction, that is, supplying the line still more distant from the power house, are brought respectively through the two switches above mentioned while the ammeter and circuit breaker are in at the negative end of the battery and thereby carry the full battery current. The voltmeter positions are respectively connected to measure the voltage of the battery, of the incoming and of the outgoing feeder, all of which voltages are the same when the switches and circuit breakers are closed, but are different if any one of these three instruments is opened.

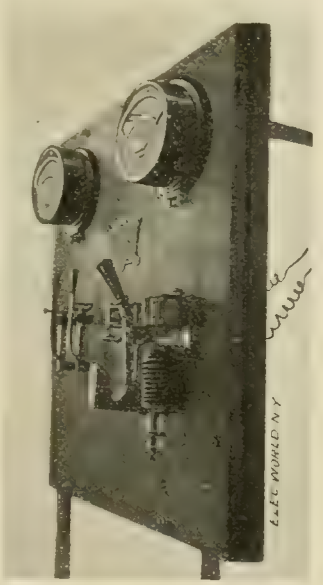


View of Storage Batteries.



Two Views of the Motor-Generators, Booster and Switchboard.

At the power station [illegible] the main equipment consists of two [illegible] Westinghouse multipolar railway generators, each belted to a Cooper-Corliss cross-compound engine. For the feeder running out toward the battery a special motor-driven booster is installed, consisting of a 50-kw Westinghouse motor directly connected through a flexible coupling with a generator of similar capacity mounted on the same bed-plate, the whole resting on the wooden floor of the station, supported by 12-inch x 12-inch timbers at a position directly in the front of the switchboard. Both motor and generator have plain shunt-field windings with the ordinary field rheostats. The speed of the set is supposed to be 800 r. p. m., at which the dynamo should give 250 volts, its rated carrying capacity being 200 amperes. The set is controlled by one panel of the switchboard, the motor-supply circuit passing through an ordinary double-pole single-throw switch, an overload circuit breaker and a motor starter with automatic low-voltage release. One terminal of the dynamo is permanently connected to the positive bus bar of the station and the battery feeder is connected to a single-pole double-throw switch in such a way that it may be thrown either to the other pole of the booster dynamo or directly to the positive bus bar. A round-type Westinghouse voltmeter measures the pressure of the booster and two Westinghouse ammeters measure respectively the current taken by the motor and the current delivered by the booster. The battery feeder, after leaving the throw-over switch mentioned above, is led to a Westinghouse circuit breaker with a special attachment to prevent the battery backing up in case the station voltage runs down. This attachment consists of a fine-wire shunt coil wound in conjunction with the regular series coil to excite the plunger operating the trigger. When in use this shunt coil magnetizes the plunger with a polarity the reverse of that given by the series coil. With this arrangement in case the current in the feeder and the series coil dies out the shunt coil trips the breaker, while if the feeder is overloaded the magnetic effect of the series coil overcomes that of the shunt coil and magnetizes the plunger in the opposite direction, in this way also opening the breaker. Thus this simple addition makes an ordinary overload circuit breaker both an over and under load breaker with the same sensitiveness on both actions.



SWITCHBOARD AT SUB-STATION.

The booster is run regularly twenty hours a day, being started in the morning at the time the engine is started, 5 A. M., and run until 1 A. M. the following morning. The lowest voltage which the booster will conveniently give without serious field distortion, namely, 200 volts, is now in service, although this is found to be a little too high with the present load and the copper in the line. The pressure at the battery end varies around 600 volts, the battery being permanently overcharged and any small incoming current, such, for example, as 25 amperes, causing violent "gasing."

Mr. R. L. Rand, superintendent for the company, states that the battery reduces the fluctuations of the voltage to a negligible point, and is so satisfactory generally that a second set of twice the ampere-hour capacity has been ordered to be installed at Bound Brook, 11 miles from the power house.

Ferraris Memorial.

It appears that the fund for a permanent memorial to Galileo Ferraris is not being subscribed to as was expected. Neither the Italian Government nor the municipal authorities have contributed to it. The fund now amounts to only about $3000.

Telegraph Line the Length of Africa.

Work has been commenced on the construction of the British overland telegraph line from Cairo, Egypt, to Capetown. On the northern end the work has already reached Omdurman. A party is about to start for the upper Congo, and work is advancing at the southern end.

Electrolysis in the Cleaning of Metallic Surfaces.

BY C. F. BURGESS

To one who has not had his attention called especially to the question the removal of foreign substances from metallic surfaces might at first thought appear to be a problem of little moment, and at least not one worthy of scientific study and investigation. Such, however, is not the case, as will be seen by noting some of the commercial applications of cleaning processes.

That metal which at the present time is of the greatest service to man would have its value greatly enhanced if it were not for the fact that it corrodes upon exposure to air and moisture. To prevent or reduce this corrosion as much as possible various methods are used to insulate the iron surfaces from moisture, air, or other gases by applying some kind of continuous coating to the metal. The principal forms of coatings are the paints, usually made by mixing lead pigments with linseed oil, applied in a thin layer which soon hardens, or by coating the iron surfaces with a thin coat of some other metal which will not corrode as readily as does iron.

The requirements for such coatings are that they shall be continuous and durable, protecting every portion of the surface, and that they shall adhere firmly to the metal. In order that these requirements shall be fulfilled it is essential that the iron present a clean surface before the protective coating is applied. The durability of the protective coating depends largely upon the thoroughness with which the metal has been cleaned, and the financial importance of the question may be seen by noting the enormous annual expenditures made by some of the railroads in keeping their bridges and other iron structures protected from corrosion.

The efficiency of the protection to iron afforded by dipping into molten zinc depends in large degree upon exposing a chemically clean surface to the molten metal, and this is even more the case when the protective metal is applied electrolytically. In the case of dipping, the so-called "galvanizing," small impurities on the surface are likely to be bridged over by the cohesion of the molten metal, which on cooling solidifies and thus protects the entire surface, even though the zinc does not adhere to every portion of it. This bridging over does not occur, however, when the coating is applied electrolytically, for the foreign substances on the surface, which are usually non-conductors, will prevent a deposit from forming in the localities where these impurities exist, and the difficulty of cleaning is the greatest obstacle in the way of successful electro-come soluble, or loosening them so that they may be easily removed by mechanical means. Another process which may be called a chemical one is the burning of the impurities by the application of a high heat, which, however, will act on only a small portion of substances found on metallic surfaces, such as lacquer and enamel.

Which of the above methods or combination of methods is used in practice depends upon various conditions, such as size and weight of work, character of metal, character of substances to be removed, and kind of coating to be applied. By some of the above methods the results may be obtained as completely as is desired, but there is still much to be wished for in the way of rapidity, convenience and cost.

lytic galvanizing of iron, which is so desirable from the many advantages which such a process has over the hot dipping process.

The success of any electro-plating work upon metal may be said to depend more upon the proper cleaning of the article to be plated than upon any other detail of the process, and this cleaning is one of the largest items of expense in an electro-plating plant.

The most common substances to be removed are oxides or other metallic compounds insoluble in water, which may exist from an imperceptible film to thick mill scale; grease or oils, as a result of handling or other previous treatment; paints, enamel, lacquer, etc., which may have been previously applied to the surfaces.

The means commonly used to effect this cleaning may be classified under the following divisions:

Mechanical.
Chemical.
Electrolytic.

In the mechanical means may be mentioned grinding, scraping, scratch-brushing, rubbing with pumice stone or other abrasive, and the use of the sand blast.

The chemical processes consist usually in employing a pickle or dip of some chemical substance, such as an acid or an alkali, which acts chemically upon the foreign substances, causing them to be-

The methods which seem to offer the best means of satisfactorily solving this important problem are the electrolytic processes, and it is the purpose of this paper to deal especially with such processes and to give some results of investigations along this line.

There might possibly be a valid objection to differentiating the electrolytic processes from the mechanical and chemical means above enumerated, for the electrolytic processes are similar to the other two in some respects. The passage of a direct current through an electrolyte decomposes that electrolyte and thus supplies the active agents which are to act chemically on the impurities on the metallic surfaces. The gases, also, which are liberated exert a physical action, and may thus act as a mechanical agent.

On passing the direct current through a solution of such a stable and chemically inactive compound as common salt, NaCl, the chemical action at the anode may be said to resemble that produced by a strong acid, or an oxidation, while at the cathode it is the reaction of an alkali, or a reduction. It is upon the utilization of these reactions at the electrodes that the electrolytic cleaning processes depend.

If the article to be cleaned is suspended as the anode in such a bath there will be a tendency of the oxides on the metal to dissolve, and for the metal itself to become attacked and go into solution, depending, of course, upon the metal and the nature of the electrolyte. In this respect it is similar to the acid pickling bath used so extensively for the removal of mill scale and rust from iron wire and other iron products. This "electrolytic oxidation" may serve as a convenient method for the removal of a thin coating of metal which has previously been deposited, replacing the electroplater's "stripping" solution.

The anode reaction will, however, have little or no effect on substances of an oily or greasy nature, but the chemical properties at the cathode afford all that may be desired in this direction. With the above-named electrolyte, sodium is liberated at the cathode, immediately uniting with the water, forming sodium hydroxide and hydrogen which rises to the surface. The reducing properties of the so-called nascent hydrogen thus formed are well known, and whether by the hydrogen alone, or by aid of the sodium, any oxide, sulphide, chloride, or similar compound on the metallic surface serving as the cathode will be quickly reduced to the metallic state.

The sodium hydroxide formed will attack the grease or oil, producing saponification exactly as is done in the electroplater's lye vat. In most cases, the chemical action at the cathode will in no way affect the metal itself, but will act only on the foreign substances present, thus allowing polished surfaces to be cleaned without destroying the finish. This is not the case with the anode reactions, which, in addition, are not effective in removing substances of a fatty or oily nature. It is seen, then, that placing the article to be cleaned as the cathode offers the most satisfactory method in [illegible]

The availability of the cathode reactions for cleaning purposes was recognized as early as 1841, as shown by a British patent, in which this process was included as one of the claims of a plating process. At that time the only source of current was the voltaic cell, and the expense of the electric energy thus developed prevented a commercial application of the process. Now, however, with the sources of cheap electrical energy at hand, the method is meeting with some considerable attention, with promise of greater development in the future.

[illegible] adopted by electroplaters for cleaning [illegible] as they come from the grinding and polishing wheels and immerse them for some time in a bath of hot lye to effect the saponification of the oil and grease. To complete the cleaning the surfaces are brushed with whiting or other similar material, which operation adds very materially to the [illegible]

[illegible] in the plating department of the electrolytic laboratory of the University of Wisconsin, and the marked advantages over the old methods will warrant a continuation of its use. The equipment for the work consists simply of a wooden vat similar in construction to a plating vat, with conducting rods of brass tubing connected to the leads from the dynamo. The solution which was first employed consisted of a strong solution of sodium chloride, the anodes consisting of carbon plates, 8 inches by 12 inches, connected permanently to the positive terminal, and suspended on both sides of the vat. The article to be cleaned is wired, as in preparation for plating, suspended for a few minutes from the cathode bar, then rinsed in clear water and transferred to the plating solution.

With a fairly high current density the oxides and similar compounds are reduced, and oils and grease quickly disappear, so that clear water will run freely over the entire surface. The bubbles of gas which are formed uniformly over the entire cathode surface serve to remove any loosely adhering non-conducting particles, thus avoiding the necessity of a brushing by hand.

The use of sodium chloride as the electrolyte is very objectionable, however, when a large amount of cleaning is to be done, owing to the offensive nature of the chlorine gas which is given off at the anode and which escapes into the air. A solution of sodium hydroxide is much more satisfactory on this account, as the oxygen liberated at the anode produces no harmful effect, but on the other hand this solution has the disadvantage of foaming when worked rather hard, which not only conceals the article from view while in the solution, but tends to retain the products of electrolysis, hydrogen and oxygen, which are liable to become ignited upon removing work from the tank, producing an explosion which may cause a spattering of the electrolyte.

The properties which a suitable electrolyte should have are: First; it should be a good conductor; second, it should contain no metal ion which is likely to be deposited upon the article to be cleaned; third, the gases given off should not be of an offensive or dangerous nature; fourth, the electrolyte should be one which does not foam, thus obstructing the view and preventing the free escape of the gases into the air.

The anodes should be of a conducting material which will not become attacked by the anode products. Carbon of certain qualities is probably as satisfactory a material as any, though even this will gradually wear away, the rapidity depending somewhat upon the nature of the electrolyte, but more largely upon the firmness and density of the carbon. One of the difficulties attending the use of carbon plates is the connection of the plate with the positive bars, for the suspending wire is sure to corrode at the point of contact with carbon unless special precautions be taken. This corrosion would introduce such a high resistance as to practically stop the flow of current. The following arrangement will entirely obviate the difficulty, and carbon plates which have been thus fitted up have been in use for over a year, with apparently as good electrical contact now as ever. Two holes about one-quarter inch in diameter are drilled through the plates near the top. The upper portion of the plate is then given a fairly heavy coating of copper, in a copper sulphate bath. This is then "tinned" with soft solder and placed in a mould into which molten lead is poured. The lead lug thus formed insures a permanent contact with the carbon, and a lead strip will serve best as a means of suspending the anode in the tank.

With many solutions it does not matter whether the lead lug dips into the solution or not, but in others the lead would get into the solution and thus spoil it for the purpose in view.

The electrical energy necessary to effect the cleaning of articles of iron or copper as they come from the polishing room may be taken as approximately equal to that used for the electro-deposition. Although the current density must be considerably greater for cleaning than for plating, the time is much shorter. Current density has a marked effect upon the rapidity of cleaning, and the disappearance of foreign substances in no wise follows Faraday's law. The following figures taken from some observations made by Mr. H. A. Smith illustrate this very clearly. The measurements were made to determine the effect of current density upon the rapidity of removal of a film of grease from an iron surface such as it acquires from a grease polishing wheel. The electrolyte was a nearly saturated solution of sodium chloride:

Current Per Square Foot.	Time Necessary for Cleaning.
20 amperes	15 minutes
40 "	3.5 "
[illegible] "	0.75 " about

With a solution of potassium hydroxide a current density of 80 amperes per square foot cleaned the iron almost instantly.

It is obvious that the high current density is the more economical from the fact that the length of time is not inversely proportional to the current density, but varies more rapidly. With a density of 40 amperes, which may be readily obtained at a pressure of about 5 volts, the cost of power for cleaning, per square foot, would be about .06 cents, assuming power at 4 cents per horse-power hour.

Some of the advantages of the electrolytic method of cleaning over that commonly used in an electroplating plant are the following: There is less complication from the fact that the cleaning vat may be of similar construction to the plating vats, and connected to the bus bars in the same way. There is a considerable saving in labor and material in dispensing with the hand brushing. After once wiring an article there is no need of touching it with the hands, for it may be transferred directly from one tank to another. The oxides and other metallic compounds may be removed simultaneously with removal of grease and dirt, thus avoiding the use of a cyanide or an acid dip. A metal which has a brightly polished surface may be cleaned without destroying the polish.

That the gases liberated at the cathode have a very remarkable physical effect in removing non-metallic coatings from a metal surface was demonstrated in an attempt to protect a portion of the cathode surface from the deposition of a metal in a plating solution. It was found difficult to apply an insulating coating which would not peel off as soon as the current density was high enough to cause liberation of gas bubbles. These bubbles seem to form between the metal surface and the non-conducting coating, thus forcing the two bodies apart. This phenomenon seems to be entirely unassociated with a chemical reduction of the coating in question.

This phenomenon might readily be put to a commercial use in the removal of paint, lacquer, enamel, etc., from metal articles which are to be refinished.

Tests of Furnace Gases in Combustion Engines.

From a paper entitled "Expériences sur L'Emploi Direct des Gaz des Hauts-Fourneaux dans les Machines Motrices," by Aimé Witz, published in "La Revue Universelle des Mines," and reprinted in pamphlet form, the following abstract has been translated. The object of the tests was a study of the practical use of the gases derived from coking furnaces in single-cylinder engines of large size. For a settled conclusion on this point it is necessary to make a prolonged trial to show whether these gases with their variations of quality and pressure will give continued and regular work. The tests were also conducted to give an exact determination of the consumption of gas, oil and water, the latter both for the cooling of the cylinder and the washing of the gas under normal conditions of industrial work. The engine was of the type known as "simplex" constructed at the shops of La Société Cockerill, with the following dimensions: cylinder diameter, 32 inches; stroke, 40 inches; 105 r. p. m. and a rating of 200 effective horse-power. It was decided to give this engine a continuous test of twenty-four hours, developing its normal power, missing about 10 per cent. of the admissions in order to give the usual reserve necessary in practical work.

The gas was furnished by four coking furnaces without any change whatever in their general arrangement or firing, and the trial thus had no conditions more favorable than would be found in regular practice. The power was absorbed with a brake water-cooled and weighted to measure the load. A speed counter, recording tachometer, Crosby indicator, thermometers and a specially calibrated gas meter were also used to get complete data. The principal data of the test are given in the following table:

Date, 19th and 20th of July, 1898.
Duration, 24 hours.
Average speed, 105.2 r. p. m.
Mean brake horse-power, 181.16.
Average number of admissions, 47 per minute.
Ratio to total cycles, 85 per cent.
Temperatures of the exhaust, 480° to 510° C.
Temperatures of the water:
    Entering jacket, 22.7°.
    Leaving jacket, 33.7°.

The various tests of gas consumption gave an average of 3.33 cubic metres (about 130 cubic feet) per brake horse-power hour. The water used by the scrubbers amounted to 30 litres (about 1 cubic foot) per horse-power hour, and by the cylinder to about 72 litres (2½ cubic feet). Of lubricants there was used altogether 17.3 grams per horse-power hour.

The general conclusions given in the paper are that the motor developed 181 horse-power with more than 10 per cent. of the admissions suppressed, and thus retained a considerable reserve capacity, and that the load was carried for twenty-four hours without trouble, and the consumption of the gas did not vary from one hour to another, and the calorific power of the gas remained close to 991 calories, the low average consumption of 3.33 cubic metres per horse-power hour being not only remarkable but almost unhoped for. The consumption of water and oil was better than had been anticipated, and it is expected that this can be yet reduced. The speed regulation is stated to be as good as can be obtained with the steam engine, and the variations of the quality of the gas did not affect its power sufficiently to be noticed in the engine performance.

Camille A. Faure.

The tardy report of the death of Camille A. Faure on September 14 has just reached this country. The name of Faure instantly calls to the mind of the electrical engineer his chief title to distinction, namely, his improvements of the storage battery, he being the first to build up the negative "pasted" plates with prepared spongy lead in place of the tedious and expensive Planté process of preparing the substance electro-chemically. Camille A. Faure was born May 21, 1840, at Vizille, in the mountains of Dauphiné, of an old French family of peasant landowners. Although he received some education at the Ecole des Arts et Métiers, he was largely self-taught. His first employment was as a mechanical draughtsman and superintendent of construction with various large iron works in France and England, his work in the storage battery field making its first evidence in 1878 when he discovered the value of spongy metallic lead for the negative plates, the use of sulphate of lead being invented two years later. In 1882 he further improved the battery by adopting methods of increasing the surface of the plates with a given volume, and still later he did his part in the development of this branch of electrical engineering by improving the means of surrounding the plates with a porous covering, the idea of which was probably original with him.

ELEC WORLD. N.Y.

CAMILLE A. FAURE.

Besides his work on the storage battery, M. Faure added to the world's knowledge of applied physics by other inventions, among them improvements in the manufacture of explosives, a system of signals used on shipboard and the application of electricity to the separation of chloride of sodium and to the preparation of various artificial fertilizers and the production of aluminum, and during the latter part of his life by improving explosive engines for automobile work. M. E. Hospitalier, editor of "L'Industrie Electrique," states of him: "All who have known him recollect well his indefatigable industry, his strong mentality and the originality of his ideas; a man with whom, as is rarely the case, theory and practice were always happily combined, and regret the loss of this inventor, who, although externally a little brusque, possessed an excellent heart."

DIGEST
OF CURRENT ELECTRICAL LITERATURE
AMERICAN AND FOREIGN
By Carl Hering

Dynamos, Motors and Transformers.

ELECTRIC GENERATORS. Parshall and Hobart. Lond. "Engineering," Oct. 7.—In this continuation of their long serial they discuss the effect of armature reaction in two extreme cases, showing that by using the proper number of poles a machine can be made to operate entirely satisfactorily as regards sparking. Multiple circuit windings, multiple windings, and two-circuit coil windings are briefly discussed. They then consider the voltage per commutator segment as related to inductance; this voltage is not always a true criterion of the inductance of a coil; the value for the average volts per commutator bar also varies according to whether carbon or copper brushes are used.

PHASE TRANSFORMERS. Meyer. Lond. "Elec. Rev.," Sept. 30, and "Science Abstracts," July.—A brief, illustrated abstract of the article noticed in the "Digest" May 14.

Lights and Lighting.

ELECTRIC LIGHT ON TORPEDO VESSELS. Pontifex. Lond. "Elec. Eng.," Oct. 7.—A short article on the electric light on torpedo boats on which all the lights are turned off when the searchlight is in use, in order that only one dynamo will be required. It is chiefly a description of the prevailing methods used on the British vessels.

DROP OF VOLTAGE IN THE ARC. Mrs. Ayrton. "El'ty," Oct. 19.—An abstract of the paper noticed in the "Digest" Oct. 15.

ELECTRICAL DECORATIONS AT CINCINNATI.—"West. Elec.," Oct. 15.—Some illustrations of some of the decorative lighting effects on the occasion of the recent national encampment of the G. A. R.

Power.

ELECTRICAL ENERGY IN BULK.—Lond. "Engineering," Oct. 7.—A leading editorial on this subject, referring to some of the schemes under consideration. In the Midlands it is proposed to erect a station to supply energy within a radius of 26 miles, including a number of important towns; another plant is proposed at Wolverhampton. The subject of the possible economy is discussed, some figures being given, and it is shown that the economy is not to be sought in fuel only; if the energy is to be sold at 2 cents per kilowatt hour, or less, which must be the case if some of the schemes are to be successful, coal will be one of the largest items of the works' costs; its cost can scarcely fall below 0.2 cents per unit, assuming the station to be at the mines; but coal can be delivered 10 miles by canal boats at 25 cents a ton, which amounts to 0.064 cents per unit, and there is, therefore, no advantage in placing a generating station at a distant coal mine if the expense of transmission is considered. Attention is called to the great difference between supplying the energy for power and for lighting.

ELECTRIC CAPSTAN AND TURNTABLE GEAR.—Lond. "Engineering," Oct. 7.—The beginning of a well-illustrated description of those used on the Northern Railway of France for hauling cars or moving turntables. Owing to the intermittent nature of the work the current is supplied from accumulators.

PUMPING PLANT.—Lond. "Elec. Eng.," Oct. 7.—A brief description of a recently installed plant at a coal mine, which is said to be the largest installation of pumping machinery in the United Kingdom; [illegible] are pumped for every ton of coal taken out.

ELECTRIC STEERING OF SHIPS. [illegible] "Elek. Anz.," [illegible]—The continuation of his long illustrated article [illegible]

WATER-POWER PLANT. Giovaninelli. "L'Eclairage Elec.," [illegible]

[illegible]

Traction.

[illegible] ing the fields; the tests were made under the exact conditions of practice, except that the car was loaded with a constant weight. He remarks that with gradual acceleration, making up the time lost thereby by using the highest speeds, a very much more favorable consumption of watt hours would have been obtained; (the question of acceleration, however, does not seem to have been included in the present tests). All the cars used had four axles and two pivoted revolving trucks; the battery had a capacity of 330 ampere hours at 30 amperes; five of the cars weighed partially loaded 20,200 kg each, of which the battery was 6840; the sixth weighed 17,000 kg, including the battery of 5000 kg. One of the conclusions was that the series motors gave the same effect as the shunt motors with their complicated switching arrangements and that it is therefore unnecessary to use shunt motors. The results are summarized in a table, from which it appears that the average weight is 21,200 kg, the number of stops per km 1.87, the mean consumption of watt hours per ton kilometer 27.75, the speed for the parallel connection 14.3 km per hour and for the series connection 23.6. From his tests he draws a number of conclusions; the reserve of the battery is too small; it should, at the start, be at least 100 per cent.; the unavoidable current rushes can be so great as to have an unfavorable effect on the battery unless the controller is handled very carefully. The interruptions in the regular traffic are so unavoidable that they must be taken into consideration in determining the size and capacity of the batteries; instead of a fuse he recommends circuit-breakers, as it takes too long to replace the fuse. The makers of accumulators should provide a simple means of determining in advance whether there is enough energy left in the battery for another complete trip. Good results may be expected from a re-charging station at a certain point on this line. The different connections of the motors had no appreciable effect on the consumption of power; it is much more important to have simplicity instead of a high efficiency; this he discusses in detail, calculating a case to show that the loss of time and money in repairing is greater than the gain, due to a slight increase in efficiency; the recovery of current at stopping is too inappreciable to be considered an advantage in favor of shunt motors; for trolley lines, however, shunt motors might be justified on a very hilly line, as the strain on the stationary machinery is less.

DIFFERENT TRACTION SYSTEMS COMPARED. Ziffer. "Elek. Anz.," Sept. 25, Oct. 2 and 6.—The first parts of a long article in which he discusses the advantages and disadvantages, which have been found by practice, of the various different systems of electric traction. He divides the number of systems into eight groups and discusses each separately; the trolley system is again divided into eight different classes.

SURFACE CONTACT SYSTEM. Brown. Lond. "Elec.," Oct. 7.—A note calling attention to the fact that in the Thompson system (described in THE ELECTRICAL WORLD Oct. 22) a traction engine or steam roller would short-circuit the system at each of the surface contacts; moreover, there would be considerable leakage through the numerous shunt exciting coils on a long line. He considers the Diatto system preferable. Thompson, in reply to the criticism, stated that the contact bar on the car must be at the line voltage, or nearly so, so that the presence of a mere mass of iron would not affect the contacts.

ELECTRIC RAILWAYS IN LONDON.—Lond. "Elec. Rev."; more briefly in Lond. "Elec.," Oct. 7.—A communication to the London County Council by Robinson, containing a map of the roads projected and partly under construction in the western suburbs of London.

ELECTRIC TRACTION PATENTS IN ENGLAND.—Lond. "Elec.," Oct. 7.—A brief discussion of the scope of the fundamental patents in England.

ACCUMULATOR TRACTION. Drouin. Lond. "Elec. Rev.," Oct. 7.—A translation of the abstract of his recent paper, noticed in the "Digest" Aug. 20.

EFFICIENCY OF RAILWAY MOTORS. [illegible] "Science Abstracts," July.—An abstract, with the table, of the article noticed in the "Digest" Jan. 15.

AUTOMOBILES. [illegible] "L'Eclairage Elec.," Oct. 1.—The continuation of his long illustrated abstract of the report of the [illegible] of the French Automobile Club. It contains considerable data of various vehicles and external views of a number of them.

ELEVATOR UP MONT BLANC.—"Elek. Anz.," Oct. 2.—A note on the project of the French engineer [illegible]. He proposes to construct a vertical shaft [illegible] deep connecting it with an inclined tunnel [illegible] long; the tunnel will rise [illegible] feet to a height of [illegible] feet approximately above the [illegible]; the vertical shaft is to be [illegible] feet in diameter and [illegible] feet long.

THE ELECTRIC RAILWAY. [illegible] Ry. Rev.," Oct. 15.—An article on the greatness and possibilities of the electric railway, which contains a number of interesting compilations and comparisons. Owing to the expansion of the cities of New York, Boston and Chicago, the density of population is gradually decreasing, the effects are shown of street railways on the distribution of population. Among the numerous compilations and comparisons the following may be of interest. In the States having the greatest street railway mileage more than half the population live in the cities. Every day the street cars carry as many passengers as there are inhabitants in Greater New York, Chicago, Philadelphia and Boston. To purchase the street railways would take all the coin, notes and certificates in circulation in the United States; the amount would easily pay the debt of the United States. The paying passengers amount to 2,260,000,000 per annum, which would be increased by 50 per cent. if the transfers were included. The cost of transportation on street cars and on steam cars is compared. Diagrams are given showing the population, area, miles of street railway, and average rides per capita per year in the six largest cities. There are 16,000 miles of street railways in the United States; the rails laid end to end would encircle the earth one and a third times. Two million three hundred thousand tons of coal per annum are used. Two hundred thousand men is the number of employees. The average car travels 120 miles per day, and in the course of a year each wheel passes over 8,000,000 rail joints; only 1 in 23,000,000 passengers is killed and only 1 in 800,000 is injured in any way.

STORAGE BATTERY ON ELEVATED ROAD.—"St. Ry. Rev.," Oct. 15; more briefly in "West. Elec.," Oct. 15.—An illustrated description of the operation of the battery on the South Side Elevated road in Chicago; besides showing the curves referred to in the "Digest" last week, some further data and some illustrations are given.

SUSPENSION RAILROAD.—"Sc. Am. Sup.," Oct. 15.—A reprint of the illustration, with a brief description, of the road between Eberfeld and Barmen, of which a brief description was noticed in the "Digest" Oct. 15.

TEST OF POWER PLANT. Munroe. "St. Ry. Rev.," Oct. 15.—An abstract of a thesis describing a test of the Lafayette, Ind., street railway power plant, operated by steam.

CRIPPLE CREEK RAILWAY.—"St. Ry. Rev.," Oct. 15.—An illustrated description of this road, on which three-phase currents, reduced to direct currents, are used.

STREET RAILWAYS OF CHICAGO.—"Eng. News," Oct. 20. —Long abstracts of a report to City Councils by a committee of which Harrison is chairman; it shows the need of some change in the relations between the city and the street railway companies.

DELIVERY WAGON.—"Can. Elec. News," Oct.—A brief, illustrated description of the first electric motor wagon to be used in Canada for a commercial purpose.

STREET RAILWAY CONVENTIONS.—"St. Ry. Jour.," Oct. —The whole of this issue is devoted to full accounts of the proceedings of the American Street Railway Association, the Street Railway Accountants' Association and the convention of the New York State Street Railway Association. Reprints of the papers and the discussions are given.

STREET RAILWAY CONVENTIONS.—"St. Ry. Rev.," Sept. 15.—A full account, with the papers, discussions and transactions, of the recent Boston convention of American Street Railway Association, of the Street Railway Accountants' Convention, and of the meeting of the Street Railway Association of the State of New York. Two of the papers are reprinted in the issue of Oct. 15.

Installations, Systems and Appliances.

FRANKFORT-o.-M.—"Zeit. f. Beleucht.," Sept. 30.—Long extracts and tables from the report of the operation of this alternating current station for the year ending in March.

BERLIN.—"Zeit. f. Beleucht.," Sept 20.—A short article showing the growth of some of the central stations in that city.

Wires, Wiring and Conduits.

WIRING RULES.—Lond. "Elec. Rev.," Oct. 7.—A brief discussion of the recent rules issued by the Manchester corporation. The fact that all fittings must be approved in writing by the corporation engineer is thought to be a step in a dangerous direction; it is not considered wise to worry consumers with every little detail; moreover, consumers will feel that if everything has received such approval they are perfectly safe; it is argued that only special apparatus should require special approval. Several other points are discussed.

SHIP WIRING. Bagot. Lond. "Elec. Eng.," Oct. 7; reprinted in "El'ty," N. Y., Oct. 19.—A short, illustrated article, giving some hints on the use of the single-wire system in which the negative pole of the dynamo is connected with the hull of the vessel.

Electro-Physics and Magnetism.

THEORIES OF ALTERNATING CURRENTS. Rhodes. "Roy. Soc. Proc.," 62, p. 348; abstracted briefly in "Science Abstracts," July.—The article deals with the complete investigation of the complicated arrangements of mutually dependent circuits. The method depends on the fact that if a simple harmonic function is differentiated twice in succession, the result is proportional to the original function. He also shows that any periodic voltages and currents can always be represented by simple sine curves, having the same root mean square value and suitable phase position, dependent only on the time constant of the circuit and on the periodicities of the harmonics present.

IMAGINARY QUANTITIES IN TRANSFORMER EQUATIONS. Pomey. "Science Abstracts," July.—An abstract, with some of the formulas, of the article noticed in the "Digest" April 30.

HIGH FREQUENCY AND HIGH POTENTIAL CURRENTS. Niewenglowski. "Cosmos," Sept. 24.—A short, illustrated article of a semi-popular nature, describing the apparatus as made by Radiguet, and experiments made with it.

CONTINUOUS-CURRENT SPECTRA. Kalaehne. "Wied. Ann.," No. 8; abstracted briefly in Lond. "Elec.," Oct. 7.—He used the continuous current from high potential accumulators, as this enables the spectra to be studied at a lower temperature, which sometimes does not exceed 100°; he used 600 cells and in a number of cases obtained band spectra as distinguished from line spectra.

RESISTANCE OF WIRES FOR ALTERNATING CURRENTS. Gray. "Phil. Mag.," Oct.—A short communication on the calculation of the virtual resistance of thin wires for rapidly alternating currents. He calls attention to a formula of his which Boynton recently quoted in his article on the high frequency induction coil, but from which he made some incorrect deductions; he corrects the error and shows that the formula is only approximate.

EFFECT OF GASES ON DISCHARGES. Wesendonck. "Wied. Ann.," 65, p. 553; abstracted in the "Elek. Zeit.," Oct. 6.—It has been stated that high chimneys are seldom struck by lightning, which was thought to be due to the gases; he made laboratory experiments from which he concludes that the gases are not the cause, as they tend to favor the spark discharge rather than to hinder it.

ELECTRICAL PROPERTIES OF GLASS. Gray and Dobbie. "Roy. Soc. Proc.," 63, p. 38; abstracted at some length in "Science Abstracts," July.—Descriptions of experiments undertaken to determine the circumstances which affect the conductivity and specific inductive capacity of glasses. Their experiments seem to show that when the composition approaches to a definite chemical compound the glass has a high resistance.

ELECTRICAL RESISTANCE OF METALS. Liebenow. "Science Abstracts," July.—A long abstract of his article which was noticed in the "Digest" last year.

ROENTGEN RAY THEORY. Walter. "Wied. Ann.," p. 74; abstracted in Lond. "Elec. Rev.," Oct. 7.—He claims that the adoption of the wave form is by no means universal; he assumes that Röntgen rays are composed of the same particles as cathode rays, after they have completely lost their electric charge by their impact on the anti-cathode. Measurements showed that the ratio of the charge to the mass of a cathode particle is about a thousand times as great as the same ratio in the electrolytic ion.

ROENTGEN RAY APPARATUS.—"Elek. Zeit.," Oct. 6.—A number of illustrations of recent forms of apparatus made by a German company.

CATHODE RAYS.—"Elek. Zeit.," Oct. 6.—An abstract of a paper read before the Hungarian Academy of Science, in which the author (the name is not given) gives a proof that the magnetic and electric deflections, and therefore also the velocity of the rays, may be changed by electrical influences.

DARK CATHODE SPACE. Wehnelt. "Wied. Ann.," 65, p. 511; abstracted in the "Elek. Zeit.," Oct. 6.—He shows that this space is not like a poor conductor but like a perfect dielectric

CIRCULATION OF GASES IN CROOKES TUBE. Swinton. "Phil. Mag.," Oct.—Reprints of his two Physical Society papers, abstracts of which were noticed in the "Digest" June 25, on the "Circulation of the Residual Gaseous Matter in a Crookes Tube."

PHOSPHORESCENCE. Jackson. "Phil. Mag.," Oct.—A reprint of a long Brit. Assn. paper.

ZEEMAN EFFECT. Preston. Lond. "Elec. Rev.," Oct. 7.—The beginning of a long abstract of his Brit. Assn. paper in which he described experiments showing the visible separation of the lines into triplets, which he was the first to accomplish.

MAGNETIZATION OF CYLINDERS. Holborn. "Berlin Akad. Sitzber.," 10, p. 150; abstracted briefly in "Science Abstracts," July.—He endeavored to find the situation of the poles in a magnetized iron cylinder under various circumstances. For a cylindrical magnet 15 cm long the distance between the two poles varies between 10.8 and 13.7 cm, or between 72 and 91 per cent. of the total length. As the field increases, the distance between the poles first decreases and then increases again.

ALTITUDE AND TERRESTRIAL MAGNETISM. Rijckevorsel and Bemmelen. Lond. "Elec. Eng.," Oct. 7.—A brief abstract of their paper read before the recent conference on terrestrial magnetism, describing investigations with the influence of altitude above the sea on the elements of terrestrial magnetism. The experiments covered a period of two years, and were made on the Righi, one of the Alps. They conclude that they consider it proved that if there is any influence of the altitude it is so exceedingly small that it can hardly be detected with present surveying instruments, and it is therefore quite unnecessary to take altitude into account in magnetic surveys; if, however, it should be found that there should be such influence, it is more likely to be an increase of the vertical forces with the altitude than anything else.

TERRESTRIAL MAGNETISM. Schuster. "Phil. Mag.," Oct. —He discusses the possible effects of solar magnetization on the periodic variations of terrestrial magnetism.

INTERNATIONAL MAGNETIC CONFERENCE.—Lond. "Engineering," Oct. 7.—Brief abstracts of the papers read, some of which have already been noticed in the "Digest."

ROENTGEN RAY NOTES. Rollins. "Elec. Rev.," Oct. 19.—A continuation of his notes. He calls attention to the harmony between tubes and generators, claiming that the maker of the tube should know the kind of generator with which it is to be used, and after the tubes have been adjusted they should not be used on any other generator. The use of Rontgen light tubes for spectrum analyses is briefly referred to. He points out some advantages of the use of high e. m. f.; with his large machine, containing sixteen plates 6 feet in diameter, he found that radiant energy could be produced of the wave length required for Rontgen light, with a vacuum so low as to be equal to the resistance of one-sixteenth of an inch of air on this generator; this is an advantage, as it is easier for makers to furnish tubes with low than with high vacua; he recommends such generators where portability is not important. To dry the air in the enclosures around influence machines he recommends circulating the air by passing it over the chloride of lime by means of a blower.

RADIOGRAPH TUBES.—"Sc. Am. Sup.," Oct. 22.—A translation of an illustrated article from "La Nature," describing Villard's tube, which is regenerated by means of hydrogen, entering through a platinum rod, as has already been described in the "Digest."

CIRCUIT CONTROLLER FOR VACUUM TUBE LIGHTING. Tesla system. "Elec. Rev.," Oct. 19.—A reprint, with the illustration, of his recent patent for such a device.

ALGEBRA OF ELECTRICITY. Hellick. "Elec. Eng'ing," Sept.—The beginning of an elementary article intended for beginners; the present portion refers to the electrical units.

Electro-Chemistry and Batteries.

PHOSPHORUS. Kershaw. Lond. "Elec. Rev.," Oct. 7.—A short article on the electro-thermal process of the manufacture of phosphorus. After some brief historical notes he describes very briefly the Readman-Parker process, which is in use at Oldbury and at Niagara. Natural phosphates are heated, intimately mixed with carbon and a suitable flux, in the electric furnace, by means of a current passing between carbon poles; the heat is due to the resistance and not to the arc. The furnaces are small and capable of yielding 1.5 cwt. of phosphorus per day; the process is continuous; between 80 and 90 per cent. of the phosphorus contained in the raw materials is extracted; the Niagara works use 300 horsepower. This process is now established in four countries, and is replacing the chemical process. In considering the future of the industry he calls attention to the fact that most of the phosphorus is used in the match industry, and as there is a movement now to make matches without phosphorus, the phosphorus industry is at present in a very unsettled state.

ELECTRO-DEPOSITION OF SILVER AND ITS SEPARATION FROM COPPER. Kuester and Steinwehr. "Zeit. f. Elektrochemie," 4, p. 541; abstracted briefly in "Science Abstracts," July.—By following the usual published instructions the results were uncertain and unsatisfactory; these instructions err in requiring a certain current density instead of a constant voltage; for a good precipitation it is essential that the voltage should not exceed a certain value; over 100 experiments were made to find the most suitable conditions and it was found that perfect precipitation was obtained when the solution, whose volume was about 150 cb cm, containing about 0.5 gram of silver, is mixed with 1 or 2 cb cm of nitric acid of 1.4 sp gr and 5 cb cm of alcohol, the e. m. f. being kept constant at 1.35 to 1.38 volts for six to eight hours; excellent results were then obtained in the analysis of an ordinary coin.

ELECTRO-DEPOSITION OF IRON.—"L'Ind. Electrochem.," 7, p. 20; abstracted in "Science Abstracts," July.—The metal may be easily obtained, either as a powder or as dense and hard as tempered steel; the dense product contains a large amount of occluded hydrogen. For producing the powder the citrate or oxalate of iron is preferred, but the current density must be carefully regulated. [illegible] sulphate of iron is almost always used. The presence of chlorides should be avoided, as the [illegible] solution should be neutral and should be mixed with [illegible] of ammonia, sodium or [illegible] ampere per [illegible]

INDUSTRIAL SEPARATION OF COPPER. Neumann. [illegible] the paper noticed in the "Digest" [illegible]

[illegible]

[illegible]

[illegible]

Company of Great Britain during the first six months, which shows that it has earned a profit from the start. (This company uses the electrical process.)

Units, Measurements and Instruments.

MAGNETIC HYSTERESIS AND FOUCAULT CURRENTS. Niethammer. "Elek. Zeit.," Oct. 6.—The first half of an article calling attention to the differences obtained in making measurements of hysteresis by the usual method and by means of the alternating current. He divides the apparatus into two classes, one in which the iron is magnetized and de-magnetized lineally (as in transformers) and those in which the iron is magnetized cyclically in all directions, as in revolving fields. For the designing engineer it is important to know whether the magnetic coefficients for permeability and hysteresis, which are found for one kind of magnetization, could be applied directly for another kind of magnetization; all difficulties are overcome if the permeability and iron losses are measured by a method in which the iron is subjected to the same processes as in the apparatus to be constructed: the results obtained by the magneto-static methods with ballistic galvanometers, etc., can therefore be applied directly only for the calculation of the fields of dynamos; for alternating-current apparatus the measurements must be made with the wattmeter or by a calorimetric method; moreover, it is not right to use the first magnetization of the samples of iron. In all his measurements he therefore determined the iron characteristic and permeability curve from the maximum magnetizing forces and inductions which form the points of a succession of hysteresis curves, obtained with the use of alternating currents. The curve obtained in this way and that obtained in the usual way are shown; the characteristic for the alternating-current magnetization is appreciably lower; for the same H and for $B = 3000$ the difference is 23 per cent., for $B = 5000$ it is 12 per cent., for 10,000, 8, and for 13,000, 7 per cent. The curve form of the voltage does not affect the magnetization and permeability; when the curves are decidedly unsymmetrical—that is, rising more rapidly than they fall, due to hysteresis—it is shown that the determination of the magnetization curve can only be accomplished properly by the use of alternating currents; electro-dynamometric averages, such as are used by Steinmetz in his papers on alternating-current phenomena, may lead to entirely incorrect results; if the current curve is unsymmetrical and quite pointed the induction will be very high, while if it is flat then the induction will be lower and the Foucault current losses are appreciable. He shows that Steinmetz's hysteresis coefficient is decidedly not constant; between $B = 1000$ and 9000 a mean value can be used, but below 1000 or above 10,000 the Steinmetz equation is not permissible; the Steinmetz index, 1.6, varies in general between 1.7 and 1.9 for B less than 1000, or greater than 8000, and for values between 1000 and 8000 between 1.5 and 1.7; he urges that when the Steinmetz coefficient is given it should be added what induction is referred to. To say that the work of hysteresis is proportional to the number of cycles is not exactly correct; moreover, apparatus will heat from 40° to 50°, and with increasing temperature the hysteresis diminishes; for soft wrought iron and $B = 3000$ to 14,000 and for 10° C. it is about 1 per cent., the average for the ordinary load being a diminution of 4 to 5 per cent.; with increasing temperature the permeability also increases about 1.5 to 1 per cent. for $B =$ 4000 to 10,000; long heating of over 100° C. makes the iron poorer by about 5 per cent. to 10 per cent.; the Foucault current losses also diminish with increasing temperature: for 10° difference the variation is about 5 per cent., Turning or filing the plates after assembling should in all cases be avoided; in a continuous-current armature, for instance, the iron losses were thereby increased 1.5 to 2 times.

GALVANOMETERS. Ayrton and Mather. "Phil. Mag.," Oct.—A reprint of their long third paper, read before the Physical Society, an abstract of which was noticed in the "Digest" June 18.

ELECTRO-DYNAMOMETER IN SHUNT. Wien. "Science Abstracts," July.—An abstract, with the formulas, of an article on the use of shunts with electro-dynamometers.

MEASUREMENT OF PHASE DIFFERENCE. Rossi. "Science Abstracts," July.—The beginning of an illustrated abstract of the article noticed in the "Digest" May 21.

MEASURING THE CAPACITY OF CABLES WHEN LAID.—Lond. "Elec. Eng.," Oct. 7.—Brief, illustrated descriptions of several methods.

CAPACITY OF CONDENSERS. Lori. "Accad. Lincei. Atti.," 7, p. 150; abstracted in "Science Abstracts," July.—He describes researches made to find out whether anything analogous to [illegible] hysteresis occurs when a condenser is gradually charged and discharged. He found that there is no evidence of such electrical hysteresis.

ANALYSIS OF PERIODIC CURVES. Weiss. "Rev. Gen. [illegible]—An article describing the application of the [illegible] which applies to periodic curves in general.

NATIONAL PHYSICAL LABORATORY.—Lond. "Elec.," Oct. 7.—A reprint of the report of the committee appointed by the [illegible] to inquire into the desirability of establishing such a laboratory. The committee makes the following recommendations: That such an institution should be founded for standardizing [illegible] instruments, for testing materials, and for determining [illegible] the Royal Society should control it and nominate the governing body, with the secretary of the Board of Trade as an [illegible] member. The subject is discussed in the leading editorial.

EFFECT OF WAVE FORM ON CAPACITY AND INDUCTANCE MEASUREMENTS. Weber. "Annal. Phys. Chem.," 63, p. 360; abstracted, with some of the formulas, in "Science Abstracts," July.—In measuring capacities and inductances alternating currents are often used, with the assumption that they are of the simple sine form, but this assumption is in most cases incorrect; he endeavors to determine in how far the measurements may still be considered valid. He gives a rather complicated formula for calculating the correcting factor.

ALTERNATING CURRENT CURVE RECORDER. Callendar. "Can. Elec. News," Oct.—A reprint of the article which was abstracted in the "Digest" Sept. 17.

ELECTROSTATIC TESTING FOR OPEN CIRCUITS.—Hewett. "Teleg. Age," Oct. 1.—A description of his methods of testing at a terminal and at a way station of a telegraphic circuit.

Telegraphy, Telephony and Signals.

TELEPHONE CALL SYSTEM.—"Elek. Rundschau," 15, p. 97; abstracted in "Science Abstracts," July.—A brief description of Stock's system to do away with the necessity of talking on the part of the operator. In front of the microphone at the exchange is placed a small trembler, giving four beats per second, which is connected, and thus advises the subscriber that he is being attended to; when the operator is ready she disconnects this trembler, so that when the noise stops the subscriber knows that the operator is ready to receive instructions.

BLOCK SYSTEMS IN FRANCE. Walzel. "Elec. Tech.," Sept. 30.—A long, illustrated abstract of an article from the French describing recent progress in the block systems used on the Northern Railway of France.

VALLEY TELEPHONE CO.—"Elec. Eng'ing," Sept.—A well-illustrated description of this independent telephone company at Saginaw, Mich.

Miscellaneous.

ENAMELS FOR HEATING APPARATUS. Saglio. Lond. "Elec. Eng.," Oct. 7.—A brief abstract of his paper. He made researches with the properties of various enamels, and found that silica, kaolin, petalite and zircon make enamel infusible and insoluble, but give it less expansiveness; calcic phosphate increases the expansiveness, gives it viscosity in fusion and a certain insolubility; cryolite, fluorspar and, above all, rutile, increase the expansiveness and the fluidity of the enamel.

GUTTA-PERCHA. Obach. "Science Abstracts," July.—A long abstract of his recent Cantor lectures.

SPECIFICATIONS. McLaren. Lond. "Elec. Rev.," Oct. 7.—The beginning of a reprint of a paper on electrical engineers' specifications, referring more particularly to the mechanical engineering features.

VIENNA EXHIBITION.—"Zeit. fuer Elek.," Oct. 2.—The beginning of a report on electricity at the Jubilee Exhibition. The present portion refers to the electric lighting of the exhibition and the transmission of power.

ELECTRICAL INSTITUTE.—"L'Energie Elec.," Sept. 16.—A long, illustrated description of the Montefiore Electrotechnical Institute at Liege, Belgium, endowed by Mr. Montefiore; several views of the interior of the laboratories are given.

ACTION OF ELECTRICITY ON PLANTS. Cooke. "El'ty," Oct. 19.—A long abstract of the paper noticed in the "Digest" last week.

MARITIME ELECTRICAL ASSOCIATION.—"Can. Elec. News," Oct.—The reprints of the proceedings of the first convention of this association, including the presidential address and the reprint of a paper by Hamilton on electric gong buoys, in which he gives an illustrated description of his proposed method in which the buoys are connected by submarine cables.

Book Review.

LECTURE NOTES ON THE THEORY OF ELECTRICAL MEASUREMENTS. By Prof. William A. Anthony. John Wiley & Sons, New York; 12mo, vi + 90 pages, diagrams. Price, cloth, $1.

This work is the publication of the notes prepared for the third-year classes of the Cooper Union Night School of Science, of which the author is professor of physics. It is intended as a guide to the student, who is expected to take more elaborate notes of the lectures, serving to give an accurate outline and correct any important misconceptions in the student's mind. To those getting up similar courses the work should prove a good guide, and to those having such courses already established it will undoubtedly give valuable suggestions. The subject is an extremely difficult one to teach, owing to its rather abstract character and remoteness from practical every-day applications. Especially is this true of the fundamental derivation of the C. G. S. system of units, and any aid to teaching in this line is useful.

Exhibits of Electrical Interest at the Mechanic Fair, Boston.

The twentieth triennial exhibition of the Massachusetts Charitable Mechanic Association, lasting from October 10 to December 3, 1898, shows a notable advance over previous exhibits. At one time a food show filled with the stands of souvenir sellers and candy booths, the fair has developed until now it is an exhibition of great interest and value to visitors. The most remarkable feature of the present show is the number of electrical exhibits. A few notes of interest about these are given below.

THE DIESEL MOTOR COMPANY OF AMERICA, 11 Broadway, New York, has on exhibition the same motor that was shown at the New York electrical show at Madison Square Garden, and described and illustrated in these columns in the issue of May 28, 1898. In its present location, however, it is not direct-coupled to a generator, but is belted to a line shaft from which several neighboring exhibits are run. It is running on crude petroleum, known on the market as Eagle fuel oil. Mr. Edward Puchta, who is in charge of the engine, states that the company has decided to construct engines itself for sale instead of licensing other builders, and is about to proceed on this plan.

THE MAXHAM ELECTRIC THIRD RAIL COMPANY, Tremont Building, Boston, Mass., shows in operation an experimental model of a new design of sectional conductor street car system. The mechanism is very simple, the third rail being divided into insulated sections, below each of which is a section of similar length of ordinary round trolley wire supported on a pair of transverse rock arms in such a way that it may be tilted up against the surface rail proper, making a crude form of switch. The tilting is effected by means of a flexible depressible rail at one side, engaging the other end of the rock arms and depressed by a device on the car. The rod or wire switches are also intended to be used as a conductor by means of flexible leads attached to their ends.

THE GENERAL ELECTRIC COMPANY shows its electric railway around the world, which was described and illustrated in these columns in the account of the American Street Railway Association Convention, which was held in the same hall. This is supplemented by a few features not shown in the street railway exhibit, consisting of a large script sign of miniature lamps, a fence made up of street railway gears and pinions, with controllers for corner posts and insulators on the pickets, and other minor features. The General Electric Company supplied all the motors for driving the many exhibits throughout the building, which were almost entirely motor-driven, and several of the large generators for lighting and power purposes, and the building is lighted entirely, with the exception of the exhibition lights, by General Electric enclosed arc lamps.

THE U. S. ELECTRICAL SUPPLY COMPANY makes considerable of a show, this sort of fair being well adapted to the display of its wares. Mr. W. J. Clarke is on hand with the wireless telegraph set which was used in the New York show at Madison Square Garden, with the submarine bomb blowing up a ship and with the same X-ray apparatus. He takes particular pride in the latter, in that there are now in use the same coil and the same Crookes tube that were used in Madison Square Garden, the two having seen service of a length equivalent to four weeks of ten hours a day. The tube is pretty well blackened, but still emits X-rays plentifully. It is fitted with a shunt passed through a chemical which lowers the vacuum in case the resistance becomes too high. Downstairs the same company shows a Criterion acetylene generator, as manufactured by Messrs. J. B. Colt & Co., for whom the United States Electrical Supply Company is acting agent at the fair, as it is also for the Thermo-Electric Company, of New York City, the manufacturer of the Cox generators. The acetylene jets are shown in line with an electrical incandescent bulb, an ordinary fish-tail jet burning Boston gas, and some Welsbach mantles, shown by the Welsbach Company in the next booth. The competition does the acetylene no harm.

AMONG OTHER EXHIBITS AND EXHIBITORS are the Samson Cordage Works, of Boston; the Boston Gear Works; the New England Pump Company, showing rotary pumps and gas engines; Walter H. Foster, 126 Liberty Street, New York, showing a large line of machine tools and a motor-driven air compressor supplying several pneumatic tools; Moore vacuum tube light; the Mason Regulator Company, of Boston, showing automatic valves of many styles and a pump governor in action; the Hayden & Derby Manufacturing Company; the Consolidated Valve Company and the Ashcroft Manufacturing Company, the latter company showing a recording tachometer, giving on the tape a time record of the instantaneous variations of speed of the shaft to which it is belted, which in turn is driven by a Diesel motor; the Niles Tool Works, the particular feature of whose exhibit is the American patent pulley built up of steel-plate punched and stamped to shape; the Ball Bearing Company, of Watson Street, Boston, which shows a line of ball-thrust bearings, the balls being maintained at a proper distance apart by two collars with apertures through which the balls bear, and journals in which rollers run and are maintained in alignment, not by pins through the rollers, but by strips between them and connecting to collars which prevent the rollers from slipping out endwise, and Jenkins Brothers, who show, besides a large line of valves, a new magnetic lamp holder, which is described at length in another column of this issue.

THE AMERICAN ELECTRIC HEATING CORPORATION, Cambridgeport, Mass., shows an extensive line of electric heating and cooking apparatus, as noted in the description of the Edison Company's booth. The largest pieces are two of the company's large ranges, consisting of nothing more or less than a slate table on which can be placed the electric heating apparatus and a slate panel fitted with eight receptacles for the plugs of the flexible cords to the various heaters. Below the slate table is a plate warmer kept at a moderate heat. Beside one of these ranges is an electrical oven, which at the time of the writer's visit was doing good service in roasting chickens for the restaurant upstairs. A bewildering array of other apparatus includes the following devices: A broiler, a small stove with a switch for giving three heats, sad-irons, foot warmers, heating pads, soldering irons, glue pots, etc. One of the newest and most ingenious things is a portable heating coil shown in several forms. This consists simply of a nickel-plated tube coiled into either a spiral or helical shape and containing resistances, one end of the tube rising to a considerable height, the whole being designed to be slipped down into anything that the user may want to cook or to heat, from a coffee pot to a soup kettle. The simplicity and usefulness of this device are obvious at first thought. Besides the two forms of coiled tube it is also made up in the form of a flat disc, with a vertical stem for the leading-in wires, this disc being more easily cleaned than the other, but giving with the same volume a smaller radiating surface.

THE WALWORTH MANUFACTURING COMPANY, Boston, Mass., has a booth strongly built of 8-inch high-pressure iron pipe and cast-iron fittings made up in the form of arches and enclosing a space in which is a complete line of valves and steam-pipe auxiliary brasswork.

MESSRS. GEORGE L. TYLER & CO., Boston, make an exhibit of gas and gasoline engines of the Hamilton type, one of which is in service running a Keystone dynamo, which is exhibited by the Hancock Equipment Company, of Boston. The dynamo is supplying current to a 3-hp motor of the same make.

THE JOHN A. ROEBLING'S SONS COMPANY, Trenton, N. J., makes a small exhibit, which is a permanent fixture of the Mechanic Building, as it is a present to the association. It is a framed and glass-covered panel, showing samples of the various forms of wire and cable and insulations made by the company.

MR. JAMES L. RUSSELL, 170 Summer Street, Boston, the Eastern agent of the various houses mentioned below, makes an exhibit of the products of each. Among them are the instruments of the Syracuse Electrical Instrument Company, mounted on a switchboard built by the Shawmut Fuse Wire Company, and in circuit with a dynamo made by the Onondaga Dynamo Company, with enclosed arc lamps made by the Nowotny Electric Company, Cincinnati. The Philbrick mast arm is also sold by Mr. Russell. (See illustration).

THE AUTOMOBILE CARRIAGE EXHIBITS, which the exhibition management hoped would be a strong feature of the fair, were a notable failure; that is, in point of numbers. At the time of the writer's visit there were only two makes of electrical carriages—one, that of the Pope Manufacturing Company, of which two styles were shown, a fuller description of which will appear later in these columns, and the other, that of the Riker Electric Motor Company, of which only a tricycle was on view. There will be more vehicles from this company exhibited later. Beside the electric carriages there is but one make of gasoline carriage, that of the American Motor Company, 32 Broadway, New York, although several gasoline engines made for vehicle service are separately shown.

MESSRS. BLODGETT BROTHERS & CO., 301 Congress Street, Boston, show their electric self-winding clocks and time-dial service. The winding is done with any good open-circuit battery and a small motor with three horseshoe field magnets, soft iron segments in the armature and a commutator that switches on one or another of the magnets. The time-dial service equipment consists of one master clock, with a make-and-break device, closing a circuit through the actuating magnets of the various time dials at predetermined intervals, the escapement of the time dials being of a very positive character. A large four-faced clock, which appears in the foreground of the accompanying view of the Edison exhibit, is also the work of Blodgett Brothers & Co., as are all the main clocks in the building.

[illegible] pumps in great number and great variety, a few of those interesting to central station men being as follows: A duplex outside-packed plunger double-acting steam pump for high-pressure boiler feeding; a combined receiver and pump on one base for taking drips of condensation, etc., and returning them under high pressure; a combined jet condenser and pump, and some "babies" which are [illegible] matic oiling devices. A so-called "sinker" pump for boiler feeding in locations [illegible] minute, but does not seem to have found its way into the central station field as yet, although it should prove valuable in many instances. That shown is built extra heavy, sufficiently so for feeding against any commercial boiler [illegible] Hayes, the New England manager of the company. (See illustration).

[illegible] as though it were in an international electrical or telephone exhibition. With [illegible] mensions, and weighs but 65 pounds, contains a microphone transmitter with [illegible]

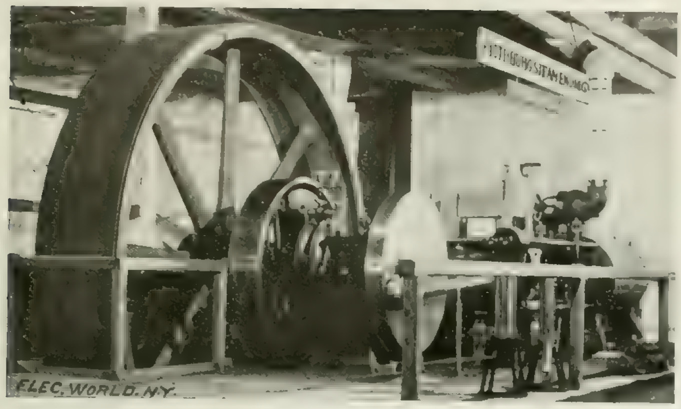
THE SPRINGFIELD ENGINE STOP COMPANY, Springfield, Mass., will install a Columbia electric engine stop upon the larger Fitchburg engine, but it has not been attached as yet. This is similar to the Corliss electric engine stop, which has been previously described in these columns, the mechanism being started by means of push-buttons or automatic contacts at any point from which it may be desired to stop the engine, a magnetically controlled valve admitting steam behind a piston, which in the case of Corliss engines throws the trip-toes to the zero-cut-off position, but in the case of other forms of engines closes the main stop valve.

THE FITCHBURG STEAM ENGINE COMPANY, Fitchburg, Mass., has two engines in the hall, doing useful service mechanically as well as displaying their good points. The larger is a single cylinder horizontal, 18x36, rated at 150 horse-power, running at 90 r. p. m., and belted to a countershaft, to which are also belted some large General Electric lighting generators. A smaller engine of the same type is also in service, directly belted to a generator. The engines are fitted with the now well-known cam wrist-plate motion and shaft governor, giving very quick action to the steam valves and an independently driven exhaust. A still sharper admission and exhaust is obtained by double-ported piston steam valves, and these valves are slightly unbalanced in the direction of their travel by the steam pressure acting on the area of the stem, holding them tightly against one side of the cam, giving a most beautifully noiseless running. A neat attachment unusual in engines with positive cut-off is a hand gear for manually operating the steam valves in starting and stopping. Another device insuring added comfort to the engineer is the set of bronze gibs on the crosshead. Mr. Fred Fosdick makes good use of the exhibit to point out the merits of the engine. (See illustration).

THE RIDGWAY DYNAMO & ENGINE COMPANY, successor to the J. H. McEwen Manufacturing Company, Ridgeway, Pa., makes a most useful exhibit, under the charge of Mr. J. L. Kimball, 63 State Street, Boston, the New England agent. The exhibit consists of a 75-kw Thompson-Ryan machine generating 125 volts at 260 r. p. m., mounted directly on the shaft of a McEwen 14x14½ high-speed engine. The latter is fitted with a modification of the Rites inertia governor, and the dynamo shows some recent modifications, the series winding being now a plain spiral of ribbon wound into slots between the four teeth of which every pole is composed. The flanges of the field yoke which formerly covered the field coils have also been abandoned. The series spiral is offset one-half pole angle from the shunt winding, thus exactly balancing the distorting effect of the same current in the armature. The machine is also fitted with a modification of the reaction brush holder, differing somewhat from that customarily used, the face of the holder against which the brush slides being almost radial, and the direction of rotation being such as to force the carbon brush against this surface instead of the contrary, as is customary. The machine is wired to a switchboard built by the Albert & J. M. Anderson Manufacturing Company, fitted with Keystone instruments, and carries a large electrical sign on the roof of the building at night and considerable of a day load. (See illustration).

THE JANDUS ELECTRIC COMPANY AND THE BUCKEYE ELECTRIC COMPANY, Cleveland, Ohio, make a combined exhibit under the supervision of Mr. H. T. Edgar, the New England manager for both companies, with offices in the Tremont Building. The Jandus Company shows seven complete arcs, both in the standard and short lengths, with various styles of globes and cases and the latest improvements in the controlling mechanism. The latter consists of a plain series solenoid concentric with the carbon, the spool serving also as a dashpot for the plunger, which is its own piston. This carries the well-known clutch, consisting of four knurled rings which grip the carbon. The 220-volt lamp is now made up in a different form, the control mechanism consisting of two solenoids diametrically opposite each other in the shell and two dashpots at the other two sides of the square, making a shorter lamp. This lamp is shown in operation, taking two and a half amperes and drawing an arc seven-eighths of an inch in length. In the centre of the exhibit there appears a handsome oxidized-silver frame, which attracts considerable attention, and the exhibit is yet to be completed by the addition of alternating-current enclosed arcs. The Buckeye incandescent lamps make a splendid showing on a large lamp board at the back of the exhibit, and also in the candelabra form, tipping the branches of the antlers of one of the most perfect bucks' heads that the writer has ever seen. In the line of new things a [illegible] lamp is shown with four anchors, two fastening in the sides of the bulb. Many decorative and colored lamps are shown, with beautifully clear translucent glass. The filament of the lamps is a special point of pride with Mr. H. C. Estabrook, who is in charge of the combined exhibit. It is made of a cellulous material derived from corn pith, and with a final exhaustion and treatment in a naphtha compound the completed filament shows a polished steel metallic finish that is the envy of others working in the same line. It is also flexible, but does not sag. (See illustration).

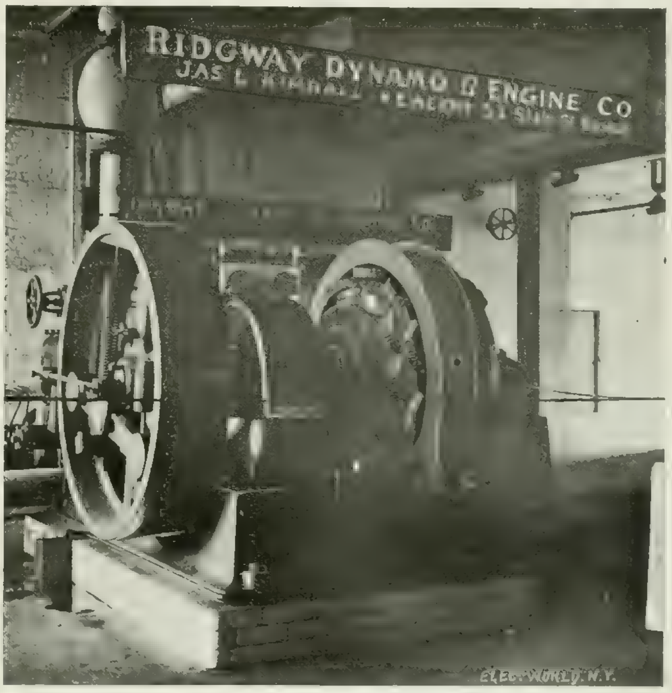
THE EDISON ELECTRIC ILLUMINATING COMPANY, of Boston, makes a most elaborate exhibit and follows the custom set by its associates in New York and Chicago in constructing a booth of a pleasingly artistic architectural design, and filling it with electrical apparatus of a most instructive [illegible]. The exhibit of the Boston Edison Company covers a space [illegible] feet, and is housed by an open structure of columns and beams built after the [illegible] painted to imitate marble and frequently re-covered with fresh Alabama smilax. The structure is divided into two sections joined [illegible] is lighted by [illegible] incandescent lamps, all frosted. Around the outside (see the accompanying illustration) are electrical signs [illegible] designs of [illegible] lamps and all [illegible]. One of the two main [illegible] application of power and arc lighting [illegible] electrical heating, cooking and incandescent lighting [illegible] of an electrical hydrant intended for [illegible] a heavy cast-iron box, [illegible] may be provided with keys [illegible] when the proper coin has been [illegible]. A flexible cord is provided to attach [illegible] to the visitors of the fair most [illegible] is the complete line of electric heating



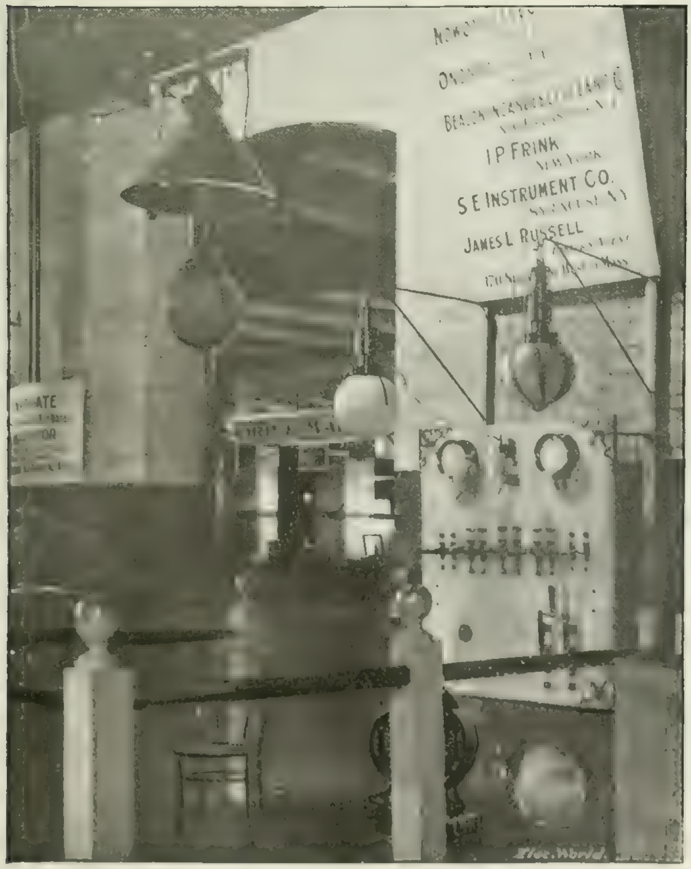
The Larger Fitchburg Engine.

Telephone Apparatus by Whitman & Couch.

Exhibit of Deane Steam Pumps.



Thompson-Ryan Dynamo and McEwen Engine.



Apparatus Shown by James L. Russell.

THE JANDUS ELECTRIC CO.
NEW BOSTON TERMINAL STATION
JANDUS LAMPS.
A FEW PROMINENT USERS OF JANDUS ENCLOSED ARC LAMPS.
ELEC. WORLD. N.Y.

The Jandus and Buckeye Exhibits.

See Page 454.]

and cooking apparatus which is exhibited by the American Electric Heating Corporation, of Cambridgeport, Mass. A description of this apparatus will be found in separate note. The exhibit contains also a full line of Jandus enclosed arcs, a complete line of instruments, including a mammoth 8000-ampere astatic Thomson integrating wattmeter in operation, a Wright demand-meter and a G. E. prepayment or coin-in-the-slot meter. Another Thomson recording wattmeter is shown in operation with a lamp load to prove to the uninitiated a fact concerning which they are rather skeptical, namely, that the meter does stop when the current is turned off. Of the large line of apparatus for making use of electric power there is room here for but a brief list. Among other things are a Sprague push-button elevator for house service; a Burton liquid forge; a Worthington house pump, with a Zimdars & Hunt float switch; a Davidson direct-coupled fan; an Elektron dumbwaiter; a Zeigler stage lamp and X-ray coil; a Lundell summer and winter fan; a job press driven by the friction of the motor pulley on the fly-wheel, with a pedal for throwing off this friction and throwing on a brake, or vice-versa; a Stow flexible shaft outfit with emery wheels, wood bits, etc., and a Singer sewing machine and Diehl motor. The company's methods of distributing current are illustrated by a full-sized junction box; the operation of a complete photometer is shown, and diagrams of the growth of the business and of the relative business done in Boston and in other cities are mounted about the booth. On the latter point valuable data have been secured by an extended line of correspondence carried on by General Manager Edgar, showing some interesting results. For example, the number of incandescent lamps installed per thousand people is larger in Boston than in any other large city, being 1232. The number in New York per thousand of population is 859, and in Chicago 730. This is shown graphically by a representation of the solar system, Boston being the hub or centre, and the other cities revolving around it, the diameters of the various planets and of the sun being proportional to the number of lights per thousand. Other diagrams show the growth of the business. The horse-power [illegible] and [illegible] for 1898. The number of electric elevators has grown since the year 1890 from 69 to 401, the rated horse-power of such motors increasing in the same time from 689 to 4475. The increase in the number of incandescent lamps wired from 1886 to the present time is from 4847 to 166,376, the number of the company's customers at the same times being 50 and 5167. Other interesting details almost too numerous to mention are shown, a novel one being the projection of an arc on a large scale on a screen. The arc is a long flaming one, being an enclosed arc lamp with the enclosing globe removed, giving the colors of the different parts of the flame most beautifully. The exhibit is in charge of Mr. La Rue Vreden- [illegible] property, one of the most valuable electrical exhibits to the public in general ever shown.

THE HOLTZER-CABOT ELECTRIC COMPANY naturally makes an extensive exhibit in a fair located in the same city as are its home offices and factory. The well-known line of Holtzer-Cabot apparatus is fully covered by samples. A few of the more recent novelties are as follows: The Ness automatic telephone switch for intercommunicating systems attracts some attention, its chief distinguishing point being that the moment the receiver is hung up the switch is released and is instantly spring-restored to the proper normal position. With all telephone apparatus shown the Holtzer-Cabot metal cap receiver is, of course, used. Another novelty is a direct-geared motor-driven bandage winder for hospitals, with a spring drive designed to slip in case the [illegible] to take bandages of any [illegible]

ordinary sparking coil, the armature and commutator of the generator being enclosed and dustproof. This sort of igniter will certainly give much less trouble than a primary battery, a slight compensating disadvantage being the fact that the igniter requires a battery for use in starting the engine, although with this limited use a good open-circuit battery should last indefinitely.

The Product of the Pittsburg Transformer Company.

A new concern, the Pittsburg Transformer Company, Pittsburg, Pa., has entered the field as a manufacturer of transformers, and has started the construction of a line known as Type "K," and shown in the accompanying illustrations. The new transformer is of the core type, with the windings on the two long sides of the rectangle, this type having the advantage that the coils are readily replaceable in case of trouble without separately withdrawing and replacing every lamination of the core. All iron is of rectangular cross section, and by slipping out the short sections joining the tops of the long cores the coils may be readily slipped off. Their insulation is not as liable to be cut in simply slipping them onto a core already built up, as is the case with transformers of the shell type.

Holtzer-Cabot Apparatus.

The details of construction embody considerable study and are of no little interest. The low-tension coil is wound nearest the iron, and is separated from the high-tension coil, which is wound over it, by a micanite plate. The long coils of the primary and secondary in close juxtaposition for the whole length gives a small magnetic leakage. The primary is wound a little shorter than the mould, giving a chance to bend over the ends of the micanite plate, and also fold over the sheets of rolled paper that are wound between the layers of the primary, giving a high insulation and long creeping distance between layers, and particularly between the ends of the layers, which are the weakest points in core-type transformers. The secondary is made up of rectangular [illegible]

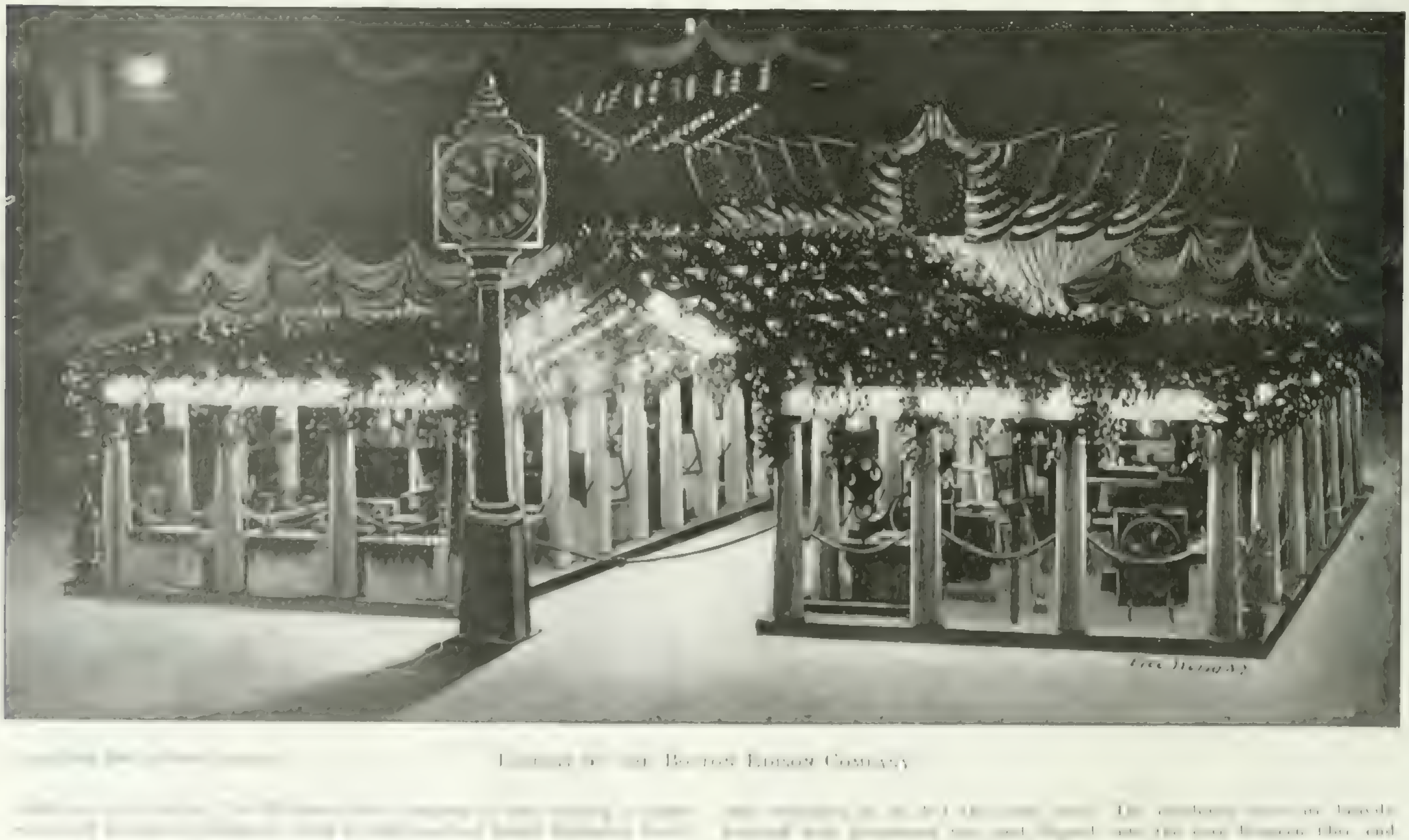
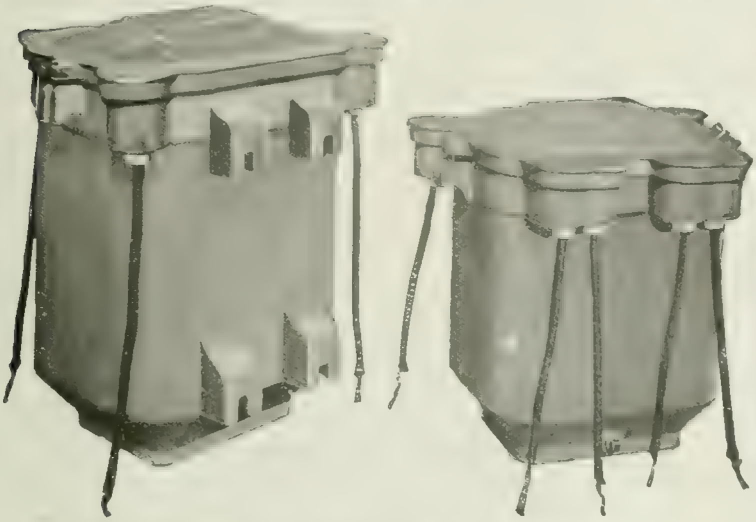


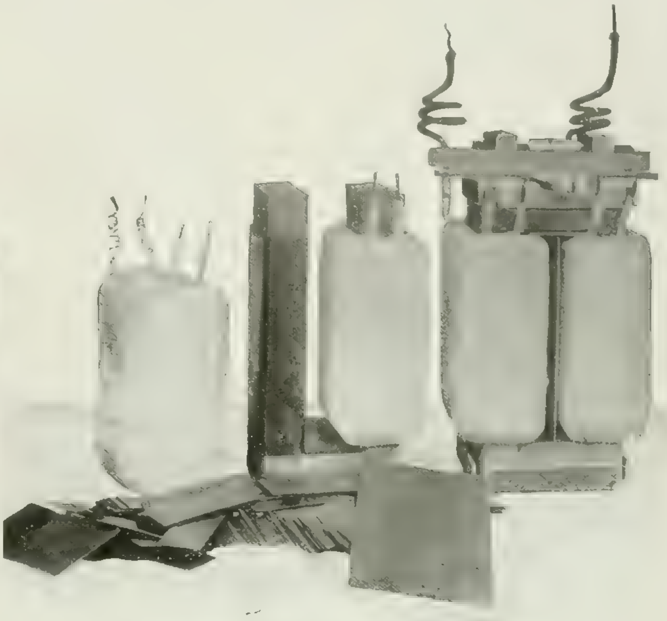
Exhibit of the Boston Edison Company.

to the leads which pass out downwardly through porcelain bushings, four leads being taken out from the secondary to get the proper series and multiple connection outside of the transformer case. The transformers with oil are tested between copper and iron, and copper and copper, with a pressure of 10,000 volts. The case is of cast iron japanned to render it mineral-oil tight, the transformer being designed for either oil or dry insulation. It is fitted with slotted lugs, which can be slipped over bolt heads to fasten it in place, yet leaving it readily removable.

The transformer is carefully designed for low iron loss, which the company's tests show to vary from 2.2 per cent on the 1 kw to 1 per cent on the 5-kw size; also for close regulation, which on inductive loads varies between 2½ per cent. and 2 per cent on the same sizes, respectively, and for low temperature rise and consequently considerable overload capacity.

The company also puts out for the protection of the transformer an all-porcelain single-pole primary fused terminal.

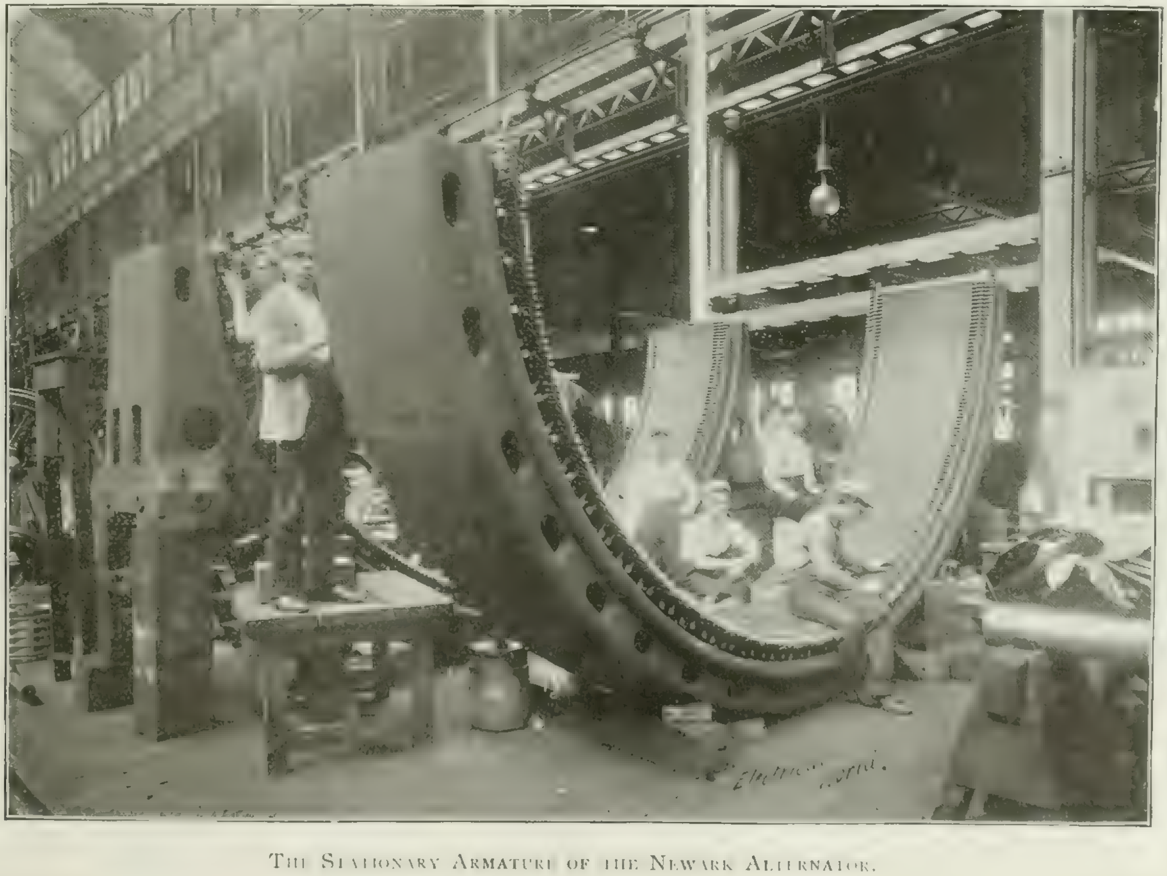

Rear and Front Views of Type "K" Transformers.


Component Parts of the Transformer.

The Visit of the Knights-Templar to the Westinghouse Works.

On Wednesday and Thursday, October 12 and 13, the members attending the Knights Templar conclave at Pittsburg visited East Pittsburg, where those attending were granted the fullest opportunities of inspecting the works of the Westinghouse Machine Company and the Westinghouse Electric & Manufacturing Company. In the former two of the large steam engines for the Metropolitan Electric Supply Company, of London, were assembled for tests. Westinghouse gas engines of all sizes were shown under construction. Gas engines were also shown under test, one engine coupled to a dynamo being intermittently loaded to show the perfection of the speed regulation. In the electrical works the Knights were shown through the main aisle of the long shop, where there were in various stages of construction the parts of generating machinery aggregating in capacity an output of about 50,000 horse-power. A large part of this was alternating apparatus, and among the largest machines were the following: A 5000-hp dynamo for the St. Lawrence River water power plant, a 2000-hp alternator for the Metropolitan Electric Supply Company, of London; four 1500-kw generators for the Snoqualmie Falls plant, a 850-kw generator for the People's Light & Power Company, of Newark; a 750-kw dynamo for the United Electric Light & Power Company, of New York, and four 750-kw generators for the Kings County Electric Light Company, of Brooklyn. Besides these there were many direct-current machines and a number of induction motors of 300 horse-power and smaller sizes, and rotary transformers of 500-kw capacity.

One of the most interesting types of machines was the 850-kw rotating-field alternator for the plant in Newark, parts of which are shown in the accompanying illustrations. This machine is designed to be direct driven by an engine at 90 revolutions, and has 80 poles, the diameter at the air gap being 168



The Stationary Armature of the Newark Alternator.

inches, the machine delivering two-phase current at a normal pressure of 2300 volts, with a frequency of sixty cycles per second. The machine is, however, so wound that it will give with full non-inductive load a terminal pressure higher by 300 volts, and will also stand a current output 60 per cent. above the rating for several hours. Both armature and field are bar wound, the field windings being laid up edgewise, the field coils being noticeable for their shortness. The armature winding differs from the customary continuous single winding of the Westinghouse Company, having two independent distributed lap windings, one for each phase, with three slots per hole per phase, the independent groups of three laps each being connected in series with adjacent groups, there being but two paths in the whole winding of either phase. The ampere turns of the armature are small compared with those of the field, there being but two bars per slot. This gives the armature low self-induction and low reaction under inductive loads, and gives good regulation on motor loads with low power factor. A considerable air gap and an unsaturated magnetic circuit are used for the same purpose.

A Private Plant Telephone System.

Within the last few years there has been remarkable progress in the adoption of telephone systems for private plant use. In plants of this character the central station system has always been considered impractical where the service was not sufficiently voluminous to require the constant attendance of an operator, owing to the time required for an irregular attendant to make a desired connection.

To avoid this delay in small plants many devices have been evolved, from an ordinary strap switch to a complicated automatic switchboard. One of the most [illegible] is the private intercommunicating system

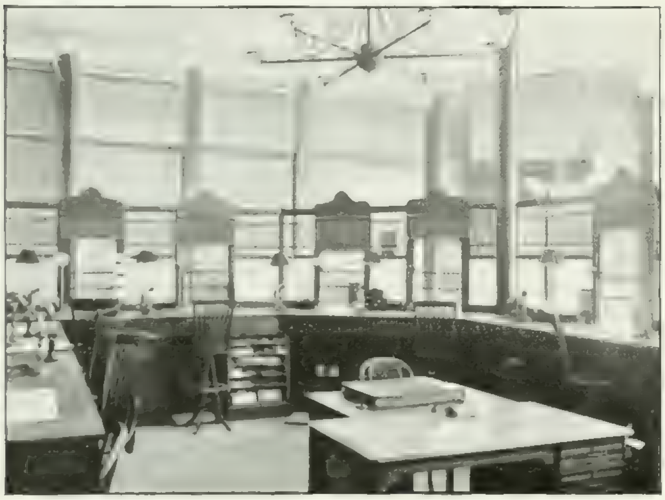


FIG. 1.—TELEPHONES IN APPLICATION OFFICE.

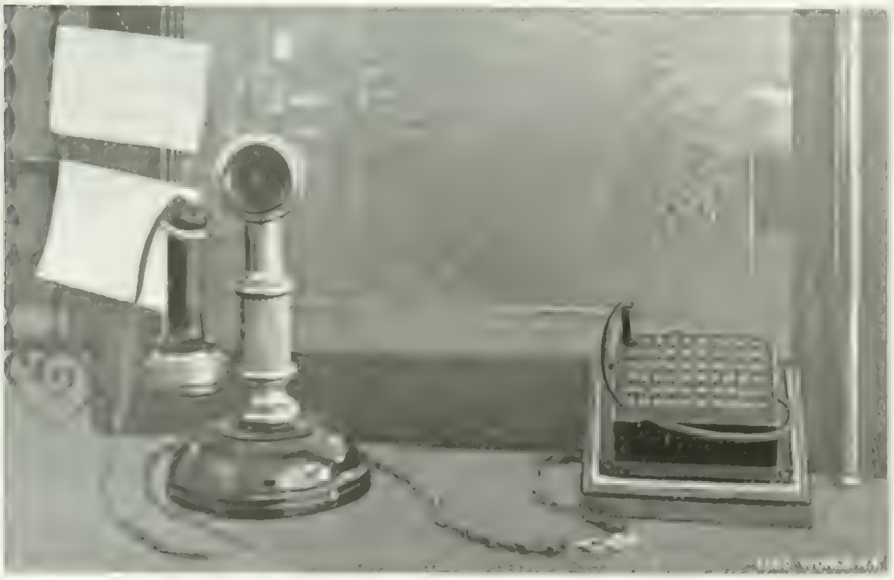


FIG. 2.—STANDARD DESK SET AND PLUG SWITCH.

The desk set is neatly designed and very substantially constructed. The plug switch consists of a series of jacks compactly mounted, to which the direct lines from the instruments in the bookkeepers' department are connected. Each desk in this department (Fig. 3) is furnished with a long swinging arm telephone and a plug switch connected direct with each instrument on the main floor.

In this system the user is not required to first call an operator at a central office, but completes the calling circuit to the station desired by inserting the plug in the corresponding jack, regardless of where the plug of the called instrument may be. The talking circuit is completed by the person called placing the plug in the home number. Should a user neglect to disconnect an instrument when through, or fail to place the plug in the home station jack, it does not prevent that station from being called by another station, as is the case in ordinary strap switch systems. Any number of pairs of instruments may be used simultaneously without interference. The objectionable cross-talk, so frequent in systems of this kind, is entirely avoided by the peculiar arrangements of circuits.

Fig. 4 shows a pedestal, near the president's desk, with a desk telephone and plug switch for the office system and a telephone connected with the public exchange. These pedestals were furnished with the private system, and were specially made to accommodate the public exchange telephone as well as the private plant instrument. The instruments are of the regular long-distance type, and in cities where independent public exchanges have been established the private system is connected directly with the public exchange, and the separate instrument is not required.

This system is said to be used in many of the largest business houses in the principal cities throughout the United States, and is being installed in many large residences, hotels, public institutions, factories, and for connecting mines,

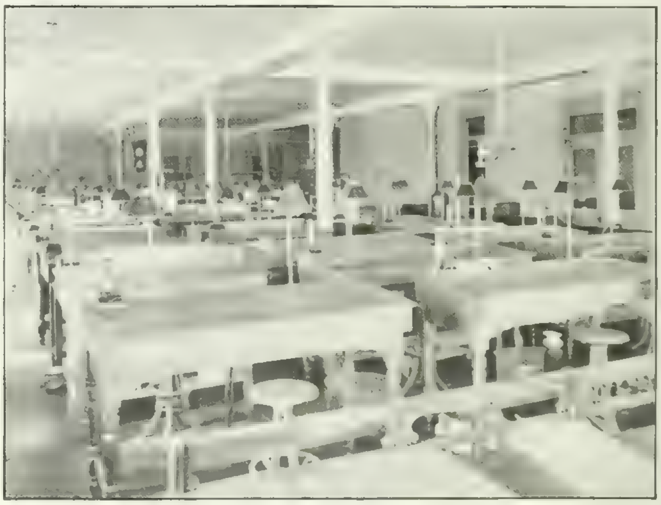


FIG. 3.—BOOKKEEPING DEPARTMENT.

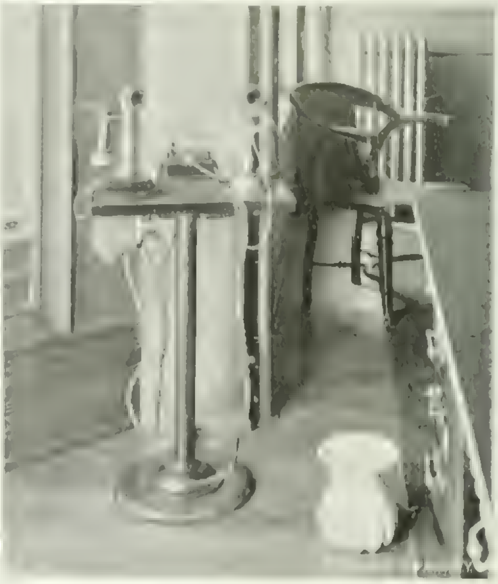


FIG. 4.—PEDESTAL.

[illegible]

[illegible]

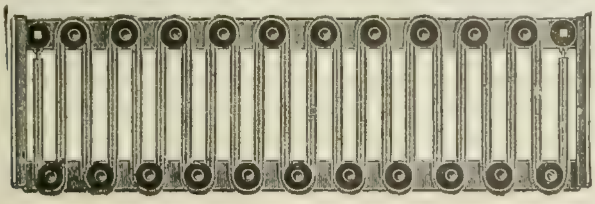
[illegible]

Electric Car Heaters.

[illegible]

[illegible]

springs. These coils have a stout asbestos cord running through their centre from end to end. An oblong frame of flat steel, provided with suitable pins projecting from either side, furnishes suitable supports for round-grooved porcelains on which the coils are mounted. The asbestos cords are drawn taut and fastened on their respective sides to the terminal porcelains at either end, to which also the coils are made secured independently. The asbestos cord furnishes a continuous support throughout the length of the coils, prevents the possibility of the coil in any manner getting out of place and permits the coil to be put in place and maintained there without tension on the same.



Heating Coil.

Rubber covered flexible terminal conductors are connected to the coils by good mechanical joints and soldered, the flexible conductors passing through porcelain-bushed holes to the outside of the case. All heaters in a car are designed to be connected in series in two circuits.

The company states that the present types of American heaters have been in continuous service for five years, and have demonstrated that they may be maintained with absolutely no cost for repairs, being practically indestructible.

A Portable Electric Safety Lamp.

The Lamp.

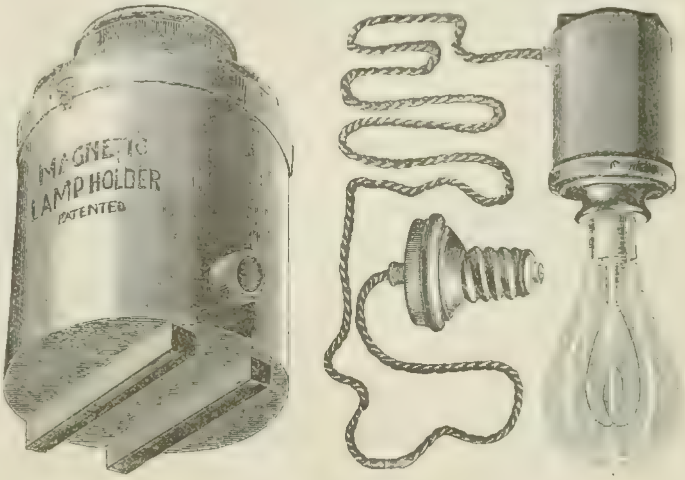
There has recently been devised a portable electric safety lamp for use in special cases when an open flame or even one safeguarded, as in the miner's lamp, would prove dangerous. The combination consists of a dry battery arranged to be carried in a holder at the belt, or in the pocket. The battery is controlled by a small rheostat, maintaining an even supply of current to the lamp and allowing it to burn with the same brilliancy during the life of the battery. The electric lamp, connected to the battery by a flexible cord, is the miner's lamp, manufactured at the Edison Lamp Works of the General Electric Company. It is of six candle power, and is set in a small white enamelled parabolic reflector. provided with a stick pin to allow it to be attached to the hat or any part of the clothing. The light is strong enough to allow ordinary printed matter to be read at a distance of 100 feet from the lamp.

The combination is manufactured by Elmer E. McIntyre, of Pittsburg, Pa., and has been found very useful by gas inspectors in reading meters in dark cellars; by repair men exploring cellars and trenches for gas leaks and defective pipe connections or examining gaseous sewers; by miners and mine inspectors in gaseous mines, where the risk of explosion even from the miner's lamp is ever present; by watchmen in powder mills and warehouses storing inflammable oils and essences or by workmen repairing oil and gas tanks or examining the riveting inside steam boilers. This lamp is especially valuable, as it leaves the hands free. Its weight is about 2 pounds.

Electric Safety Lamp Lighted.

Magnetic Lamp Holder.

A unique incandescent lamp holder is shown in the accompanying illustration, the figure at the left being the holder and that at the right showing the lamp and holder combined. Within the holder is an electromagnet, the poles of which are in the shape of two bars, of rectangular section, set parallel to each other, as illustrated. When the lamp is burning, the magnet coils being connected in series with the filament, the holder is energized, and the resulting magnetic lines of force emanating from the poles afford a means of attaching the lamp to any body of iron or steel. It is obvious that this device will find many uses in such places as machine shops, where it is frequently desired to move a lamp quickly from place to place around lathes and drills, for instance.



Magnetic Lamp Holder and Its Application.

The lamp and holder will fasten itself to any mass of iron or steel instantly, and will remain in any position.

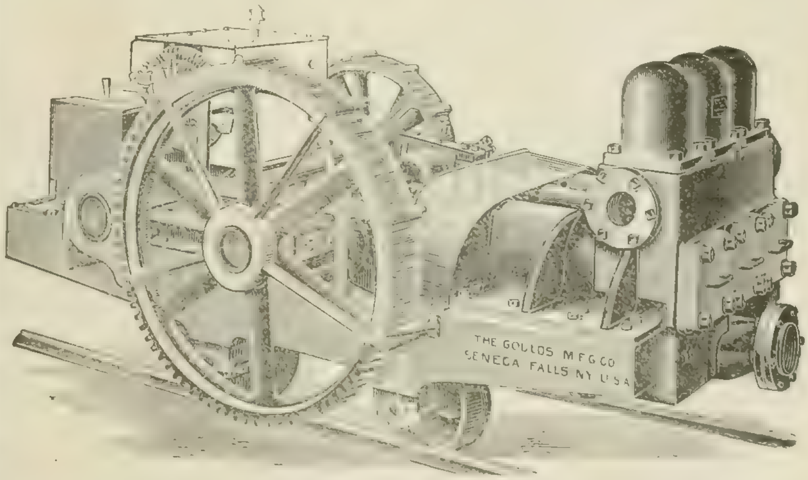
This device will be particularly useful in engine and boiler rooms, in making repairs on elevators, in boiler shops, etc. It is entirely portable, and is made for Edison, Westinghouse and Thomson-Houston lamps.

Messrs. Jenkins Brothers, 71 John Street, New York, are the sales agents for this novel device.

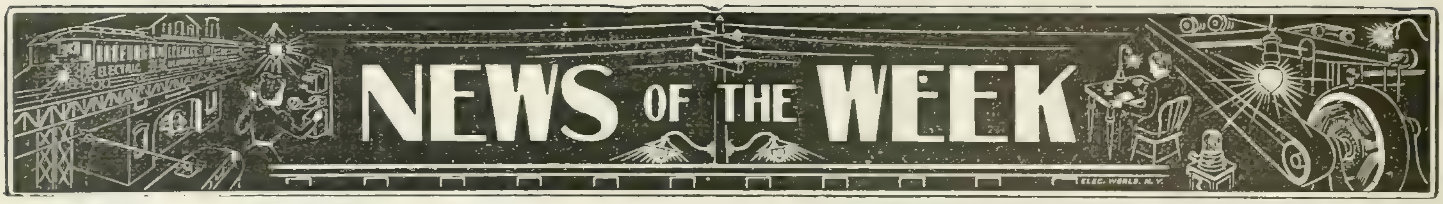
A Triplex Electric Mine Pump.

The flexibility and convenience of electric power application are well illustrated in the apparatus represented in the accompanying cut. This machine was built by the Goulds Manufacturing Company, Seneca Falls, N. Y., for "The William A" colliery of the Connell Coal Company, at Lackawanna, Pa. The armature of the motor is connected with the pump through double-reduction gears, the upper half of the gears being protected by shields. The motor is ironclad and enclosed in such a manner as to render it waterproof.

The triplex electric mine pump, as built by the Goulds Company, requires but occasional attention for oiling, and pumps at a uniform rate under all conditions, and it is impossible for it to "run away" when the water is pumped out. That electric pumping has become permanently identified with mining is evident from the rapidly extending use of apparatus of this kind. In this particular case the pump is used to pump water from the mine drift back to the base of the mine shaft. This pump is especially adapted for going into shallow cuts, which is a necessity in a mine pump of this kind, and the entire outfit is easily moved from place to place. With the pump and motor a float is placed in the pump, which automatically controls the operation of the motor. When the water falls below a certain level the current is cut off and the motor stops, and when it rises the circuit is closed and the machine again starts up.



Mine Pump Driven Electrically.



NEWS OF THE WEEK

ELEC. WORLD. N. Y.

Financial Intelligence.

DIVIDEND.—The directors of the Edison Electric Illuminating Company of Boston have declared a regular quarterly dividend of 2 per cent., payable November 1.

THE CHICAGO EDISON COMPANY reports an increase in gross earnings for the six months ended September 30 of 20 per cent., and an increase in net earnings over fixed charges from 11 to 12 per cent. The net earnings do not keep pace with the gross earnings, owing, it is explained, to the policy of the company of reducing the average price per electrical unit to consumers.

THE EDISON ELECTRIC ILLUMINATING COMPANY OF NEW YORK reports gross earnings during the month of September of $230,123.78, an increase over September, 1897, of $47,936.71; net earnings $88,925.62, an increase of $20,042. The gross earnings for the nine months ended September were $2,170,763.50, an increase of $427,008.98 over the corresponding period last year. Net earnings $908,377.75, an increase of $142,522,52.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
9 Murray St., NEW YORK, October 24, 1898.

A THEATRE PARTY, including many well-known members of the New York electrical fraternity, accompanied by their lady friends, will listen to the opera of "The Fortune Teller" at Wallack's Theatre on Tuesday evening next, and afterward enjoy supper together in one of the handsome dining rooms of the Waldorf-Astoria.

MR. MAXIM AGAIN FREE.—The charges of bigamy and abandonment brought against Mr. Hiram S. Maxim by a woman calling herself Helen Maxim, to which case reference was made in the last issue of THE ELECTRICAL WORLD, have been formally dismissed at Poughkeepsie, N. Y. Mr. Maxim was discharged and released from bail.

AT A MEETING of the directors of the Western Union Telegraph Company, held in this city last Wednesday, Mr. Thomas F. Clark was elected to the office of vice-president and as a director of the company. Mr. Myron T. Wilbur was elected treasurer to fill the vacancy occasioned by the death of R. H. Rochester. Mr. Clark takes the place in the directorate made vacant by the death of Mr. J. W. Clendenin, and was acting vice-president prior to his election.

ELECTRIC HEATERS IN SHOW WINDOWS.—A popular form of advertising is the display of goods in store windows, and anything that obscures the view from the sidewalk necessarily impairs the efficacy of such displays. In the winter time, for instance, the air within the store frequently condenses upon the cold window glass and obstructs the view from the outside, unless some precautions are taken to prevent such a result. One of the most convenient ways to avoid condensation is to use an electric heater in show windows. This can be easily done because most all stores use electric light, and [illegible]. Here is a suggestion for enterprising storekeepers who are bothered in the winter time with "sweating" windows. The remedy is simple, as electric heaters are now marketable commodities.

MEETING OF THE NEW YORK ELECTRICAL SOCIETY.—The [illegible] meeting of the society will be held at the Pearl Street sub-station of the Edison Electric Illuminating Company of Brooklyn, at 7:30 P. M., Thursday, October 27. Mr. W. S. Barstow, chief engineer, will make an address on the company's work, after which a brief inspection of the station will be made. The rest of the evening will be devoted to a flying visit to the sub-station "A" and to the Union central station at Bay Ridge. Special parlor cars will take the members from the Pearl Street station to Bay Ridge, and on the return trip from [illegible]. The Brooklyn Heights [illegible] New York end of the Brooklyn Bridge for the convenience of the New York members on their [illegible].

AT A RECENT MEETING of the directors of the Brooklyn Elevated Railroad Company it was decided to instruct the counsel of the company to begin immediate proceedings before the Supreme Court for the discharge of the re- [illegible] of the regular thirty days' notice the bill of sale of the road will be made out [illegible]

[illegible]

cents per kilowatt hour for 1, 2 or 3 hours' average daily use of the total number of lamps installed; and 5 cents per kilowatt hour for all use in excess of three hours' average daily use. For larger loads with a consumption of 2000-kw hours or over each month and two hours' average daily use of all lamps connected the charges are 10 cents per kilowatt hour for the first three hours and 5 cents per kilowatt hour for all use in excess of three hours' average daily use. These rates include the incandescent lamp renewals and the arc lamp trimming. For power, a maximum charge is made of 12½ cents per kilowatt hour, with discounts running from 20 per cent. for a monthly consumption exceeding 100-kw hours to 50 per cent. for a consumption exceeding 1500-kw hours. For payment within ten days after the presentation of the bill a further discount of 5 per cent. is made on all bills of $500 or over and 10 per cent. on bills of $1000 or over. The advertisement of these rates concludes with the following statement, which puts the whole matter in a nutshell: "These prices are made to encourage the use of electricity for domestic lighting and power purposes to the exclusion of other methods."

BUFFALO AND NIAGARA FALLS NOTES.

BUFFALO, N. Y., October 21, 1898.

THE ELECTRIC PLANT at the Curtiss malt house at Black Rock is to be ready for use early next month. It is an innovation in this section, and the great malting interest will be anxious to know how it succeeds, though there seems to be no doubt of satisfactory work. Still Buffalo is so conservative that good things have to be thrust down the throats of the people before they will accept them.

THE FIFTH ELECTRIC GENERATOR is now in operation at the Niagara Falls tunnel power house, and appears to be doing good work. Of course, not all of the 25,000 horse-power now available is needed, but it is a wise policy of the management to keep well ahead of the needs of the business, and at least one generator will be retained for an emergency, though the machinery has now run so long without an accident of account that it ought to be established now that no difficulty is to arise on account of the mere novelty of the undertaking.

IT HAS BEEN FOUND that the feed wires for the Lockport trolley between Tonawanda and Lockport are not sufficiently well distributed over the line to properly feed the current, and more are to be put in. Under the present arrangement the current from Niagara is taken to the farther end of the line at Lockport, where at present the transformer station is located; then the modified current is sent back over the line and delivered at various points. A transformer station is building at Tonawanda, which will when finished meet the return feed wires half way and obviate the difficulty.

THE WORK of setting the new Buffalo lighting station in order proceeds slowly. A large room is to be filled with motors, each with generators attached, for the accommodation of small power customers, and after that the small room for the eleven transformers which are the property of the Cataract Power & Conduit Company. These are in position, but no connections have been made yet, and only about half the motors in the principal room are in place. With the small force at work on the plant there is no prospect of more than a small part of the station being ready for use right away.

THE KEY to the situation in Buffalo, so far as the rapid extension of electric power is concerned, is about to be turned in the appearance of the long-looked-for apparatus at the Urban flour mill. Work has begun, and everything, it is reported, will be completed and ready for operation by November 4. With this mill in operation by electric power there is promise of the other city flour mills falling into line, [illegible]. The electric apparatus is to be installed without disturbing the steam plant, and it is even arranged so that the steam engine can be started up and run in connection with the electric power, if desired.

CHICAGO NOTES.

Branch Office of THE ELECTRICAL WORLD,
936 Monadnock Building,
CHICAGO, Ill., October 21, 1898.

MR. [illegible], president of the Chicago Edison Company, gave a [illegible] at the Grand Pacific Hotel, Chicago, on Saturday evening, October 15, in honor of the [illegible] of that company who volunteered for active service during the late war.

THE HARVARD ELECTRIC COMPANY, of this city, wishes to deny a report [illegible] telephone [illegible] and blocks. It says there is nothing in the rumor.

THE [illegible] ELECTRIC COMPANY, of Chicago, has made [illegible] of credit. The company says that the stock of belting and merchandise on [illegible]

Washington Notes.

Washington, D. C., October 22, 1898.

THE TELEPHONE CONTROVERSY AS UNDERSTOOD BY THE TREASURY DEPARTMENT.—The latest adversary to take issue with the Chesapeake & Potomac Telephone Company in the matter of its refusal to abide by the late law of Congress, fixing the maximum rate for the use of a telephone in the District at $50 per annum, is the United States Government through the Treasury Department. The matter was brought to the official notice of the Treasury by Public Printer Palmer, who inquired of the department whether the provision in the act of June 30, 1898, fixing the amounts which may be paid for the use of telephones in the District did not invalidate the contract entered into by him with the telephone company in August, 1897, for the installation in the printing office of a twenty-five-station switchboard. The reply to this inquiry by Comptroller Tracewell, of the Treasury Department, is emphatic and unequivocal. He declares that the "telephone company being a corporation is a creature of the law, is protected by the law and must obey the law. It must furnish both individuals and the Government the benefits of its telephone system, and do this under the rate of charges fixed by law or give way to others who will." In the special instance of the Government Printing Office the comptroller gave it as his opinion and so decided "that from and after the taking effect of the provision of the law of June 30, 1898, its effect was to abrogate the contract set out, for the prices therein fixed are in excess of those fixed by the law for the use or rental of a telephone." In view of this decision, it is understood that what applies to the Government Printing Office of course applies to all other departments of the Government. Should the telephone company refuse to abide by the Comptroller's decision with regard to Government contracts it is the intention of the department that the Attorney-General shall be requested to begin injunction proceedings, and it is confidently believed that the courts will sustain Comptroller Tracewell's views.

THE DISTRICT ELECTRIC COMPANIES QUARRELING OVER CONDUITS.—An interesting point of dispute between the United States Electric Lighting Company and the Potomac Electric Company, two rival corporations, has been settled, if the opinion of the attorney for the District is accepted as authority in the case. The cause of complaint was, as stated in a communication to the District Commissioners by Captain Thomas, president of the United States Company, that the Potomac Company was utilizing the conduits of the Postal Telegraph Company to run in a cable at Fourteenth and F Streets, and had connected up with the same. Captain Thomas stated that the Potomac people had no authority to make such a connection, and if they had he would be at perfect liberty to utilize the conduits of the Metropolitan Railroad Company to run his own cable down Four-and-a-Half Street. Upon investigation by the commissioners it was found that in one of the vaults under the sidewalk in the west side of Fourteenth Street the brick arch to the vault had been broken through and two cables brought through to the opening, apparently from the conduit of the Postal Telegraph Cable Company. These wires were traced through to the room containing electric motors which operated the elevator in the Wyatt Building. The matter was then referred to the attorney for the District by the commissioners. Upon inquiry by the attorney, the Potomac Company stated that in November, 1897, by reason of the fire in the plant of the United States Electric Lighting Company, the service of that company was for a time discontinued. This discontinuation seriously crippled the business of the Postal Telegraph Company, and in order to guard against a recurrence of this trouble the latter company made application to the Potomac Electric Power Company for connection with its lines, and was at that time only able to make connection through the conduits of the Postal Company by joining the two conduits at Fourteenth Street and New York Avenue. In his opinion, rendered to the District Commissioners, Attorney Thomas says that the Potomac Company claims that it is a joint owner of the conduit at Fourteenth Street. The attorney states that the cables in it were placed there with the knowledge of the commissioners. He asserts that there are two questions involved in the matter: First, whether the conduit on Fourteenth Street is legal, and, second, whether it was necessary for the Potomac Electric Power Company to have a permit from the commissioners to make the connection complained of. Attorney Thomas decided in favor of the company in the first question on the ground that Congress, in a clause in the efficiency bill of July 8, legalized all existing conduits within the fire limits, whether for electric lighting, telegraph or telephone service. In regard to the other question, Attorney Thomas says that the controversy is reduced to the point that the Potomac Company made the connection without a permit, but that if Congress had not legalized all the conduits the commissioners would have granted a permit for a house connection, and there is now no necessity for any action in the case by them.

St. Louis Notes.

St. Louis, Mo., October 21, 1898.

NEW INCORPORATION.—The Joplin Illuminating Company, capital stock $80,000, was incorporated under the laws of Missouri last week. Among the leading stockholders are John C. Porter, Harrison L. Drummond, Charles Nelson, John S. Dunham and Francis Kuhn. The new corporation will manufacture gas and electricity.

THE LINDELL RAILWAY FRANCHISE.—The bill granting a franchise to the Lindell Railway Company, and allowing it a large number of valuable concessions, and which passed the upper house of the City Council a few days ago, was passed by the lower branch this week, and is now awaiting the mayor's signature. Property holders along the various lines are making a big fight on it.

UNDERGROUND WIRES IN ST. LOUIS.—The stockholders of the National Subway Company, of St. Louis, will meet on November 5 to vote on a proposition to increase the capital stock of the company from $250,000 to $2,000,000. The law compelling electric companies to place their wires under ground in that city has greatly increased the value of the company's property and franchise, and necessitated an increase in its capital.

COUNTY RAILROAD AND TELEGRAPH TAXES.—The following abstract of taxes levied against railroads and telegraph companies in St. Louis County was submitted by the county clerk and approved by the County Court last week and charged against the county collector; Clayton & Forest Park Railroad, $281.94; Midland Electric Railway, $540.78; St. Louis & Suburban Railway, $2,551.21; St. Louis & Meramec River Railroad, $1,336.34; St. Louis & Kirkwood Railroad, $1,443.93; Southern Electric Railroad, $1,116.11; St. Louis County Street Railroad, $110.95; Western Union Telegraph, $520.70, and Pacific Mutual Telegraph, $85.08.

Pacific Coast Notes.

San Francisco, Cal., October 17, 1898.

THE GRIFFITH MINE, located in the State of California, will soon be electrically equipped with Westinghouse motors and other apparatus.

MR. A. O. SCHOONMAKER, of New York, is now represented on the Pacific Coast by the Electric Railway Manufactures & Supply Company, 548 Mission Street, San Francisco. This company will carry a full stock of Mr. Schoonmaker's mica, cut and uncut, segments and rings, for prompt delivery.

THE OAKLAND MESSENGER, BURGLAR & FIRE ALARM COMPANY, of Oakland, Cal., was recently incorporated with a capitalization of $20,000; actually subscribed, $6000. Among the company's objects are to build and operate telephone and telegraph lines, conduct a general messenger business, etc. The directors named are Albert Aucker, Henry H. Beck, Frederick Kahn, Philip Marx and Edward I. Wolf.

THE SUNSET TELEPHONE COMPANY now has in successful operation its through line from San Francisco to Portland, Ore. On October 17 at the invitation of Assistant General Manager Louis Glass, a number of San Francisco business men tested the capabilities of the line and listened to the exchange of compliments which took place over the wire between Mayor Phelan, of this city, and Mayor Wood, of Portland. A quarter-minute conversation between San Francisco and Portland, Ore., or Tacoma, Wash., cost 75 cents.

ELECTRIC POWER FOR FARMERS.—A movement is on foot to have a pole line extended along the Sacramento River from the Sacramento Gas & Electric Railway Company's Folsom power station for the accommodation of farmers and others who wish to use electricity to operate pumps. The pumps will be used for reclamation of the low lands along the river and for irrigation purposes. An electric railway project is also being talked of in the same connection. A company may be organized in order to work on a large scale and buy current at cheap rates.

Canadian Notes.

Ottawa, Ont., October 21, 1898.

THE CITY COUNCIL of Hull, Quebec, has decided to ask for tenders for lighting the city by arc lights. The tenderers will be asked to quote for the whole electric plant, the city to have the right to purchase within five years.

THE TORONTO STREET RAILWAY COMPANY is said to be considering the advisability of extending the Toronto & Scarboro Railway from the present terminus, at the Hunt Club, to the west side of the Highland Creek hill, a distance of 7 miles. A survey of the proposed route has already been made.

THE SHAREHOLDERS of the Montmorency Electric Power Company, of Quebec, have ratified the action of their directors in selling the property of the company to the Quebec, Montmorency & Charlevoix Railway Company. The shareholders of the former company not only receive for each $100 share of their stock in that company a share of an equal amount in the latter, but also a twenty-year debenture of $100 bearing interest at 5 per cent. per annum.

THE METROPOLITAN ELECTRIC COMPANY, of Ottawa, has purchased the immense Britannia water power, at Britannia, in the suburbs of this city. The deal was completed last week, and the amount involved is understood to be over $20,000. Mr. J. R. Booth, the millionaire lumberman, owned the water power, the capacity of which is estimated at about 40,000 horse-power, and he has given a guarantee to the Metropolitan Company that it could obtain 1500 horse-power with but an outlay of $6000.

THE ANCHOR ICE trouble in the Ottawa River during the winter months will this season be overcome by the Ottawa Electric Railway Company by means of a large storage battery. The company has heretofore been troubled with anchor ice getting in the wheels at the power house. The power has been greatly reduced as a result, and occasionally there was not enough available power to run the cars. The new storage battery will act as an auxiliary and as a regulator, and will compensate for any drop in voltage.

A NEW SOURCE OF CARBON FOR CARBIDE FURNACES.—Prof. V. L. Emerson's invention for the conversion of sawdust and saw-mill refuse into commercial products was tested this week before a large gathering of the prominent lumbermen of this district and citizens of Ottawa, among whom were several members of the Dominion Government. Professor Emerson says that the invention is a pre-eminent success. The machine gets its fuel from the gas obtained from the sawdust, so that the process is a continuous one. It runs automatically. First, the sawdust goes through a drying process by having all the excess of heat contained in the burned gases forced through the sawdust in a drying kiln. Then this sawdust is carried by an elevator to the top of the retort, and by means of an automatic feed is supplied to the machine as required. The retort is an upright iron cylinder, between 15 and 20 feet high and about 3 feet in diameter, surrounded by brickwork. Within the retort is a series of hoods on a central hollow revolving shaft, which has perforations under the hoods. The various gaseous products escape through the lower end of the retort, where the liquid products are condensed and separated, emerging through two outlets. At one outlet passes off a wood creosote product, which can be utilized for a variety of purposes, and from the other crude pyroligneous acid, from which can be prepared wood alcohol, acetic acid and various other products. The gases pass through a purifying process, and after being highly heated are forced through the sawdust as it passes down the retort.

The excess of gases passes into the furnace, supplying heat, which is practically sufficient to carbonize the sawdust in the retort. The carbon prepared from the sawdust passes out through an opening for the purpose at the lower end of the retort. The remaining product is a pure form of carbon, which, it is claimed, makes especially pure acetylene gas if used in carbide furnaces.

English Notes.

(From Our Special Correspondent.)

London, October 12, 1898.

THE "ARON" METER.—A company is being floated in this country to take over from Dr. Aron the manufacture of his meter, and has agreed to buy, not only the English patents, but among others the German, Austrian, French and American ones. It is therefore quite probable that in a few months the sale of this meter will be extensively pushed in the United States. The new pattern of the Aron meter is very different from the old one, which has been in use for so many years, chiefly in Germany. Although essentially a clockwork meter, it is now self-winding, and a device has been added by means of which the clockwork and counting mechanism are both reversed every few months, so that any inaccuracy in the regulation of the clockwork is automatically compensated. The instrument will be produced in such quantities that it will be quite possible to compete with motor meters in price, and it has the great advantage that there is practically no inferior limit to its starting current.

[Note.—On page 383 of The Electrical World, October 8, were given some further facts regarding the proposed organization of an American company to handle the Aron meter in the United States.—The Editor.]

THE LONDON COUNTY COUNCIL.—The London County Council has decided to purchase the whole of the system of the London Tramways Company for the sum of £800,000. These lines are at present worked by horse traction, but I should not be surprised to hear that, at any rate on some of them, electric traction will be introduced, although the Council has an amusing prejudice against the overhead trolley. In one instance, they have been obliged to give way in this respect, owing to extreme pressure having been brought to bear on them, and they have permitted the introduction of the trolley on about 1½ miles of an extended system on lines which are being completed in the west of London by the London United Tramways Company, this 1½ miles being the only section within the area of the Council's administration. The London County Council is also worrying about the telephone question, although the service in London in point of efficiency, at any rate, is equal to any in Europe or America. The subscription rates are, it is true, still much higher than in most countries on the Continent, although I believe somewhat lower than in New York; but it must be remembered that the area over which the local service extends is an extremely wide one. The Council intends to ask the Postmaster-General whether he will take the necessary measures for the establishment of a telephone service competing with that of the National Telephone Company in the metropolis, and if he will not consent to do this they intend to apply to Parliament for the necessary powers to establish a municipal system. Glasgow, it will be remembered, has obtained a license from the Postmaster-General, and will also apply for Parliamentary powers in [illegible].

INTERRUPTIONS TO ELECTRICITY SUPPLY.—No less than four cases of interruption to supply have occurred since last week, none of them, however, of a very serious nature. The most important occurred in London on Friday night. The private lighting supply from the City of London Electric Lighting Company's station is divided into two sections—lighting the eastern [illegible] thus throwing the full load on the remaining four machines, which, unable to furnish the current demanded of them, slowed down and got out of phase, necessitating the whole of that side of the station being shut down. The four machines were immediately started and a fifth also brought into synchronism, [illegible] those oft-recurring conduit explosions, the covers of three surface boxes having [illegible]

General News.

The Telegraph and Telephone.

[illegible]

[illegible]

[illegible]

[illegible] Union Telephone Company will be completely remodeled at an expense of at least $100,000. Work will be completed in from five to six months.

MEMPHIS, TENN.—The extensions of the long-distance telephone lines in the South are progressing from this city down to New Orleans. It may be possible on January 1 next for Boston to "hello" with New Orleans and Galveston, Tex.

DENVER, COL.—Colorado Springs capital has been interested in a new telephone line to be erected in Oklahoma, $20,000 having been subscribed for the construction. The new company will be known as the South McAllester Telephone Company.

LITTLE ROCK, ARK.—Articles were filed in the Secretary of State's office incorporating the Grand Prairie Telephone Company, of Hazen; capital stock, $10,000. George D. Foster, J. G. Thweats, J. M. McClintock, A. L. Aydelott and David Brockway are the incorporators.

PORTLAND, ME.—The New England Automatic Telephone Company has been organized at Portland for the purpose of conducting a general telephone business, with $500,000 capital stock. The officers are: President, Charles H. Adams, of Boston, Mass.; treasurer, William W. Lowe, of Boston, Mass.

McPHERSON, KAN.—McPherson is now connected with Salina, Marion and Newton by telephone. The line from Newton was completed a few days ago. The toll lines at McPherson, Salina and Newton are all owned and managed by local men, while Newton and Hutchinson are connected by the Bell Telephone Company.

ASHLAND, WIS.—Ashland will soon have two competitive telephone lines to Ironwood. The Wisconsin Valley Company's system has been completed to that point for nearly a month, and the Wisconsin Telephone Company is rapidly approaching that point. The first-named line goes to Ironwood by way of Mellen, while the other crosses the reservation and connects with Odanah and Saxon.

OGDEN, UTAH.—The Rocky Mountain Bell Telephone Company is building a line of No. 8 copper wire from Ogden via Boise City, Idaho, to Portland, Ore., there to connect with the Pacific Bell Company's system, throughout Washington, Oregon and California. The probable extension of the long-distance system during the coming summer, from Omaha to Salt Lake, will make a continuous telephone line across the continent.

WILKESBARRE, PA.—A new telephone company has been organized, and within a few months everything will be in working order. It is known as the People's Telephone Company of Wilkesbarre, and the stock is held by local capitalists, among them John W. Hollenback, George A. Bedford, W. A. Lathrop, Abram Nesbitt, Irving A. Stearns, C. E. Stegmaier and A. Markle. The People's Telephone Company agrees to supply residences with telephones at the rate of $24 a year, and business places at the rate of $30 a year, or both for $50 a year.

FORT SMITH, ARK.—The Pan Telephone Company is again operating its plant in this city. The resumption of the old name comes about by the sale which was made recently. About a year ago L. E. Ingalls sued the Arkansas Telephone Company in the Federal Court here for money advanced by him to rebuild the plant of that company in this city. Judgment was rendered against the company, and Col. James Brizzolara purchased the plant and satisfied the judgment. Col. Brizzolara sold the plant to L. E. Ingalls for $7500, and then Mr. Ingalls sold it to the Pan Telephone Company for $14,950.

SEDALIA, MO.—Another long distance telephone line is to be constructed between St. Louis and Kansas City via Sedalia. It will be a direct competitor of the line now being completed, and the result will probably be a material reduction of rates for this city and all other intervening points. The company back of the enterprise is composed chiefly of St. Louis capitalists, but Kansas City parties will also be interested, and another exchange for that city is one of the possibilities of the near future. The St. Louis parties are said to include the gentlemen interested in the Weir-Kinloch plant of that city. The company's capital stock is $10,000,000.

Electric Light and Power.

MONROE, LA.—The City Council will issue $50,000 bonds for an electric light plant.

BENNETT, PA.—On November 8 the question of issuing $25,000 electric [illegible] bonds will be voted on.

ATLANTA, GA.—At the recent election in this city the proposition for a municipal electric light plant was adopted.

[illegible], MICH.—At a special election to vote on bonding the town for $28,000 for electric lights and water works, the proposition was carried by a large majority.

KOKOMO, IND.—The electric light plant of the Citizens Light & Power Company, [illegible] in the hands of a receiver, by order of court, will be [illegible]

[illegible], MINN.—The City Council has decided to investigate the feasibility of the city operating its own lighting plant, and has appointed a committee to report not later than January 1 next.

[illegible]—The town of Butler has purchased the electric light plant [illegible] Henry McIntyre, the consideration being $8500, on such [illegible] out of the profits.

SOUTH MILWAUKEE, WIS.—The ordinance passed by the South Milwaukee Common Council for the purchase of the electric lighting plant by the [illegible] at the meeting of that body, with the mayor's veto.

[illegible], MICH.—After quibbling with the lighting plant question for more than six months the Common Council has approved the contract [illegible] Company, for a complete plant to cost about [illegible]

[illegible], N. J.—A committee has been appointed by the Council to [illegible] the cost of installing an electric light plant in connection with the [illegible] and operated by the city. Messrs. Appleby, Harvey [illegible] the committee.

YORK, PA.—The Martic Electric Power Company, of York, Pa., which has purchased the Susquehanna & Tidewater Canal, running from Wrightsville, York County, to Havre de Grace, Md., is contemplating the introduction of trolley canal boats on the canal, the power to be supplied from its plant in the Susquehanna River, near Wrightsville.

DOYLESTOWN, PA.—The stockholders of the Newtown Electric Light & Power Company have agreed to lease the plant to the Newtown Electric Street Railroad Company. The lease runs for a term of twenty years, and 5 per cent. is guaranteed the shareholders. It is intended to greatly increase the capacity of the plant, and it is said the new management will spend $40,000 on the improvements.

ROCKFORD, ILL.—The City Council has granted a franchise extension of twenty-five years to the Rockford Light & Power Company, on condition that it be consolidated with the Rockford Traction Company within one year. The company is obliged to pave and repave between its tracks, and provide cars with vestibule and fenders. An amendment for 3-cent fares and other propositions which it was feared would kill the consolidation were lost.

BOSTON, MASS.—In a report covering the operations for the six months ended June 30 last, President Rogers, of the Edison Electric Illuminating Company, states that the first, second and third stations of the company are now equipped, not only with steam plants, but with storage batteries, while the fourth and fifth stations are equipped with storage battery only. The company now has the largest storage battery installation in the world. The company had connected at the date mentioned 161,466 incandescent lamps, 1486 arc lamps and motors with an aggregate capacity of 6473 horse-power.

PHILADELPHIA, PA.—The Electrical Committee of City Councils considered the estimates for the next year of the electrical bureau. Director Riter explained that a saving of upward of $21,000 will be effected next year in the cost of electric lighting throughout the city, on the basis of 7003 lights, the existing number. The average price per lamp per night will be 31 84-100 cents, or about $116.22 a year. The cost of 7003 lamps this year will be $835,134.60, as against an estimated cost of $813,908.75 for next year, the proposals for 1899 being proportionately lower than in 1898. The item was passed for this amount and a new item was introduced for $100,000 for additional lamps.

SEATTLE, WASH.—Mr. G. M. Esterly, superintendent of the Dawson City Electric Light & Power Company, who has been in the States for the last few weeks purchasing apparatus for his company, gives some interesting information regarding the prices paid in the Klondike region for labor and materials. His company purchased 4000 cords of wood at $14.75 a cord, making $59,000 in all. Teams were hired at the rate of $10 an hour each, at the beginning of the work. Hay and feed for horses cost $500 a ton, and a team may be hired without a man to drive it for $25 a day, which is now considered quite a reasonable sum. Arc lights at Dawson bring $14 a night, and incandescents from 50 cents to $1.25. Even at these seemingly enormous prices, Mr. Esterly states that his company could use 4000 lights if it had them. Electric light is cheaper than kerosene, he says, for oil is $2 a gallon. The Dawson City Electric Light & Power Company was recently incorporated with a capital of $75,000.

THE ELECTRIC RAILWAY.

TOLEDO, OHIO.—The Toledo Traction Company, of which Norman B. Ream, of Chicago, is the principal stockholder, has purchased the Toledo Electric Company, the purchase price being $325,000.

ALLEGHENY CITY, PA.—The Mt. Troy & Reserve Township Traction Company has suspended operations, at least for a time. This company was organized some time ago, but has only been operating about a year.

WESTFIELD, MASS.—George W. Dunham, president of the Springfield & Hartford road, is making plans to build a line through Feding Hills to Westfield, which will connect with the Woronoco line running from that place.

CANANDAIGUA, N Y.—It is announced that the Canandaigua Electric Light & Railroad Company, of this place, will discontinue running the trolley cars during the months of December, January, February and March, as it is privileged to do by its charter.

SIOUX FALLS, S. DAK.—The electric line between Sioux Falls and East Sioux Falls, S. Dak., has been torn up by the Eastern owners. The equipment was shipped East. The line paid dividends at one time, but during the last two years it has done no business.

NEWTON CENTRE, MASS.—The Newton & West Roxbury Street Railway Company has been granted a franchise to run its cars from the Dedham line through Dedham, Parker, Boylston and Walnut Streets to Newton Highlands. This will connect the Newtons with the remote Oak Hill district.

SANTIAGO DE CUBA.—A franchise for an electric railway to run from Santiago to the cemetery and to El Caney has been granted by General Wood to prominent local business representatives. It is said that this road will be a very great public convenience, although it is hardly likely to more than pay expenses for the first three years.

NORRISTOWN, PA.—The Schuylkill Valley Traction Company has reorganized by electing the following officers: President, C. D. Beebe; directors, C. D. Beebe, N. H. Larzelere, R. M. Douglass, Thomas Corday, D. B. Shepp, H. S. Holden and G. B. Leonard; general manager, secretary and treasurer, R. M. Douglass; superintendent and electrician, A. G. Davids.

PITTSBURG, PA.—Owing to numerous delays the new Monongahela traction line to McKeesport will not be ready for running until November 1. It was expected to have it in shape for cars to be started October 1, but numerous delays by injunctions from property holders and other causes have held back the work. It is intended to make it one of the best traction roads in the country.

NEW YORK CITY, N. Y.—The Twenty-eighth and Twenty-ninth Streets Railroad Company, of this city, has secured permission from the State Railroad Commission at Albany to change the motive power on its lines from horses to compressed air. The company applied for permission to change its motive power to either the underground electric conduit system, storage batteries or compressed-air motors.

SANDUSKY, OHIO.—A syndicate is negotiating for the purchase of the Sandusky, Milan & Norwalk Electric Railway and the People's City line. The transaction is said to be the first step in a plan to build electric railways connecting a large number of northern Ohio cities and towns with Cleveland. John McKelvey, a well-known railroad man, is engineering the deal, and it said that the papers will be signed in a few days.

NEWPORT NEWS, VA.—The sale of the Newport News, Hampton & Old Point Electric Railway Company has been effected. The consideration in this sale is given as $750,000, but it is said that at least $1,000,000 will change hands as a result of the deal. The purchasing company was organized some months ago for the purpose of building a line run in opposition to the one already in existence, and has secured some valuable franchises.

UTICA, N. Y.—The Utica Belt Line Railroad Company is erecting on the line of its road a new riveted lattice bridge having a span of about 75 feet. The bridge is known as the Halfway Bridge. It is a modern structure in every way for the class of work which it is called upon to do. It is to be all steel except the cross ties on which the rails rest. The Berlin Iron Bridge Company, East Berlin, Conn., has the contract for furnishing and erecting the steelwork.

BROOKLYN, N. Y.—Counsel of the Brooklyn Heights Railroad Company informed District Attorney Marean in Brooklyn a few days ago that the company had agreed to grant the demands of its men based on the ten-hour law. The men some weeks ago called the attention of the District Attorney's office to repeated violations of the law by the company. They complained that by working them according to the "swing system" they were getting from sixteen to twenty hours work a day out of each man.

BOSTON, MASS.—It is stated that the controlling interest in the Rockland & Abington Street Railroad Company has been bought by Pepper & Register, representing a Philadelphia syndicate. The road has a capital of $120,000, and has paid an annual dividend of 6 per cent. It is a valuable piece of property, being the connecting link between Brockton and shore travel to Nantasket. It is reported that this is the first step toward the consolidation of all the electric street railroads in Southeastern Massachusetts.

BOSTON, MASS.—W. P. Clark, of Peabody, Mass., has been appointed receiver of the Newburyport & Amesbury Horse Railroad Company, upon application of the Mechanics' Savings Bank, of Providence, R. I., which holds $25,000 of the company's bonds, on which the September interest was defaulted. The railroad company in 1892 made a mortgage of all its property to the International Trust Company, of Boston, to secure an issue of $350,000 of bonds, with the understanding that the trust company was to act as trustee for the bondholders. After the September coupons were defaulted, it is alleged, the International Trust Company was asked to begin foreclosure proceedings, but it declined to do so. Hence the present proceeding by the Mechanics' Savings Bank.

SAN FRANCISCO, CAL.—In a decision rendered on October 14 Superior Judge Seawell dismissed the application of the Board of Railroad Commissioners for a writ of mandate to compel the Market Street Railway Company (Southern Pacific) to produce its books for examination. The commission wished to fix a schedule of street-car fares, but Judge Seawell holds that the term "railroad" in the statutes does not refer to street railways in the true meaning of the word, and that the law does not imply the power to fix passenger rates, and that any other interpretation would involve the carriers of passengers and freight by coach and baggage companies. Judge Seawell holds that only municipal authorities have the power to fix the rates of street-car lines. The case will be appealed to the Supreme Court.

MT. CLEMENS, MICH.—Receiver J. G. Tucker, of the Detroit & River St. Clair Railway, has effected a sale of his road to the Detroit, Lake Shore & Mt. Clemens Company. The sale also includes the tracks and franchises of the traction company in the streets of Mt. Clemens. These will afford the Lake Shore people an outlet over Gratiot Street to the city limits, whence it is proposed to construct the road over the intervening gap of 5 miles to connect with the Chesterfield line. This done, the Lake Shore will have a continuous roadway from Detroit through Mt. Clemens, Chesterfield and New Baltimore to Marine City. It is proposed to build the balance of the road this fall and equip the Chesterfield branch with electricity so that the Lake Shore parlor cars can run into St. Clair River ports by the time navigation closes.

LEGAL NOTES.

CORRECTION.—In THE ELECTRICAL WORLD of October 8 last, under this head, was published a paragraph in reference to the injunction granted in the suit of the Sprague Electric Railway & Motor Company v. the Detroit Citizens' Street Railway Company. The name of the Walker Company was there coupled with this suit. The Walker Company writes to the effect that it "has never supplied any motors or equipments to the above mentioned railway company, nor to any other street railway in Detroit, with the exception of the Mt. Clemens Fast Line." The use of the Walker Company's name in this connection was, therefore, an error.

ELECTRIC WIRES.—The owner of electric wires carrying a dangerous current is chargeable with negligence in stringing them over a bridge so near the top of it that it is impossible to make repairs on the bridge without coming in contact with them. A workman making repairs has a right to assume that contact with them will not be dangerous, especially after the workmen have made an examination of them, and ascertained, as they suppose, that the wires are not dangerous. The apparent perfect insulation of electric wires, which is calculated to deceive and to cause one unfamiliar with the facts to suppose them safe, amounts to an invitation to them to risk contact therewith. Perham, Admr., v. Portland Electric Company, Oregon Supreme Court, 1898.

LIABILITY FOR KILLING A DOG.—A dog is not a trespasser on a street car track which is laid in the highway on the same level with it. The right to recover for injury to a dog is not lost by killing him under the honest but mistaken belief that he was fatally injured. A motorman cannot rely upon the quickness and celerity of a dog to absolve himself from all duty and care to prevent running over him with an electric car. The owner of a dog has such property in him that he may maintain an action for killing or injuring him. A street railway company is liable for the killing of a dog by an electric car, caused by the negligence of the motorman. Citizens' Rapid Transit Company v. Dew, Tennessee Supreme Court, 1898.

ENCLOSED ARC LAMP DECISION.—In the suit of the Marks Enclosed Arc Light Company, New York, v. The Washington Mills Company, New York, a decision has just been rendered in favor of the complainant. The suit was begun in the United States Circuit Court September 10, 1897, and the decree granted to the Marks Company by Judge Coxe on October 18, 1898. The patent infringed is No. 520,996, of Marks & Ransom, dated June 5, 1894. This patent broadly claims the method of operation used in all modern enclosed arc lamps. The Washington Mills Company was a user of the Kinsman lamp sold by the Electric Construction & Supply Company, New York. The decision peremptorily stops the sale of unlicensed enclosed arc lamps by the Kinsman Company, and also involves the payment of damages by the defendant.

PERSONAL NOTES.

MR. M. COKELY, who is probably known to many of our readers, has been appointed superintendent of the works of the C. W. Hunt Company, Staten Island, N. Y., assuming the duties of that position October 14 after several months' work revising the factory systems. Mr. Cokely was for many years with the General Electric Company, and later with other prominent firms.

MR. GEORGE F. BRUNT, president of the Brunt Porcelain Works, of East Liverpool, Ohio, on October 24 shot and killed his hostler, Dudley E. Lee, the son of a colored minister of Pittsburg. Brunt discharged Lee the Saturday before, but the latter returned, and an altercation ensued. Lee followed Brunt to the latter's home and entered the house, when Brunt shot him. Brunt surrendered and was released on $10,000 bond.

MR. D. W. MORRISON, well known as a constructing engineer for the Chicago Edison Company, has accepted a position to go to England and put in two important steam plants. He is to do the work for the Crane Company, afterward acting as its agent for Great Britain. His first installation will be the 12,000-hp plant which will supply the electric current for the Central Underground Railroad of London, now nearly completed. This will be a condensing plant with a cooling tower, using Allis engines, Babcock & Wilcox boilers and General Electric dynamos. The second task will be the United Traction Company's power house at Dublin. The latter will be a surface condensing plant of 5000 horse-power. Mr. Morrison had charge of the installation of the Harrison Street power house of the Chicago Edison Company, and has been identified with a number of the prominent electrical plants of the Western cities. His selection forms another instance of the lack of engineers abroad with American methods and ability.

Directory of Scientific Societies, Associations, Etc., and Meetings of the Same.

FRANKLIN INSTITUTE (Electrical Section), Philadelphia, Pa.—Secretary, [illegible]

ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA, Pittsburg, Pa.—Meetings, third Tuesday of each month.

NORTHWESTERN ELECTRICAL ASSOCIATION.—President, F. A. Copeland, La Crosse, Wis.; secretary, Thomas R. Mercein, Milwaukee, Wis.

THE PACIFIC COAST ELECTRIC TRANSMISSION ASSOCIATION. President, W. F. Pierce; secretary, George P. Low, 427 Tenth Avenue, San Francisco, Cal.

AMERICAN STREET RAILWAY ASSOCIATION.—President, C. E. Sergeant, Boston, Mass.; secretary, T. C. Penington, 2020 State Street, Chicago, Ill. Next meeting, Chicago, 1899.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES.—President, R. R. Bowker, New York; secretary, Wilson S. Howell, P. O. Box, 114, [illegible]

PENNSYLVANIA STATE STREET RAILWAY ASSOCIATION.—President, Robert E. Wright, Allentown; secretary, S. P. Light, Lebanon. Last meeting, Scranton, Pa., September 7-8, 1898.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS.—President, W. W. Ryder, Chicago; secretary, P. W. Drew, Milwaukee, Wis. [illegible]

NATIONAL ELECTRIC LIGHT ASSOCIATION.—President, A. M. [illegible] Porter, [illegible] Broadway, New [illegible]

MASSACHUSETTS CHARITABLE MECHANIC ASSOCIATION, Bos[illegible]

THE NEW YORK ELECTRICAL SOCIETY.—President, Gano S. Dunn; secretary, George H. Guy, 120 Liberty Street, New York. Next meeting, Oc[illegible]

[illegible] RAILWAY [illegible]

[illegible]

[illegible] B. Bishop, Washington, D. C., president; Dr. John Gerin, Auburn, N. Y., [illegible]

[illegible] June 1.

[illegible]

INDEPENDENT TELEPHONE ASSOCIATION OF THE UNITED STATES.—President, Judge James M. Thomas, Chillicothe, Ohio; secretary, W. J. Vesey, Fort Wayne, Ind. Next meeting, June, 1899. Place to be named hereafter.

ASSOCIATION OF FIRE AND POLICE TELEGRAPH SUPERINTENDENTS AND MUNICIPAL ELECTRICIANS.—President, J. W. Aydon, Wilmington, Del.; secretary, H. T. Blackwell, Jr., New York. Next meeting, Wilmington, Del., September 5, 1899.

CHICAGO ELECTRICAL ASSOCIATION.—Meetings, first and third Friday of each month, from October 1 to June 1; J. R. Cravath, secretary, Monadnock Block, Chicago, Ill. Future meetings and paper for the season of 1898-99: "Practical Points on Electrical Measurement," by W. B. Hale; November 4, "The Electrical Equipment of a Model Printing Establishment," by George A. Damon; November 18, "The Development of the Motorcycle," by F. B. Rae; December 2, "Practical Points in Street Railway Engineering," by W. A. Harding; December 16, "Wireless Telegraphy," by Arthur V. Abbott; January 6, 1899, "Telephone Engineering—Some Problems Solved and Unsolved," by S. G. McMeen; January 20, "Observations on Ventilating Fans," Gerard Swope.

TRADE AND INDUSTRIAL PUBLICATIONS.

THE TROPENAS STEEL PROCESS is the title of a reprint of a paper read by Alexandre Tropenas before the last convention of the American Foundrymen's Association, describing this process of steel making, the main point of interest of which to electrical engineers is the fact that the product of this process—which is of the small converter type for converting pig iron into steel—is a practically pure iron (99.75 to 99.80 per cent.), possessing a high magnetic permeability and great homogeniety, and is consequently useful for dynamo-electric machinery. The process is now being introduced into the United States, one 2-ton converter having been installed in the works of the Driggs-Seabury Gun & Ammunition Company, Derby, Conn.

THE SOUTHERN BELL TELEPHONE & TELEGRAPH COMPANY has published a rather novel brochure, copies of which are being distributed by Mr. H. W. Pope, traffic manager. This neat little pamphlet is intended as an educational aid to telephone users, illustrating prettily the wrong way and the right way of using the telephone, giving a view of the B. W. C. party-line instrument, with selective call and locking and indicating device, and describing and illustrating the private branch exchange service of the company. It also gives some instructive statements of relative cost of doing business at long distance by traveling, by telegraph and by telephone. The representation of a crocodile conversing over the telephone with a polar bear is not intended as a picture from life of the use of the company's wires, but to give an impression of the distances over which conversation may be carried on even at the present time.

Trade and Industrial Notes.

THE WM. MUELLER ELECTRIC COMPANY, Chicago, has just gotten out a new catalogue of electrical supplies. A copy of it will be sent to any address on application.

THE HARVARD ELECTRIC COMPANY, 52 Dearborn Street, Chicago, invites requests for prices on its combination fuse and carbon lightning arrester and cut-out for telephone and telegraph instrument protection.

THE WESTERN ELECTRIC COMPANY, Chicago, has distributed a number of its Bulletin No. 7002, which is descriptive of arc lamps of its manufacture. A copy will be sent upon request to any person interested in the operation of an arc-light plant.

THE WEISMANTEL FEARLESS CAR FENDER COMPANY has filed articles of incorporation at Passaic, N. J., with a capital stock of $150,000, and will engage in the manufacture of a newly patented trolley-car fender and other appliances for street cars.

MR. GEORGE W. HOFFMAN, 295 East Washington Street, Indianapolis, Ind., whose metal polish paste is so widely known and used, has just shipped two large foreign orders. He reports business very good, and points to the fact that honest and reliable goods are sure to find favor.

THE ILLINOIS ELECTRIC COMPANY, Chicago, announces that it is having a large run on the Edison, Jr., improved incandescent lamps. It reports having sold thousands of these lamps to the trade this fall with best results. Duplicate orders have been received. A trial order from the trade is requested.

BERLIN BRIDGES AND BUILDINGS.—The Berlin Iron Bridge Company, East Berlin, Conn., each month produces a neat publication, which is devoted to a description of bridges, buildings, etc., built and erected by this well-known concern. The August number is the fifth of the first volume, and contains sixteen pages. Its contents, in addition to the technical matter, in[illegible] to the farm and home and of general information.

THE HELIOS COMPANY, Philadelphia, Pa., has received through its [illegible] a large order for its lamps from [illegible], Boston. [illegible], we are informed, finally awarded [illegible] of all the most promi[illegible] the receipt of large orders from abroad, taxing the company's factory facilities to the utmost.

ELECTRIC LIGHT AND POWER IN A WAGON FACTORY.—The entire [illegible] Wagon Company, at Racine, Wis., has been equipped [illegible]. The switchboard, which is of marble, [illegible] to be the acme of perfection [illegible] put in by the John [illegible] & Sons [illegible] new catalogue of telephones [illegible] for distribution, and will be sent to any [illegible]

PACKARD TRANSFORMERS.—It has always been the policy of the Packard Company to improve its products whenever opportunity offered. Its model '98 Packard transformer represents its latest improvement in the transformer line, and it claims that this apparatus is at the very top notch of transformer construction. It has a novel plan of guaranteeing just exactly what each transformer will do. All of its claims, guarantees, etc., are fully set forth in a special circular, a copy of which can be had from the Electric Appliance Company, Chicago, Western agents for the Packard goods.

THE CHARLES E. GREGORY COMPANY, of Chicago, of which Mr. A Louis Kuehmsted is treasurer and general manager, has purchased the entire business of the Electrical Exchange of the same city, including all the stock and machinery on hand as well as the good will and even the name and title. Mr. Kuehmsted is certainly to be congratulated on this latest exhibition of his energy and progressiveness. The extent of the business done at the present time by the Charles E. Gregory Company under Mr. Kuehmsted's management would not have been believed by electrical engineers a few years ago. It is said on good authority that the company has done a business of a quarter million dollars during the last six months. There can therefore be no question of the promising field open to dealers in second-hand electrical mcahinery who work on the broad and liberal lines on which Mr. Kuehmsted has built up his business.

"IMPROVED BRUSH ARC LAMPS" is the title of an artistic brochure just issued by the General Electric Company, dealing with the modifications introduced in the latest types of single and double Brush arc lamps as experience with the operation of past types has dictated. Each detail of improvement is explained clearly and concisely, and in conjunction with first-class half-tone illustrations, so that even persons unfamiliar with the Brush lamp mechanism will find no difficulty in grasping the import of the various changes and improvements. The leading features are summarized, each under its own heading, and the brochure concludes with a full catalogue of the parts not only of the improved lamp but also of lamps 30 and 31. The pamphlet is issued from the General Electric Company's own printing office, and in general artistic appearance, letterpress and illustrations compares well with the work of our best catalogue makers. It will be sent to those interested on application to any of the company's sales offices.

ELECTRIC MINE LOCOMOTIVE.—In a recent letter to the Westinghouse Electric & Manufacturing Company, Mr. R. G. Vance, Jr., superintendent of the Stevens Coal Company, makes the following statements regarding the Baldwin-Westinghouse electric mine locomotive in operation in its mine: "It gives us pleasure to say that this motor is giving the very highest possible satisfaction, and is attracting considerable attention in this valley. It has been running since May 1, and has not cost a dollar in the shape of repairs, excepting a new valve for sand box and a head-light base, broken in a collision with a car. It is running on a road of 25 per cent. steel 4000 feet long over undulating grades varying from 1 to 6 feet per 100 feet. Its regular load now consists of twenty cars of 1½ tons capacity, and the time required for each trip is from seventeen to nineteen minutes. We have pulled as high as twenty-five of these cars at one trip, which it did with all ease. When necessity requires we can pull thirty cars, giving 50 per cent. more capacity than you guaranteed."

MOULDED PORCELAIN.—The Mica Insulator Company, of New York, Chicago and London, states that there is a gratifying demand for its commutator rings. The company makes a specialty of manufacturing moulded insulation, and is now turning out for some of the large manufacturers of electrical machinery moulded rings all in one piece. This pattern of ring, it is stated, is one of the most difficult articles in the insulation line to manufacture. As it comes from the machinery employed by this company in its manufacture, it is said to be as perfect as a piece of stamped steelware, and has the same metallic ring. Another form of insulation, of which the company has made a specialty, is the armature trough or slot, which is now in use by many of the manufacturers of motors for crane work, and for those who require a heavy insulation which will stand very high voltages. While this form of insulation is a trifle more expensive than the common red paper and mica, yet those concerns that manufacture electrical machinery which gets rough usage have found it necessary to use the best possible insulation for their armatures. Electrical manufacturers would do well to communicate with the company, sending blue prints for estimates.

"SOFT COAL BURNING" is the title of a pamphlet issued by the "Railway Master Mechanic," Chicago, Ill. The author of the treatise is Mr. C. M. Higginson, who is an acknowledged expert on the subject of combustion. This is the fifth edition of the work, and has been rewritten and enlarged from the fourth edition. It has long been considered a standard treatise on the important subject of the burning of soft coal. The question of smokeless combustion of coal is attracting a great deal of attention at the present time, especially in Western cities, and the agitation has reached such a pitch that ordinances have been passed by the Common Councils in several cities to establish a series of fines for the unnecessary emission of smoke within the city limits from the chimneys of manufactories, steamboats or locomotives. The author discusses the means of obtaining economical and smokeless combustion of soft coal, and employs diagrams to aid in a better understanding of the subject. He does not claim any original discovery in the matter of coal burning, but merely notes results of methods and experiments covering a long period, and concludes that there is no reason why the results arrived at by the adoption of well-known devices and principles should not be duplicated anywhere under the same conditions.

A COMPLETE VALVE CATALOGUE.—The illustrated catalogue and price list of the Roe-Stephens Manufacturing Company, Detroit, Mich., shows a very complete line of gas valves, swing checks, safety valves, throttle valves, etc. The company calls particular attention to its new lines, prominent among which are its extra heavy pressure gate valves. These are designed for the heaviest steam working pressure, and are made of the best material and by first-class mechanics. They have been accepted by the Government in the New York City Post Office and other places where high-pressure work has been installed, and are largely used in electric railway and electric light plants where high pressure is used. Another important addition is the extra line of extra heavy nickel seat pop valves. The various valves are very clearly illustrated, and each classification is accompanied by a table showing the different sizes and prices. The Goldsmith throttle valves manufactured by this company are especially adapted for stationary and marine engines and large steam pumps. They open and close easily and quickly, and all the parts can be taken from the body and replaced without breaking pipe connections. In their operation they never leave their seats; they follow and take up their own wear. The company manufactures a very complete line of steam, brass and iron goods.

ENCLOSED ARC LAMPS FOR EXPORT.—The Standard Thermometer & Electric Company, Peabody, Mass., has lately received a European order for 1000 alternating-current enclosed arcs. That American enclosed arcs should be ordered for European service is not remarkable, considering the poor mechanism of this type built on the other side, but the Standard Thermometer & Electric Company takes considerable pride in the fact that it obtained the order in the face of sharp open competition. This company also, as may not be very well known, makes a lamp without a clutch, the feeding mechanism consisting simply of a solenoid supporting the weight of the carbon and carbon holder, with its winding and plunger adapted to give a uniform lift with the same current over a considerable travel. This style of lamp is expensive to build, and only economical in locations where lamps with complicated mechanism are barred out by special conditions. Such a case is that of the service of the Solvay Process Company, of Syracuse, which manufactures bicarbonate of soda, commonly known as soda ash. This finely ground material floats so thickly through the air that the clutch will not work at all, but the so-called "long" lamps of the Standard Thermometer & Electric Company without clutches have been in satisfactory service in these works for some two and a half years.

ARTIFICIAL DRAFT.—The subject of draft is an important one in connection with electric light and power stations, and an extract from a treatise on "Mechanical Draft," published by the B. F. Sturtevant Company, Boston, Mass., will be of interest in this connection. Mr. W. S. Hutton, the author of the treatise, states that "artificial draft can be readily adjusted to effect the combustion of different kinds of fuel at different rates of combustion. It permits efficient combustion of fuel of inferior quality, and enables a steady supply of steam to be maintained, independent of climate and weather. It enables the supply of air to be properly distributed to the fuel in the furnace to effect economical combustion. The supply of air above the fuel can be readily adjusted to effect combustion of the gases evolved by the fuel, and the supply of air below the fuel can be regulated to effect the combustion of the solid portion of the fuel, and the movement of the hot gases can be readily controlled. There is no valuable feature of the chimney that is not possessed by the fan to at least the same and in many cases to a more marked degree. The very features which are most conducive to economy are those which are incidental to the use of the fan for draft production. While the recent extensive introduction of induced draft in stationary practice has done much to emphasize the advantages of this system, the general superiority of mechanical draft, properly applied, has long been recognized by those who have given careful consideration to the matter."

THE IRON CLAD RESISTANCE COMPANY, of Westfield, N. J., lately organized, has purchased the plant, patent rights and all property formerly belonging to the Iron Clad Rheostat Company of the same place. The new company will continue the manufacture of the general type of apparatus heretofore produced by its predecessor, but with modifications which the long experience of the management of the present company has taught them to consider necessary to the successful performance of rheostats of this type. The personnel of the new organization is such that the company's customers may be assured of benefiting by all the resource and foresight which comes from thorough familiarity with the requirements for and manufacture of the product. Mr. R. H. Mansfield, Jr., the president of the new company, has been for some years general manager and superintendent of one of the largest rheostat manufacturing concerns in the country, and is well known to the trade through the connection. His prior experience as an electrical engineer was such as to make him eminently well fitted to appreciate the requirements which the product must meet in practice. Mr. A. W. Berresford, the vice-president, was for two years in charge of the testing and designing department of the same company, and in that capacity personally supervised the construction and testing of all of the product. Mr. A. P. Munning, secretary and treasurer, has had a wide experience in the financial and selling end of this line of apparatus. The new company is an absolutely independent concern, having no connection with any other house in the trade, and the management feels sure, from the points of advantage shown by the Iron Clad Type of resistance in recent tests with the improved methods of construction applied, that this apparatus will meet with approval from the entire electrical fraternity.

THE RASTER CARBON RHEOSTAT COMPANY, Chicago, Ill., has but a short time been in position to offer to the trade a full line of controllers, starters and regulators, but notwithstanding this the orders received for rheostats of various kinds are said to be now running into the thousands of horsepower. The company refers with pride to the success with which its devices have met, and believes that such a record is unparalleled. All of its apparatus is manufactured under patents controlled by the company; its automatic release for motor starters is manufactured under the Jenney patent. Many people who were skeptical as to the advisability of using carbon for resistances have, after being placed in possession of the facts, become the company's warmest friends, and from such the company is continually receiving duplicate orders. The Raster Company has lately made some very handsome rheostats, which have been shipped to Europe and Australia. All of the Raster rheostats are radically new in design. The method employed by the company of assembling its resistances and the construction of its devices are claimed to be all original. The company has been obliged to make some radical change in its factory to enable it to fill its orders with more promptness, so great has been the rush for its products. It makes a great point of prompt delivery, and has won many patrons by its attention to the trade and its methods. The company has recently secured some excellent orders for theatre dimmers, and feels much gratified over the results it is obtaining. The Raster Company states for the benefit of those who contemplate entering the business without having covered the field fully with patents, that all its appliances are fully covered by patents, not only in America, but in all countries on the globe, so that it is prepared to handle and protect business from any source whatever.

Business Notices.

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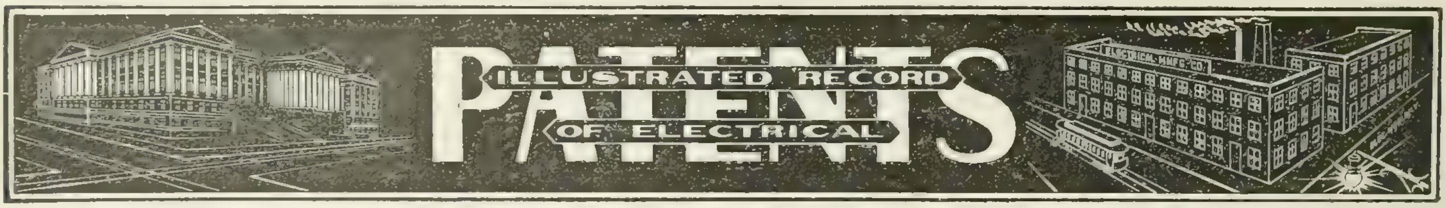


ILLUSTRATED RECORD OF ELECTRICAL PATENTS

ELECTRICAL MFG. CO.

UNITED STATES PATENTS ISSUED OCTOBER 18, 1898.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

612,410. ELECTRIC TROLLEY DEVICE; A. J. Gairing, of Johnstown, Pa. App. filed Aug. 3, 1898. The combination of a single transverse torsion spring secured at each end on the vehicle and a contact carrying arm having its lower end secured about the central portion of the said spring.

612,426. ELECTRIC METER; W. D. Marks and G. R. Green, of Philadelphia, Pa. App. filed Jan. 10, 1898. In an electric meter, the combination of a controlling arch, the position of which is determined by an ampere indicator, a pawl-carrying arm or lever co-operating with said arch and effecting the registration, a driving shaft, a driving cam carried by said shaft for actuating said pawl-carrying lever, an overweighted disc pendulum on said shaft and a motor for oscillating said pendulum.

612,427. ELECTRIC METER CASE; W. D. Marks, of Philadelphia, Pa. App. filed Jan. 10, 1898. An improved casing for electric meters, comprising a box, a frame carried by said box, a glass panel in said frame, and a metallic plate fastened in front of said glass panel and having an opening therein.

612,457. ELECTRIC RAILWAY; C. H. Meyers, of Buffalo, N. Y. App. filed Aug. 18, 1897. In an electric surface railway, the combination of a turntable, a hanger attached thereto, an arm pivoted to said hanger and carrying a traveler, and an adjusting lever mounted on the turntable and operatively connected with the arm, substantially as described.

612,535. SYSTEM FOR INSULATION OF ELECTRIC CONDUCTOR WIRES; J. H. Vail, of Philadelphia, Pa. App. filed Feb. 26, 1898. In combination with an electric conductor, an insulating covering for a portion of same, consisting of a plurality of sleeves, one within another, each sleeve being split, and having its joint or line of division breaking joint with the joint of the adjacent sleeve.

612,556. ELECTRIC ARC LAMP; C. A. Vigreux and L. V. Brillie, of Levallois-Perret, France. App. filed March 30, 1898. In an arc lamp, the combination of two carbon-holders, a brake fly-wheel, means to connect said fly-wheel to the carbon-holders, an arm suspended from the axis of the fly-wheel, a ring surrounding the fly-whel and pivoted on the above-mentioned arm, a brake block formed at the internal circumference of the ring, and [illegible]

No. 612,[illegible].—Means for Controlling Operation of Electric Motors.

[illegible]

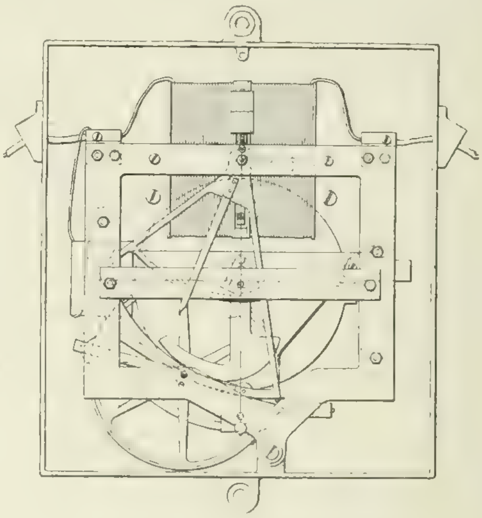
[illegible] ELECTRIC [illegible]

[illegible] MEANS FOR CONTROLLING OPERATION OF ELECTRIC MOTORS; [illegible]

[illegible] SYSTEM FOR ELECTRICAL RAIL[illegible]

612,649. BATTERY ELECTRODE; H. S. Lloyd, of Philadelphia, Pa. App. filed Sept. 20, 1897. An electrode, comprising a frame of a practically non-active alloy, and thin parallel strips of metallic lead adapted to become in action the active material, and free from interposed paste, said strips being horizontally supported in said frame, electrically connected therewith and having thickened or reinforced outer edges to lengthen the life of the strips in process of peroxidation.

612,670. ELECTRIC CABLE SWITCH; A. Norman, of Toronto, Can. App. filed April 19, 1897. An electric cable for the propulsion of vehicles, consisting of a supply conductor surrounded by insulating material, portions of which are removed at predetermined intervals, hollow metallic casings surrounding said insulating material and covering the cutaway portions, a freely flowing conducting material within each of the said casings, and a working conductor surrounding said insulating material and connected to said casings, whereby when the cable is raised a circuit is closed through the supply conductor, the freely flowing conducting material, the casings and the working conductor, substantially as described.

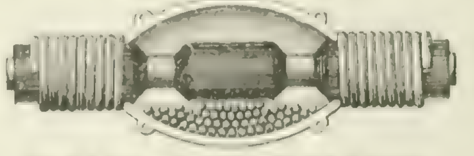


No. 612,426.—Electric Meter.

612,681. TELEPHONE EXCHANGE MECHANISM; H. P. Snow, of Erie, Pa. App. filed Nov. 1, 1897. In a telephone exchange mechanism, an office telephone normally out of connection with all of the subscribers' telephones, drop mechanism, comprising means adapted to be operated by the caller's ring and automatically connect such calling telephone with the operator's office telephone, and mechanism connected with said drops adapted when a drop is pushed back to ring up a telephone called for, substantially as described.

612,696. RAIL JOINT FOR ELECTRIC RAILWAYS; M. Barschall, of Berlin, Germany. App. filed March 14, 1898. In an electric railway track, the combination with the rail joint of an auxiliary rail supported by the sleepers and a conductor connecting both jointed track rails and placed in the space between the track rails and the auxiliary rail.

[illegible] ELECTRIC SIGNALING APPARATUS; W. F. Decrow, of Boston, Mass. App. filed Dec. [illegible]. An electric signaling transmitter comprising a train, a box number circuit operating device operated by it to transmit a box number signal at different speeds at every operation of the train, and [illegible] for said train, substantially as described.



No. 612,670.—Electric Cable Switch.

[illegible] ELECTRIC METER OR INDICATOR; W. D. Marks, of Philadelphia, Pa. App. filed Feb. [illegible]. In an ampere indicator, the combination with the actuating coil or coils of a permanently magnetized movable member and an extra winding or coil on said movable member, substantially as described.

The Electrical World.

Vol. XXXII. NEW YORK, NOVEMBER 5, 1898. No. 19.

PUBLISHED EVERY SATURDAY BY

The W. J. JOHNSTON COMPANY,

9 Murray Street, New York.

Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York.

New England Office, 620 Atlantic Ave., Boston.

Western Office, 936 Monadnock Block, Chicago.

Philadelphia Office, 929 Chestnut Street.

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THE ELECTRICAL WORLD,

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Vol. XXXII. NEW YORK, NOVEMBER 5, 1898. No. 19.

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ELECTRIC AUTOMOBILES.

It is becoming more and more apparent that the electric automobile industry is in a stage comparable with that of electric traction about ten years ago—namely, just on the threshold of a tremendous expansion. The problems arising in the development of this class of apparatus are apparently as discouraging as those of electric traction were at the time mentioned, but means of overcoming them are being gradually developed in many a shop, factory and experimental laboratory, with results that are oftentimes astonishing.

The developments in this line in France and America are quite readily compared by the illustrated descriptions of the vehicles of both countries in other columns of this paper. The competition held last summer in Paris in connection with the Tuileries exhibition brought forth a large number of electric vehicles, the study of which allows a few general comparisons of French and American practice to be drawn. In general the French vehicles appear to be more crude, more experimental, more primitive and more complicated than those of American design, albeit one cannot help admiring the ingenious mechanisms embodied in many of them to overcome self-imposed difficulties. Sprocket chains are almost invariably used by the Frenchman, apparently because hydro-carbon automobiles were developed in advance of the electric, and the oil engines were necessarily placed in the body to avoid the difficulties of flexible piping. Imitating these, the makers of electric carriages have put the motors in the body, while in America street railway practice has been followed and either a rigid or the so-called "wheel barrow" or Sprague suspension, with spur gears, has been followed. The French also, regardless of the liability of breakdown, have added complication after complication to get small refinements far in advance of the time. Such are, for example, nine speeds forward and about as many backward, electric brakes utilizing the motor as a generator on dead resistance, battery recuperation on down grades, etc., etc., while Americans have aimed for simplicity and effectiveness. The French, on the other hand, use almost entirely plain axles, while Americans as exclusively use those of the ball or roller bearing types.

The problems involved in the development of this branch of electrical engineering differ radically from those of any others, resembling only in a small degree those of rail traction. The worst problem is, of course, the storage battery, which will spatter, fume, give out on the road, leak, buckle, disintegrate, corrode, short circuit and do many other undesirable things under the severe conditions of automobile work in spite of all its recent improvements. As has been concisely said of it in a remark credited to Mr. T. A. Edison, "The ——— thing is wet."

Among the mechanical problems are, first, those of the gearing. The simplest arrangement and that generally first tried by inexperienced designers is the meshing of the motor shaft with a gear directly on the wheel spokes. This is quickly abandoned, owing to the impossibility of keeping such a gear true or of enclosing it. Ball-bearing hubs are anything but accurate in alignment and axle-driven wheels are by many preferred to hub-driven. In rounding corners, one of the driving wheels must turn much faster than the other, and the wheels cannot therefore be rigidly coupled together. To give the same torque to each with this difference of speed a differential or compensating gear, known in the shops as a "Jack-in-the-box" and commonly of the epicyclic-bevel-train type, is used. This, of course, is not necessary if the vehicle is of such a size that two motors, each independently connected to its own driving wheel, can be economically used. The connection of the two armatures in series gives any desired variation of the relative speed with the same torque on both.

In steering the common fifth wheel or centre-pivot of the forward axle-tree gives altogether too great blows and jerks to the steering handle when either wheel meets obstructions. The axle-tree is therefore commonly fixed, and the wheels turn each about its own pivot near the hub. Sometimes these pivots are vertical, and within the hub itself, at other times just offset toward the centre of the carriage and either vertical or inclined somewhat. The operation of steering is, even with this improvement, more or less tiresome, and worm gears, oil cylinder locks and other devices are often used to prevent the wheels being deflected by variations in the roadway. One maker inclines his pivots in such a way as to give the wheels a tendency to always return to a straight-ahead direction. An interesting geometrical problem in this connection is the difficulty of getting the proper relative angular deviation of the two steering wheels. If in turning they both swing through the same angle the four wheels of the carriage will not be tangent to concentric circles, as is necessary for the proper riding in a curved path. The inner wheel must be swung through an angle greater than the outer. This is commonly approximated by making the pivot cranks non-parallel.

The speed control is commonly effected in American practice by dividing the batteries into four groups which may be placed all in multiple, two in multiple and two in series, or all four in series, thus giving three voltages and three speeds, others being sometimes added by commutation or rearrangement of the field coils, dead resistances rarely being used. The French, however, favor keeping the batteries always in series, so that all the cells of one vehicle invariably receive the same discharge, as they do the same charge, and obtain their speed control by all sorts of devices, such as double commutators, changeable gears, etc., etc. The loads carried in this work are so small that magnetic or other blowouts are not necessary in the controllers which break the current satisfactorily with the quick motion obtained by cam notches.

As between the electric and the hydro-carbon-propelled automobile, the former has the advantages of quieter running, easier control, greater simplicity, less apparent danger, absence of odor, heat and vibration, which appeal powerfully to the layman and the purchaser of such vehicles. For long runs without replenishing—that is, for cross-country service similar to that of the stage coach—the hydro-carbon vehicles are undoubtedly superior, but for city service the advantages of electric propulsion are overwhelming.

BOUNDLESS SPACE A BUS BAR.

One of the American electrical journals has recently taken some of Mr. Nikola Tesla's patents undoubtedly more seriously than the inventor himself intended them, and advanced the ideas [illegible] comparable with those of the same inventor in the rotary-field line, and has, [illegible] the public in general [illegible]. The idea [illegible] with the same conducting strata by means of any suitable device, such as that used by the illustrious Benjamin Franklin, or, preferably, as stated in the patent, by means of a balloon, the earth being utilized as a ground return.

The fact is set forth that the atmosphere at 15 pounds to the square inch, or other pressures common near the surface of this mundane sphere, is a good insulator, while at lower pressures, as is well known by manufacturers of 200-volt lamps, it becomes quite a fair conductor. By a rigid suppression of the reasoning faculties and a little freedom of the imagination, fancy pictures a conductor poked up through the insulating sheath at Niagara, establishing an alternating difference of potential between the superincumbent ether and this ball of solid matter below protected by an atmospheric dielectric, which difference of potential can be tapped, so to speak, at any desired location, such as the large cities, or by express trains with electric locomotives towing balloon trolleys, making contact with an overhead conductor from which they cannot readily slip off. The use of several great sources of natural power will, of course, necessitate generators of the same frequency running in synchronism with each other, as they are all, so to speak, connected across the same bus bars, and lacking the third bus bar, multiphase systems will go out of fashion.

The system might, however, give other results more valuable than those of power transmission. With transmitting and receiving stations at Niagara Falls and New York city, respectively, the State of New York would possibly be illuminated by a gigantic Geissler tube overhead that would turn night into day, put to shame the aurora borealis, and make the advocates of diffused illumination shout for joy.*

Mr. Tesla should certainly be enjoined from putting his polished ball terminals too high, or a Crookes-tube effect might be obtained, emitting a profusion of X-rays which would disclose altogether too much to anyone with fluorescent spectacles, and might make it necessary for mortals to carry leaden umbrellas to prevent the skin being burned from the tops of their heads.

The patent gives no data as to the estimated height to which it would be necessary to elevate the terminals. It is obvious that a height sufficient for a very marked difference in the specific resistance must be attained, otherwise the voltage would be necessarily so high that fatal leakage through the extended sheet of insulating medium would ensue. No such marked change of resistance occurs at the highest elevations yet attained by man, several miles upward, and the atmospheric pressure falls off somewhat more slowly even than by a logarithmic law, so that scores or hundreds of miles of elevation would be necessary. The methods of ballooning at this elevation and supporting conductors of this length are not explained in the patent.

With a circuit looped about so many square miles of space, it is not explained how the self-inductive choking of the comparatively high-frequency currents proposed (about 1000 cycles per second) could be eliminated, and no explanation is made of the precautions to be taken against lightning. The advocates of that light-weight material, aluminum, for current-conducting purposes must take a back seat, as the ether has a lower specific gravity than anything hitherto proposed for this service. Mr. Tesla, if correctly reported, previously proposed to wabble the earth's charge for man's ignoble uses, but he now, if these things can be taken seriously, has designs on the universe. The price of copper remains in the neighborhood of 11 cents, however.

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*[illegible] vacuum [illegible]

X-Rays in the Army.

BY H. LYMAN SAYEN.

When the operations of the army near Santiago indicated the necessity of providing for the wounded in the United States, where better care, more healthful surroundings, and better food could be obtained than was possible in Cuba, the Government selected Fort McPherson, Ga., as one of the receiving points. Situated 4 miles southwest of Atlanta, on a tableland 1000 feet above the sea level, its pure air and water, excellent sanitary arrangements and central position in the South made it an excellent site for a general hospital for the army in the field.

Early in July I was ordered by Surgeon-General Sternberg to report for duty at the post in connection with X-ray work. Upon my arrival there I found that the finely equipped post hospital was used partly as an executive building and partly for sick and wounded officers. Immediately adjoining the hospital building is the laboratory building, one portion of which was the surgical operating room, well equipped with modern surgical appliances, while another part of the building was devoted to the biological laboratory, and it was here that the X-ray work was done.

The room was well suited to the work, and, as the water supplied to it was from an artesian well over 2000 feet deep, it offered exceptional facilities for the developing and printing. I had the shutters covered with an opaque, black oilcloth in order that the room might be made absolutely dark, even when the brightest daylight prevailed outside. It was found very essential to do this, not only for photographic purposes, but for the fact that it seems impossible to do satisfactory work in daylight. It is a matter of ten minutes or so for the eyes to accommodate themselves to the fluoroscope after being exposed to daylight, and it is impossible to keep them glued in the fluoroscope and at the same time manipulate the X-ray apparatus in a light room.

The original equipment of the X-ray laboratory contained as a generator an eight-plate static machine with plates 28 inches in diameter, running in ball bearings. The plates were in a moisture-proof case, which also contained a double-plate Wimshurst as an exciter. The main plates were driven by a large hand wheel which made one turn to four or five of the plates.

The apparatus was of excellent workmanship and, under conditions less exacting than this instance, might have performed the work required of it. While the writer's experience in the use of the static machine in connection with the generation of X-rays has been somewhat limited, a study of the conditions existing in this form of machine, together with the actual working of the apparatus at the post, leads to the conclusion that the static machine is theoretically and practically an inefficient current generator, aside from the fact that the highly humid Southern climate rarely permitted its use in this particular instance.

A static machine depends for its excitation on the potential induced at its terminals, and, as a consequence, when running at a low potential, as on a tube of low vacuum, it does not generate a sufficient quantity of current. The addition of a spark gap in series with the tube improves the output of the machine, but there is more energy lost in the spark gap than used in the tube. That is, if the machine is not running at a potential equivalent to a long spark, it will not generate enough current to properly illuminate the tube. A tube with a vacuum corresponding to a parallel spark gap of about 3 inches gives the most satisfactory results. When connected to a static machine, in order to get enough current through the tube, it is necessary to add a spark gap in series with it about 6 inches long. It will be seen from this that the machine, in order to give the proper current, generates three times the energy necessary; or, in other words, a 4-inch spark from an induction coil would do the same work, while the apparatus required would occupy but about one-twentieth of the space.

In view of the exigencies of the work Messrs. Queen & Co., Philadelphia, kindly loaned the writer a 14-inch induction coil, together with a number of their self-regulating tubes, while Dr. T. P. Hinman, of Atlanta, volunteered the use of his laboratory for the purpose of charging the batteries to run the coil, no electrical plant existing at the post.

The wounded sent to the post included those who were in the fight at El Caney, and in practically every case the X-rays were employed for diagnostic purposes. The difficulty of obtaining suitable photographic plates early in the work compelled reliance upon the findings of the fluoroscope, the location of bullets being marked by ink spots on the flesh. In the case of fractures the surgeon in charge of the patient was enabled to verify the position of the bones.

The number of wounded during the war that required the X-rays was by no means large, but the cases of injured received at Fort McPherson were of such a varied character as to fully emphasize the value of the new form of radiant energy in all field and hospital work during the war. While it is not in my province to comment on the surgical aspect of the subject I believe it to be the opinion of surgeons of experience that the older method of probing for bullets, with the consequent danger of carrying infection to the wounded parts, should be abandoned in favor of the X-rays. There is also the important factor of accuracy in the X-ray determinations, enabling the surgeon to remove the bullet through a small opening in the tissues.

All the operations of the surgeons at the post were successful in removing the bullets from the exact location, as indicated by the radiographs, and in many cases it was impossible to determine the nature of the injury except by means of the plates. The presence of some of the bullets was even unsuspected, as is shown by the case of J. R., private, Company C, Second Infantry. He was wounded at Santiago and arrived at McPherson with two pieces of lead in his arm. The presence of the larger piece was unsuspected, the smaller piece being so near the surface that recourse to the X-rays was considered unnecessary. A subsequent stiffness and soreness in the arm, however, gave rise to an X-ray examination, resulting in the successful removal of the bullet.

The present war is the first instance that our army medical department has had occasion to use X-ray apparatus to any practical extent. Apart from the novelty of the new force, there is not the opportunity in the army in time of peace to determine the value of improvements of this nature as is afforded the general hospitals.

The X-rays in the army are essentially an equipment for war, and in those times when the medical department is taxed to the utmost there is the utmost importance that they should have every facility to help in the successful treatment of the injured. Not only are the rays valuable from the standpoint of their immediate usefulness, but too much importance cannot be placed on the fact that, as records, there is nothing better or more accurate than a radiograph. In the case of J. R., should he try to obtain a pension, could there be found any better evidence of the fact that his bones are uninjured and that the possibilities of a permanent injury resulting are exceedingly small? If, together with the radiograph, there is kept an accurate history of the different cases we have an indisputable account of the effect of gunshot injuries.

It certainly seems that the recent developments in the design of X-ray apparatus have advanced it to such a state that there are great possibilities for the adaption of it to work in the field. A covered wagon, drawn by two mules, would furnish the dark room as well as the means of conveyance. It should be in charge of two men who should be so trained in the work that they would, between them, know how to take care of everything from the secondary of the induction coil to the hoofs of the mules. In the wagon might be placed a 12-inch induction coil so made that every part could be immediately removed and replaced by another, of which the wagon should contain a complete set. It should also contain, besides a complete supply of tubes and photographic apparatus, a little dynamo and windlass so the mules could put in their spare time in charging the storage batteries (although this seldom has to be done, as my experience at Fort McPherson demonstrated). A thousand pounds would cover the weight of the apparatus, and with such an equipment the wagon would be as independent as a company of infantry. The operators could bunk in their ambulance besides carrying a plentiful supply of rations.

An Automobile Exhibition in London.

An international exhibition of motor cars is to be held in London, England, next June, and it is hoped that trials and contests, with prizes and medals, will be arranged for.

Electric Automobiles in Berlin.

An electrical omnibus has lately been put into public service in Berlin, Germany, the vehicle being 23 feet in length, having a capacity of twenty-six passengers and weighing 6.65 metrical tons, of which the battery weighs 1¾ tons, and is stated to have a running capacity of thirty-seven hours.

Electrical Vehicles.*

BY JOSEPH APPLETON.

The question of electric vehicles is, to the general public, probably the most interesting among recent applications of electricity, and the field it opens up for storage batteries is almost beyond limitation. The last few years have seen the electric motor replace horses in our street cars, and those who have followed the conception and growth of the electric vehicle prophesy the same revolution in the carriages, cabs, wagons, etc., in our cities. Of course, to lovers of horseflesh this change will not appeal, for the substitution of a controller for a well-bred animal would deprive them of the principal pleasure of locomotion. There certainly can not be the same sympathy and affection between the owner and the electric motor as there is between him and an intelligent animal; but for commercial uses, where dollars and cents, and not sympathy, count, the case is different, and there are many reasons why the electric vehicle should supersede our present methods.

The cost of accomplishing by electric vehicles the work now done by horses would be probably one-half, when their adoption has become to any extent general, thus enabling the work of recharging the batteries to be organized on a proper scale.

There is an immense advantage from a sanitary point of view. Think of the hygienic measures necessary to care for the refuse of 100,000 horses, both in the stables and on the streets. This is about the number of horses in Philadelphia. Again, if the wear and tear of these 100,000 horses traveling over the streets and roads were done away with, how much simpler the problem of good roads would be. The electric vehicle possesses so many advantages over those propelled by oil or gas motors that, except for special conditions, where extremely long distances have to be covered without charging facilities, there seems to be little, if any, doubt that the former type will be the one to fill the field.

Briefly stated, the advantages of the electric vehicle over oil or gas motors are as follows:

Safety.—A storage battery will not explode, nor is it inflammable, like gasoline or kerosene.

Ease of Handling and Control.—An electric motor, with its controller, is certainly the ideal method of control, and is distinctly not in the same class with the levers and valves necessary to operate an engine.

Absence of Noise and Vibration.—Here, again, the electric motor is the ideal motor for the purpose, having a smooth rotary motion, instead of a reciprocating action, with its noise and vibration.

Absence of Heat and Smell.—An oil or gas motor must, of necessity, be accompanied by considerable heat, and usually requires a water-jacketed cylinder. From the exhaust there is an objectionable odor, due to the unconsumed gases; but with the electric motor neither of these objectionable features exists.

Cost of Operation.—There is no doubt, from independent tests made, that a vehicle can be propelled electrically with less consumption of energy than any oil or gas motor.

There are many other points which might be touched upon, but these will suffice. For city use, the question of large mileage capacity does not handicap the electric vehicle in favor of the oil or gas motor, as the supply of electricity can be renewed as desired by recharging the batteries. This part of the problem we will consider later.

The electric vehicle of to-day is the result of much arduous and expensive experimental work, and this club has the honor of containing among its members two gentlemen who have been foremost in the development of the electric vehicle in this country.

Messrs. Morris and Salom first took up the question in 1894, at which time very little had been done, either in this country or abroad, and the numerous problems of motors, gearing, wheels, tires, bearings, running gear, etc., had to be investigated and solved without the light of previous experience. The first vehicle they designed without regard to appearance, their object being to ascertain the [illegible] through all [illegible] streets con- [illegible] the features of weight, [illegible] and [illegible] [illegible] It [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] It was very successful, and [illegible] [illegible]

The data obtained from this proved that on good pavements a vehicle weighing, with passengers, 5000 pounds, could propel itself at a speed of 10 miles an hour, with an expenditure of energy not over 3½ horse-power, or $^7/_{10}$ horse-power per 1000 pounds.

These gentlemen next designed and constructed the vehicle known as the Electrobat, No. 2, which won the gold medal in the "Times-Herald" motor-cycle contest held at Chicago in November, 1895. This weighed only 1700 pounds with batteries, which was a great reduction in weight. The equipment consists of two motors, each 1½ horse-power, attached to the front axle, the pinions on the armature shaft gearing directly into the driving gears attached to the front wheels. The steering is accomplished by the hind wheels. The battery consists of forty-four cells, having a capacity of 50 ampere hours, each cell weighing 13 pounds. The controller is conveniently located at the front seat, and gives three speeds ahead and one backward, obtained by various groupings of the cells and motors. The maximum mileage on one charge was 25 miles, at 12 miles per hour; the maximum speed, 20 miles per hour. In the "Times-Herald" race this vehicle met in competition every description of motor vehicle, and the fact of its being awarded the gold medal is sufficient proof of its superiority and merit.

Messrs. Morris and Salom then proceeded to design electric vehicles for different classes of work, *e. g.*, hansom cabs, coupés and delivery wagons, etc. The next step forward was the formation of the Electric Carriage and Wagon Company, to operate vehicles in actual service in New York City.[1]

After more than a year's successful experience with these cabs it was decided to extend the scope of operation, and next month fifty more cabs and fifty broughams will be in operation in New York City in ordinary hacking service. Eventually more stables will be opened in New York City, and also in other cities.

The new vehicle is of similar design to those formerly used, but will contain certain minor improvements and additions, which experience has found to be advantageous. For example, the backward speed is obtained by a separate reversing switch, operated by the foot instead of by the controller, as it was found the driver would use the reverse position to stop his vehicle, instead of using the brake, thereby putting more strain on motor and battery.

An emergency switch is provided, which the driver operates by giving a spring a kick with the heel and releasing a little strip of copper from two contact blocks. This switch is also used if the driver wants to leave his vehicle on the street; he puts the copper link, or little strip, in his pocket and renders the vehicle inoperative. These new cabs show a marked improvement over the previous ones in the question of efficiency. At a speed of 12 miles per hour they take an average of less than 2½ horse-power, and will have about 40 miles' capacity. When going up an 8 per cent. grade, which is rarely met with in city use, they can make 6 miles an hour with 7 horse-power. This is far better than has ever been done before. The wheels are fitted with pneumatic tires of 5 inches diameter, inflated to about 120 pounds.

A vast amount of skill and care has been expended in laying out the new stables, and the arrangements for handling the vehicles and batteries are most complete.[2]

The Pope Manufacturing Company, the well-known makers of the Columbia bicycle, have taken up the manufacture of electric vehicles. Their vast manufacturing experience and exceptional facilities for making tubular frames, wire wheels and pneumatic tires render this company specially fitted for turning out the highest class of vehicles, both from an engineering and commercial standpoint. Its attention has been given to vehicles for private use, rather than public operation from a central stable.[3]

The mileage of the single-seated carriages of this make in New York City streets is about 30 miles. Over country roads, in the vicinity of Hartford, Conn., where there are many hills and roads having poor surface, a mileage of 28 miles has frequently been obtained. Over these roads the average speed, including all stops and slow-ups, is 9¼ miles per hour. The average consumption of energy on good roads, including all zero readings when coasting, is about 1760 watts, or 2⅓ electric horse-power.

The fact that the carriages are used by the general public, and are not operated or controlled under skilled supervision, as is the case of cabs, has made it necessary to work out a system for recharging which the purchaser can carry out without trouble. Forty-four cells are used on each vehicle, so that an ordinary 110 volt circuit can be used for charging. The batteries are charged in position, a suitable plug connection being provided. In each vehicle is arranged, in the battery circuit under the seat, a specially designed Thomson recording wattmeter, which, when the battery is charging, runs backward, and at a certain slower speed than when the batteries are discharging and operating the carriage. Instructions are given to continue the charging current until the wattmeter returns to the full position. This absolutely insures that a certain percentage of increase of current over what has been taken out has been put back into the batteries. The batteries are fully charged in from three to three and one-half hours. When first plugged in the current starts at 40 to 50 amperes, gradually decreasing to about 10 amperes as the counter e. m. f. of the battery builds up.

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*[illegible] paper [illegible] before the Engineers' Club of Philadelphia.

[1] See Electrical World, August 14 and August 21, 1897.

[2] See Electrical World, September 3, 1898.

[3] See page [illegible]

The Fischer Electric Equipment Company of Chicago is preparing to operate in that city vehicles of all descriptions. The lines it proposes to work on are to furnish the entire electrical equipment to carriage builders, using the ordinary design of carriage, with as little alteration as possible. Experience leads it to recommend two motors, thus doing away with balance-gear, and to the use of wood wheels in preference to wire wheels, and solid rubber tires in preference to pneumatic ones. It is claimed that pneumatic tires take 20 to 50 per cent. more power for the same load than solid tires, besides depreciating far more rapidly. It is proposed to do the charging with the battery in position, assuming that the public vehicles will have ample time during the day to charge from the street plug, and to adopt a prepayment system for this charging, the man putting into the switching apparatus on the charging plug a certain amount of money and getting in return a definite quantity of electrical energy.

The Riker Electric Motor Company is also building electric vehicles.[1] Some of these have been in service for some considerable time, the Victoria having made 3000 miles and the four-passenger trap 1200 miles. An electric delivery wagon is being operated by Altman & Co., in New York City.

The electric-motor vehicle must of necessity contain mechanical and electric apparatus which, in order to be maintained in proper working order and the highest state of efficiency, must have intelligent and systematic inspection. If this care and attention are given periodically, there is no doubt of the reliability and usefulness of these vehicles. It can hardly be expected that the general public will be able to give this skilled attention, and comparatively few users of such vehicles would have a mechanic in their employ who would be competent; therefore the lines upon which the business will be developed will probably be the construction of charging stations in suitable locations in the city, where the vehicles will be kept when not in use and where they will receive such attention as is necessary.

There is no doubt that the electric vehicle has come to stay. Whether future devolopments will lead to a different design it is impossible to say. The first railway coaches were constructed after the design of the old road coaches, but the design became modified in order to produce a vehicle which was best suited to the new method of locomotion. So it may be with the electric vehicle. The design may gradually change until we have a type of motor-vehicle entirely different from the horse-carriage.

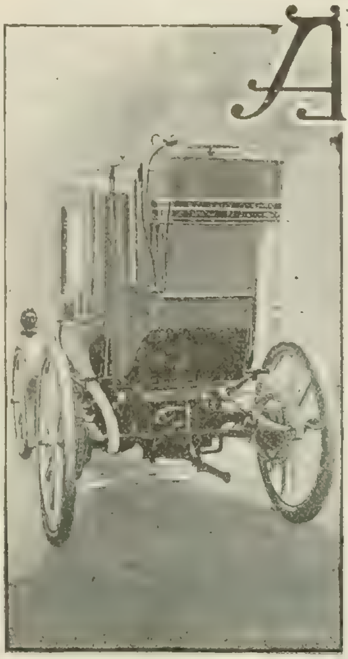
Another Automobile Exhibition.

An exhibit of motor carriages was held during the last week in September at Dusseldorf, under the auspices of the Mid-European Motor-Car Club. Most of the vehicles were of the hydro-carbon motor type, although some electrical ones were shown, one being a Columbia electric carriage.

Electric Cars in London.

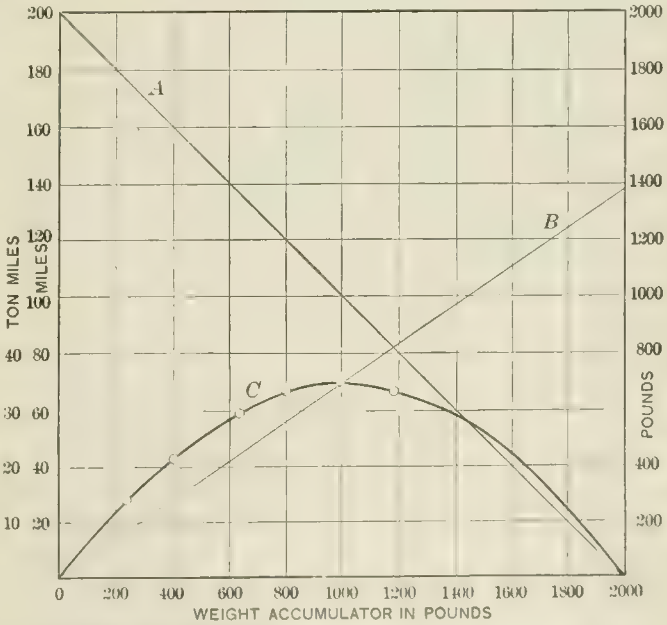
The Middlesex and London County Councils have at last granted permission for a line of electric cars in London, the English papers referring to it as an experimental line, though what can be the subject for experiment is hard for Americans to see. The current is to be supplied by overhead trolleys, although in a report recently presented by Mr. J. Allen Baker a most commendable statement is made that for service of this kind the open conduit is far preferable.

Electric Automobiles at the Paris Concourse—I.*



AMERICANS have been accused of being a utilitarian race, utterly devoid of the æsthetic sense, and therefore caring little for the appearance of their streets, so long as these serve the purpose for which they are built. In the early days of electric lighting, plants were built everywhere with feverish haste. It mattered little how things looked if only the lights worked. The streets were filled with loose and carelessly strung wires, supported on wooden poles that looked often as if some of the bottled lightning had strayed into them by mistake, so crooked were they, and it is no uncommon thing now to see a rickety arc lamp nailed to the top of a crazy pole in some places that ought to know better. The electric railway soon added its burden to the streets; it is true that a feeble protest was heard, at first, but the protestants were soon the very people who let the horse-car go by in order to take the electric following close behind on the same track.

How does it happen, then, that the motor carriage is not with us yet? Paris, the most beautiful modern city in the world, whence the trolley-wire is banished for its unsightliness, is filled to overflowing with noisy, puffing, busy, odorous little vehicles propelling themselves about the streets. We are constantly hearing of the races which are run at break-neck speed, up hill and down dale, at imminent risk of life and limb to both participants and other unfortunates who happen to be on the road. The excitable Frenchman is unable to write anything about his automobiles without first calling attention to the fact that for once he has distanced America, the home of the mechanic, on her own ground, and wonders how it has come about.



A — Useful weight in pounds
(Difference between total weight of outfit and weight of accumulator.)

B — Distances in miles

C — Useful work done in ton miles, equals useful weight times distance traversed.

Elec. World, N.Y.

Fig. 1.—Curves of Accumulator Weight and Travel.

Though late in making its appearance a successful electrically propelled vehicle does seem to be coming to the top at last, if it is possible to prophesy anything from the results of the recent competition trial held in connection with the Tuileries exhibiton. The object of this competition was to develop a carriage which would be suitable for displacing the hacks and cabs drawn by horses now plying in Paris. The reward of success being a very substantial one in the shape of a possible large order from the Paris Cab Company, those who took part in the competition made every effort to produce a successful machine.

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[1] See page 486, et seq.

*Compiled and translated from the French technical journals.

The tests to which these vehicles were subjected were elaborated by a committee appointed by the Automobile Club of France, one of the members being the head of the Paris Cab Company. The conditions were made to imitate, as far as possible, those under which an ordinary hack does its daily work. The daily travel of such a vehicle is said to average 40½ miles (65 km.), of which only 28 miles (45 km.) are employed in actual useful work. The remaining 12½ miles (20 km.) is consumed on the road going to and from the stable and the cab stand, or returning to the stand after having carried a passenger to his destination, or else in driving slowly up and down the streets in search of a fare, as they often do. This travel extends over about sixteen hours, from 8 in the morning until midnight.

For many reasons the arrangements for the automobiles had to differ somewhat from the above conditions. The tests covered nine days, and were made over three separate routes marked out through the city, having a length of 37.3 miles (60 km.), each one being covered three times during the test.

These routes lay over some decidedly rough ground. The hills of the rues de Raynouard (route A), Magdebourg (route B), and Lepic (route C), with the pavements of the rue Menilmontant, left a vivid impression on the memories of the contestants and judges, for they have some bad streets even in Paris.

The routes were laid out to pass through some of the crowded streets, so as to include a starting and stopping test. The first day was devoted to making tests of the power of the brakes of each carriage on a 6 per cent. grade, and of the power of the motor by causing each vehicle to climb a hill 2000 feet long, with a rise varying from 8.2 to 8.8 per cent.

These same tests were repeated on June 11, after the carriages had made 335 miles (540 km.) during the nine days of testing, to determine what effect the vibration and strain to which they had been subjected might have had on the machinery. Careful readings were taken throughout of the energy consumed by the electric carriages at different speeds.

There were twenty-six vehicles entered, fourteen of which were electrically propelled. They were put up at a stable loaned by M. Clément, where there was a plant abundantly able to furnish the 115 kw hours at 110 volts required daily for refreshing the electric carriages. The accumulators being all furnished by the Fulmen Company, their care during the exhibition was supervised by two engineers from that company.

All the gasoline-motor carriages, with the exception of one, the

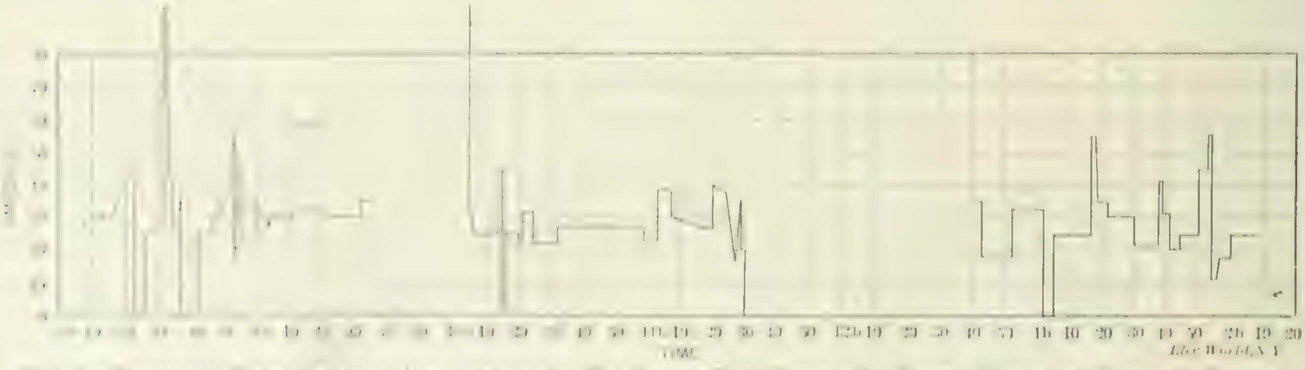

Fig. 3.—Discharge Curve for the Accumulator of Car No. 13 Over Route B. Total Weight of Car, 3060 Pounds.

[illegible]

Observations.

Charge received at station [illegible] watt hours.
Duration of discharge [illegible] hours.
Average current [illegible] amperes.
Average voltage [illegible] volts.
Average rate of work [illegible] watts.

[illegible] One [illegible] Three

makers were represented by the successful vehicles, Jenatzy, Kriéger and Jeantaud.

THE FULMEN ACCUMULATOR.

Inasmuch as all the vehicles in the contest and, in fact, nearly all in France use the Fulmen accumulator, a few words on the subject of this make of cell will not be out of place.

Perhaps the first thing to be taken up should be the proportion

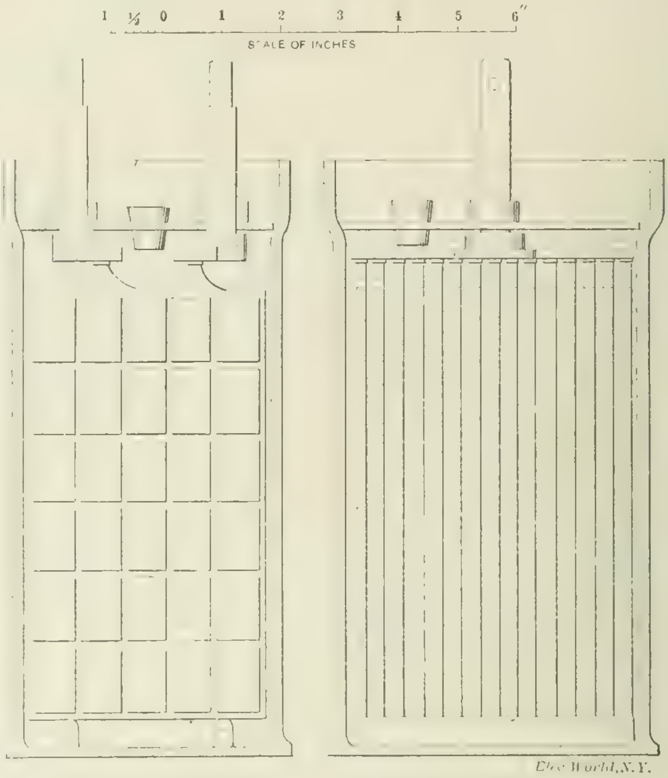

Fig. 2.—Details of Fulmen Accumulator.

that the weight of the battery may properly bear to that of the carriage for a given speed.

Practical experiment made on good, hard, dry and level macadam road has given the coefficient of tractive effort as 0.0253 to 0.0344 for iron tires, 0.0228 to 0.0299 for solid rubber, and 0.0208 to 0.0248 for pneumatics.

Put the value at 0.025 and suppose a vehicle whose total weight is 2000 pounds be required to travel at 12 miles per hour or 17.6 feet per second. The tractive effort necessary will be 0.025 × 2000 × 17.6 = 880 foot pounds per second. With a mechanical efficiency of 70 per cent. the accumulator must furnish 1257 foot pounds per second, or 1700 watts.

In one hour 12 miles will have been covered, and the expenditure of energy will have been 1700 watt hours, or 142 watt hours per ton mile, which is on the safe side, comparing it with Morris and Salom's figure of 123 to 136 watt hours per ton mile obtained in practice.

Now, with an accumulator whose normal discharge rate is 4½ watts per pound of total weight, to give the required traction effort there will have to be 377 pounds per ton, as anything less will not keep it up to speed. If this battery is capable of 9 watt hours per pound of total weight, the distance will be limited to 24 miles for one charge. An increase in the weight of the accumulator permits an increase in the distance, but as the total must remain 2000 pounds the weight of the carriage will have to decrease, a process which can go on theoretically until it reaches zero.

Let us plot as abscissæ, as shown in Fig. 1, the theoretical possible variation in weight of the accumulator, which is from 0 to 2000 pounds, and against this on the axis of ordinates we will plot the difference between the total weight and the weight of the accumulator, 2000 to 0 (curve *A*); the distance which can be accomplished by an accumulator capable of 9 watt hours per pound, 0 to 137 miles (curve *B*); and the useful work done in ton miles (curve *C*), which equals the product of the useful weight (curve *A*) by the distance it is carried (curve *B*). Notice that the maximum point attained by *C*, the curve of useful work, corresponds to the value 1000 for the weight of the accumulator, or 50 per cent. of the total weight. In other words, no advantage can be gained by increasing the weight of the accumulator beyond 50 per cent. of the total. It will be a disadvantage to do so. Nor can we go below 20 per cent., or, as we have seen, the machine will not drag itself at speed; 30 to 40 per cent. is about what is met with in practice, and this corresponds to a distance of 40 to 56 miles at 12 miles per hour under the conditions assumed above. The effect of hills, starting and stopping, etc., would tend to bring down the figure for the distance.

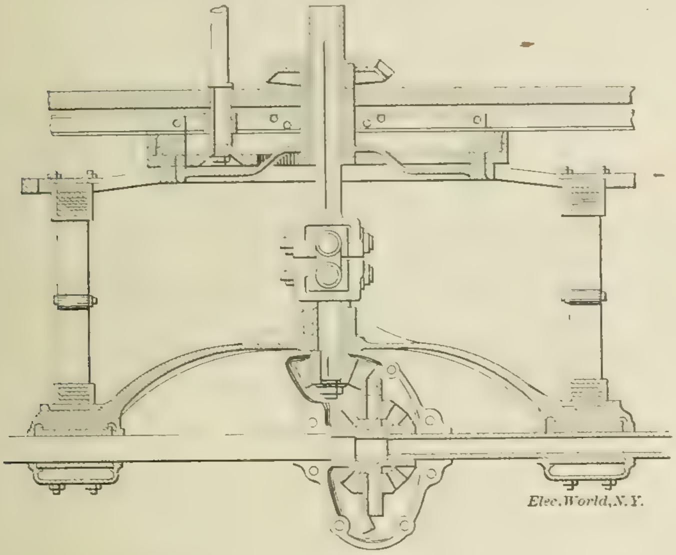

FIG. 4.—THE STEERING AND DRIVING GEAR OF THE DORÉ CARRIAGE.

The Fulmen accumulator is of the pasted type of cell, that is, the oxide or active material is mechanically applied, as distinguished from the Planté cell, in which it is formed by repeated reversals of current. The Planté type is a heavy accumulator, because the active material can only be made to extend inward on the plate for a small thickness; it has, however, a high rate of discharge, because the surface is large relatively to the capacity. The pasted type is lighter, because it is possible to have a larger quantity of active material on the same grid, but its surface is thereby reduced, which reduces the possible rate of discharge. The extra thickness increases the internal resistance, and also the tendency to polarize; the active material applied mechanically is also rather more liable to injury by excessive discharging or charging rates, resulting in pulverizing and cracking it away from the support, than is the case with the material formed by electro-chemical process. This disintegrating action results much more from excessive chemical strains than it does from any vibration strains to which the cells are subjected.

In considering the battery with relation to the automobile, the question of capacity per pound of cell is the important thing. High rate of discharge or charge is no doubt desirable, especially where any recovery of energy is to be made from the motor on a down grade. There is a tram line in Paris where the round trip consumes 8664 ampere hours and a recovery of energy of 1682 ampere hours is made on down grades, and here it pays to use a cell having a capacity of only 2 to 2½ ampere hours per pound, with a rate of 2¾ amperes. But the electric automobile has become practicable only with the advent of a cell giving 6 to 7 ampere hours per pound total weight, though the discharge rate possible is but 1⅓ amperes per pound. It takes 62½ pounds to furnish a useful kilowatt hour. Recovery of energy is still possible with this cell, but precautions must be taken to keep the charging current within certain bounds.

The plates of the Fulmen accumulator have each twenty-four rectangular tablets of active material supported by a grid of an alloy of lead and antimony. The edges of the tablets are V-shaped, so that they are held firmly in the grid. (See Fig. 2.) The plates are 5-32 inch thick, their weight being distributed as follows: 31 per cent. in the grids, 39.3 per cent. in the positive active material and 29.7 per cent. in the negative active material. Celluloid boxes have been used, but owing to their inflammability, which renders them liable to take fire from some overheated connection, they are to be discarded in future.

The manufacturers specify as normal a discharge rate of 0.065 ampere per square inch of positive plates for a continuous discharge of five hours. But the cell can furnish double that rate on a continuous discharge and four times for short intervals. At the normal rate the values for the Fulmen cell are as follows:

Discharge rate in amperes....	1.36 per pound total weight of cell
Useful watts....................	2.40 " " " " "
Capacity in ampere hours.....	6.63 " " " " "
" " watt "	12. " " " " "
Weight per kilowatt of storage.....................	417 pounds
Weight per kilowatt hour of storage..................	83 "

If the rate of discharge be doubled, bringing it up to 5 watts per pound, the energy stored will fall to 9 watt hours per pound. And though it would require at that rate only 20 pounds to store 1 kilowatt capacity, it would be necessary to have 110 pounds to store a kilowatt hour as against 83 pounds before. By halving the discharge rate, the energy that can be stored may be raised to 13.6 watt hours per pound. In other words, a gain in power per pound entails a loss in energy per pound and vice versa, and it is well to remember that the life of an accumulator is shortened when worked hard.

In charging the cells the rate to be selected depends largely on the point which was reached when the discharge stopped. If they are entirely run out the current may be allowed to reach two amperes per pound; at the end of the charge it should not exceed three-quarters ampere per pound. The manufacturers recommend putting

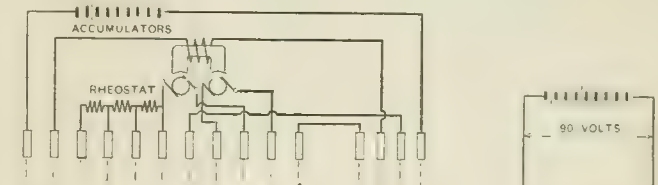

FIG. 6.—CONTROLLER DIAGRAM OF B. G. S. CIRCUITS. REVERSING CYLINDER INDICATED TO THE RIGHT. UPPER THREE POSITIONS ELECTRIC BRAKE.

the battery on a constant potential (100 volts for 44 cells) for seven hours. In this way the charging current diminishes automatically with the rise in counter e. m. f. of the cells, the charging being ended when the current reaches three-quarters of an ampere per pound.

The idea of charging from the motor while in motion on a down grade is at first sight a fascinating proposition, but practice does not quite bear it out. The chief value has been found in restoring the voltage by depolarizing the battery where it has become polarized by excessive discharge currents. The necessary mechanism for the connection adds greatly to the complication of the controller.

Under these circumstances the motor is intended to be used as a brake, doing work in the battery, and it is difficult, with such an arrangement, to avoid giving the battery a serious racking from time to time, due to excessive charging current resulting from a vigorous application of the brake. Of the three successful makers in the competition, one has eliminated the idea altogether; another, while retaining the apparatus for making the necessary connections, forbade his drivers to use it. The third made use of it frequently.

THE VEHICLES AT THE EXHIBITION.

The electric-cab competition was only a part of the exhibition for motor vehicles of all sorts, which, thanks to the public spirit of the members of the Automobile Club of France, is now a fixture in Paris, to be repeated every year. It would be a great thing for the industry in this country if something of the sort could be assured every year, say in Boston in connection with the Mechanics' Fair. Boston has been called the electrical city. It has many districts surounding it where the roads may be called good, and where the accompanying scenery is of the pleasantest. Why, then, should it not become the home of the electric automobile?

The carriages at the exhibit which for one reason or another did not compete will be taken up first.

First in order is the Doré carriage, noticeable as being one of the few retaining the old method of steering and of connecting the forward axle-tree to the carriage by a central king-bolt. This is also the driving axle, the motor being mounted in the forward part of the vehicle. To communicate rotation to the wheels, despite the motion permitted by the springs, the king-bolt (see Fig. 4) is made hollow and carries inside a rod which is made to turn with the king-bolt by a long key or feather, thus providing for the up and down motion. The lateral motion is taken care of by a universal joint in the rod which transmits the rotation to the crown gear of the differential by a bevel gear at its extremity. The whole is enclosed.

The forty-four cells are well hidden, their presence scarcely marring the outline of the vehicle at all, but they are inaccesible, a bad point. The cells remain always in series. The motor is series wound, its shaft meshing with a bevel gear on the king-bolt. The steering is controlled by a hand wheel, rod and pinion meshing, with a gear with internal teeth made fast to the frame of the axle-tree. The motor has three windings on the field and is controlled by three levers, one to open and close the circuit and introduce resistance, the second to short-circuit the field coil sections, and the third to reverse the current in the armature.

These operations occur in the order named as the carriage is started and brought up to speed. The lack of connection between the levers [illegible] a careless driver liable to make mistakes which would result in injury to motor or battery. This carriage was prevented from entering the contest by the burning of its battery jars, which were of celluloid.

The carriages exhibited by the Compagnie Française des Voitures Electromobiles are built on the interchangeable plan; the truck or frame is of steel and built to receive any kind of body. The speed reduction gears are noiseless and the differential mechanism is supported in boxes provided with an automatic oiling device. A Reynolds sprocket chain is used. The transmission machinery is supported on a hinged frame furnished with springs. Forty-four Faure-King cells carried in a double spring suspension supply the power; this battery is so arranged that it can be removed in three minutes. The motor is a Lundell with two commutators, an arrangement which furnishes a possible speed variation from 2½ to 11 miles per hour without changing the grouping of the cells, which

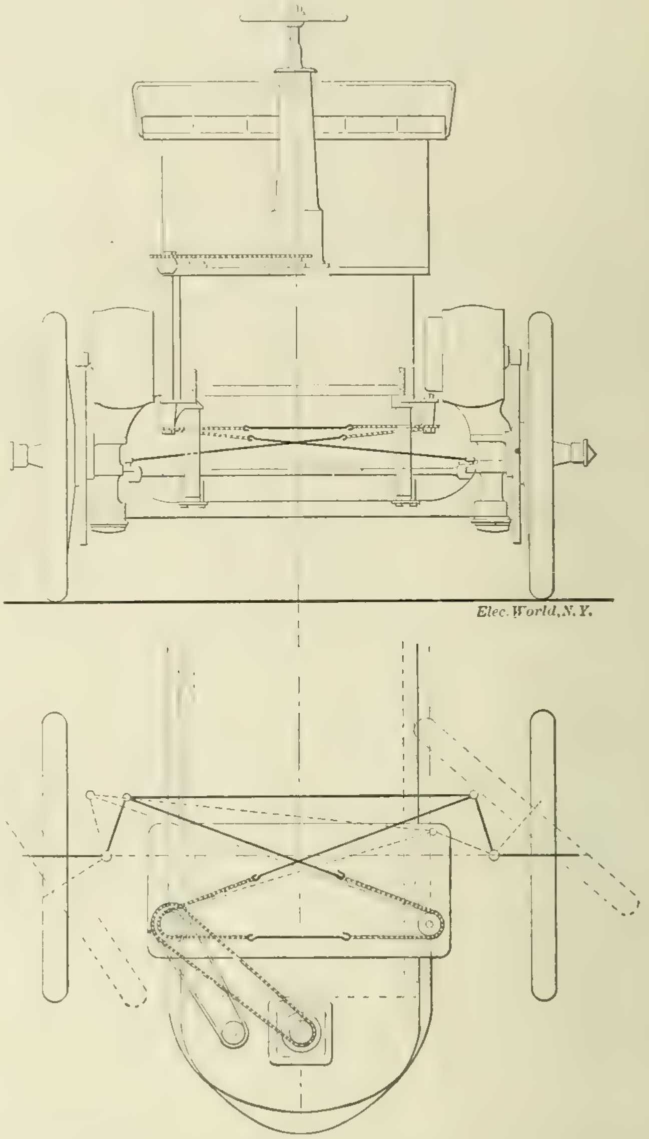
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Fig. 12a.—Steering Gear of Kriéger Vehicles, Showing Motors on Steering Pivots.

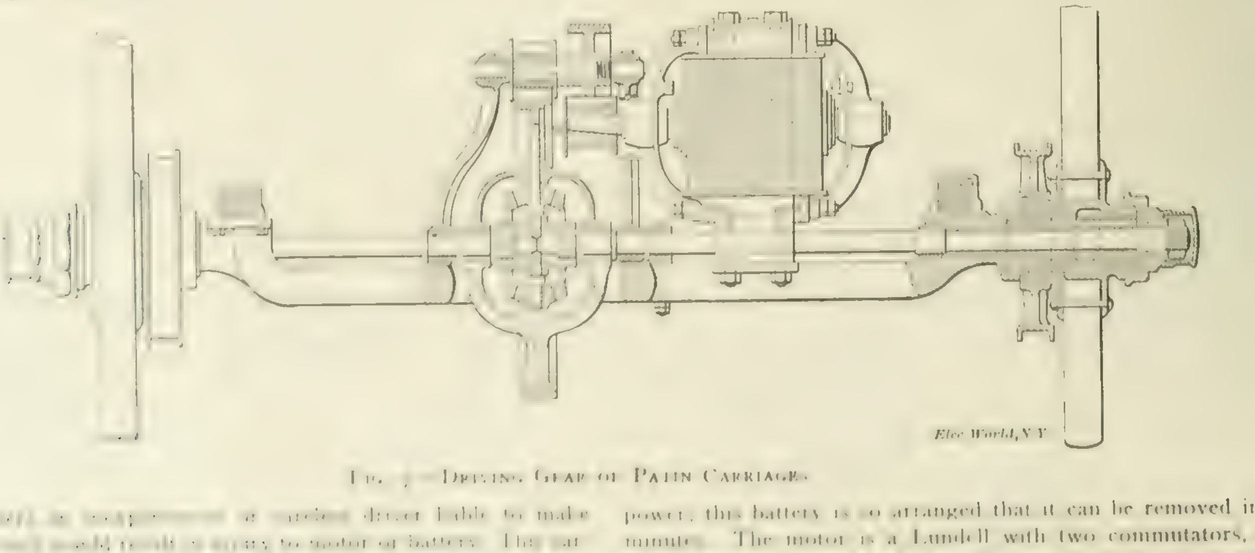
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Fig. [illegible].—Driving Gear of Patin Carriage.

are always in series, or without the use of resistances. The controller has four speeds ahead and one back, and two notches for the electric brake which puts the two motor commutators in series with each other and the resistance. The motor starts with everything in series and the subsequent speed variations are accomplished by cutting out the resistance, putting the commutators in parallel and, lastly, putting the field coils in parallel as the case requires. The forward axle-tree which steers is centrally pivoted and requires considerable force to turn it, and therefore the controlling wheel has to act through a worm gear, which makes the steering easy but slow.

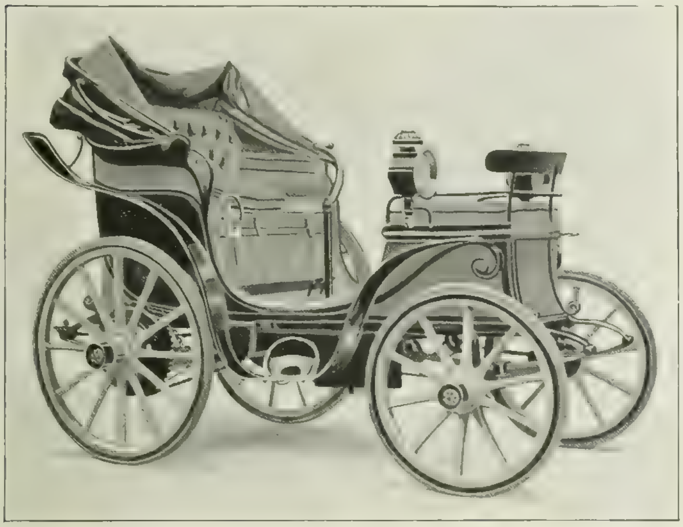


Fig. 5.—Victoria of Bouquet, Garcin & Schivre.

The Paris General Cab Company has itself entered the experimental field. Its carriages are on the interchangeable plan as regards trucks and bodies. The company is, however, building a hundred or more for use in Paris, which differ radically from those which it exhibited.

The Mildé-Mondos Company exhibited a cab for street traffic use. It is solidly built, weighing 4000 pounds. A system of rubber springs is used between the carriage and the truck to permit the use of solid rubber instead of pneumatic tires. The battery is a Bristol of the pasted type and has forty cells; it weighs 1300 pounds, which is 30 per cent. of the total weight. It has a specific capacity of 4.2 ampere hours per pound of cell. It will drive the carriage 30 miles at 8 miles per hour on one charge. The makers have used a battery of low specific capacity with the idea of giving it greater strength and staying power. The motor is a Postel, being rated at 2250 watts and 1800 r. p. m.; it has four poles and two field coils, a drum-wound armature and carbon brushes. It weighs 440 pounds with its case. The transmission presents no new features. The braking appliances include electric, band and shoe brakes. The brake pedal is linked with a switch which opens the circuit before the band acts. The steering gear is of the lever type, with independently pivoted wheels. The carriage is provided with wattmeter, ammeter and voltmeter. The voltage is kept constant and the speed variations are obtained by having field windings in sections and arranging them in different combinations.

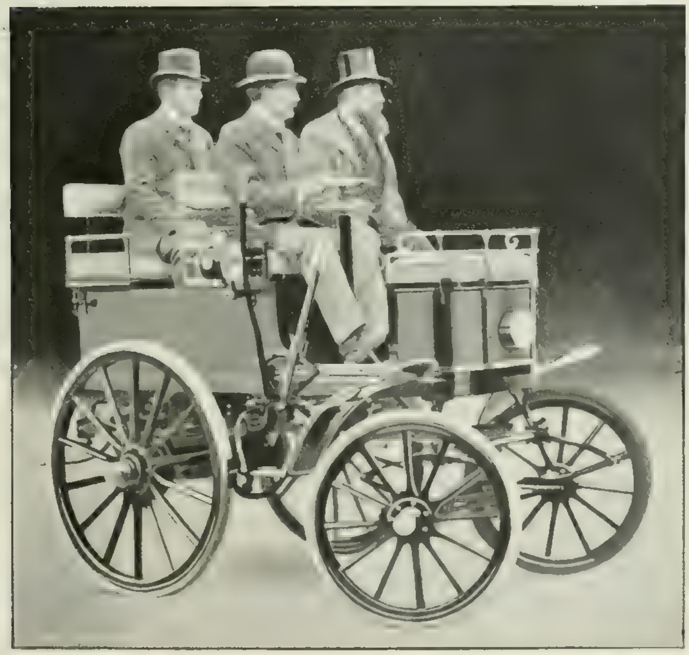


Fig. 9.—Patin Dog-cart.

The carriage exhibited by Bouquet, Garcin & Schivre, built on what is known as the B. G. S. system, is shown in Fig. 5, and is intended more especially for a private pleasure carriage. It has steel frames, is built on the interchangeable plan, and weighs 2200 pounds, while the battery weighs 770 pounds (about 32 per cent.), and is good for 60 to 90 miles, according to the kind of road. The cells are made by the makers of the carriage and have a capacity of 10 to 11 ampere hours per pound, at a rate of 1.3 amperes to 1.8 amperes per pound. The armature of the motor has two commutators and two windings on the same core. The number of turns in the two windings and consequently the counter e. m. fs. differ in the ratio of 5 to 3. By this means seven changes of speed are obtainable without altering the grouping of the cells or the number of turns of the field coils, the method of control being very much like the series-parallel system in use in street cars in this country.

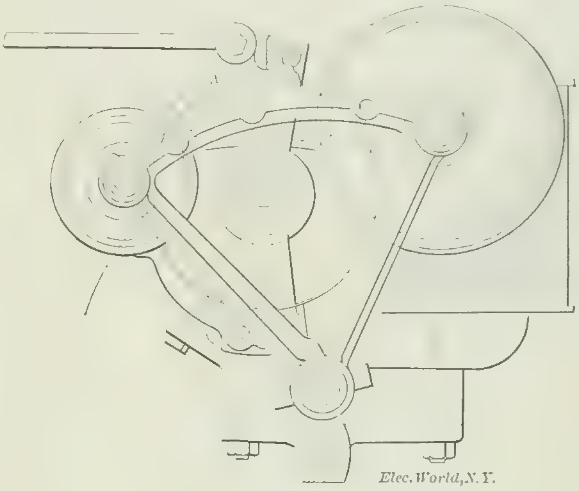


Fig. 8.—Changeable Gear of Patin Driving Train.

The motor is started (see Fig. 6) with the armature windings in series with themselves, the battery and the whole rheostat. There are three starting notches, all the resistance being cut out at the fourth notch, when the speed comes up to 4 miles per hour. The next speed is 6 miles per hour, and is obtained by cutting out the weaker armature winding. The sixth speed, 10 miles per hour, is obtained by substituting the stronger armature winding for the other. The maximum speed of 15 miles per hour is obtained by coupling the two armature windings in opposition to each other.

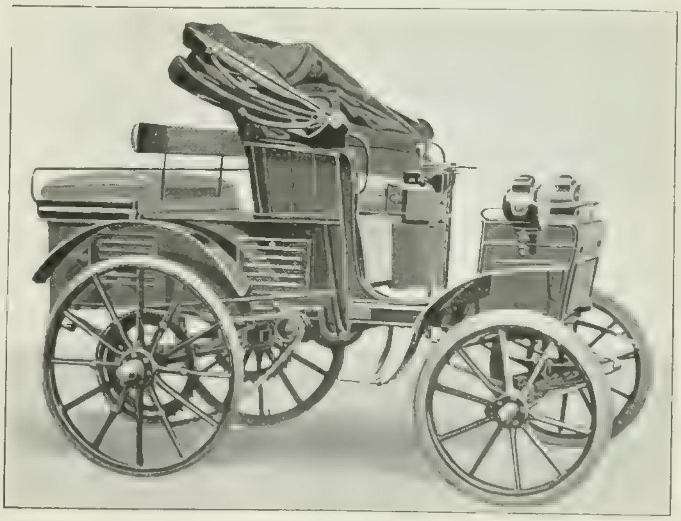


Fig. 10.—Jenatzy Dog-phaeton.

The motor is built for an average current of 15 to 20 amperes and at 12 miles per hour it makes 1500 r. p. m.; it is rated at 4 horse-power and weighs 88 pounds. The rise in temperature after five hours of service is 55° C., the electrical efficiency is 93 per cent., and the mechanical 87. Taking into account the transmission machinery the efficiency is 80 per cent., as measured at the wheels. The differential axle and the motor are accessible through a trap in the flooring and are made so as to be easily removable.

The latest form of controller has but one cylinder, which takes care of the reversing as well as its other functions. The one shown in Fig. 6 has two concentric but independent cylinders, the little one being for reversing. The steering is done with a lever, acting on the front wheels, which are connected to the front axle-tree by pivots. The electric brake is set by the controller, causing the motor to do work on one or two sections of the rheostat, or on short circuit, as the case requires. The vehicle carries an ammeter, a voltmeter and a wattmeter. The ammeter and voltmeter are in sight of the driver and are lit up at night. The wattmeter, together with the circuit-breaker, the fuses, and the charging and discharging switch, are all under the seat. The charge, as well as the discharge, is controlled by the controller.

The Compagnie Générale des Transports Automobiles exhibited a kind of dog-cart and a phaeton, in addition to the cab No. 13, which took part in the contest. They differed from it in having two

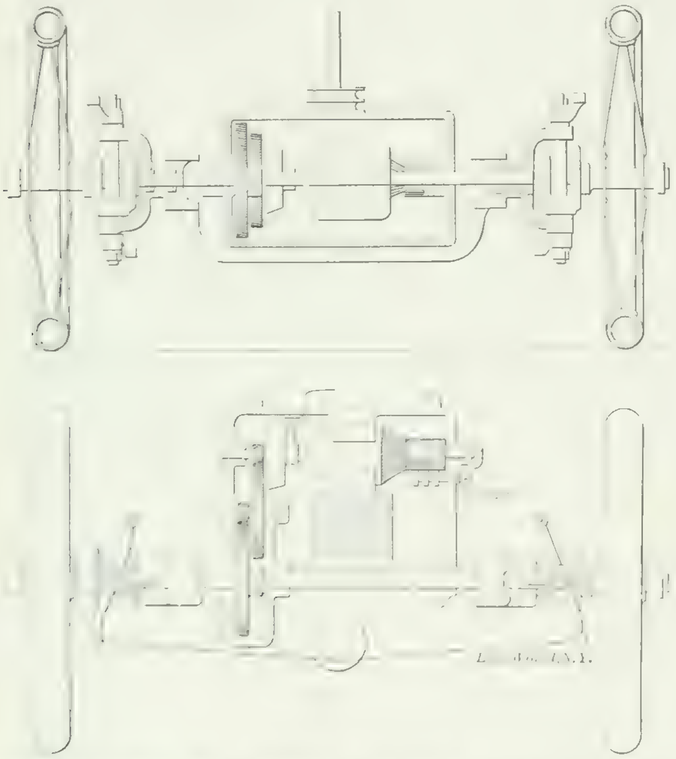


Fig. 12.—Driving and Steering Mechanism of Jeantaud Coupé, Showing Gearing, Also Steering Pivots.

[illegible] in leaving out the mechanical speed changer. The maximum speed obtainable is also greater, reaching [illegible] miles per hour.

[illegible]

[illegible] chanical speed changer are somewhat new. (See Figs 7 and 8.) [illegible] lengths, each [illegible] supported by a journal box just beside the differential gearing, and another at the point where it passes through the axle frame, this box being lined with bronze. A nut at each end secures the wheel hubs which are outside the frame to the extremity of the shaft. Each brake drum is made fast to the inner end of the wheel hub.

The motor shaft is supported by arms from the field poles, and carries a rimmed pulley concentric with which are three or four loose-fitting leather rings. (See Fig. 8.) Two other pulleys of different diameters carry gears and are mounted on an oscillating frame so that the gears are at all times in mesh with the main gear of the differential casing, while either of the pulleys themselves can be brought up hard against the leather rings on the motor pulley, being driven by the friction therewith.

This rather complicated arrangement makes it possible to change the speed-reduction ratio or to throw the load on the motor after the latter has attained full speed. In this way a sudden pull can be obtained of much greater intensity than the motor would otherwise be capable of. There is no danger of breaking gear teeth, as the gears never separate.

The motor is series wound and further speed variations are obtained by changing the number of field windings by the intervention of a controller. The usual band and shoe brakes are present, and the reverse connection is also used as a brake. A completed vehicle of this type is shown in Fig. 9.

Following are the descriptions of the automobiles which carried away the honors in the competition:

THE JENATZY PHAETON.

This vehicle, built by the Société Générale des Transports Automobiles, is intended to carry two passengers.

The wheel base is 6 feet 2¾ inches, and the wheel gauge 4 feet 9½ inches, built to this gauge to permit the vehicle to run on the car tracks. The wheels are of wood, with metallic hubs and spokes shaped rather differently from ordinary cab spokes.

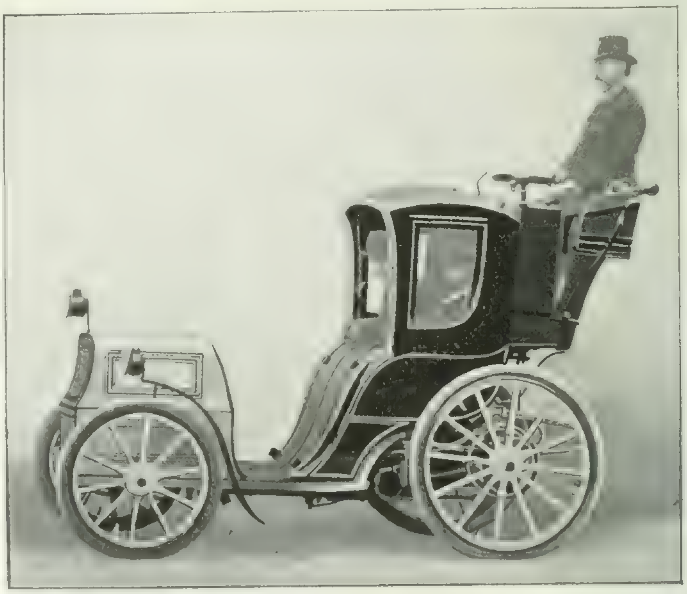


Fig. 11.—Cab Jeantaud, Side View.

The motor is of the open type, and to protect it from the dust is placed inside the carriage body, together with most of the machinery, only the ends of the differential shaft with the chain sprockets protruding beyond the walls of the body. The motor is series wound and is rated at 4 to 5 horse-power, with maximum attainable of 10 to 12 horse-power.

There are two speeds provided for in the controller, 6 and 12 kilometers (3.7 miles to 7.4 miles per hour). The battery is in two groups, placed in parallel at the lower speed and in series at the higher.

The sprockets, which are respectively of 6 and 36 teeth, are connected by a chain. There are two speeds provided for mechanically as follows: In line with the armature shaft and connected with it by a universal joint is placed a shaft carrying two loose pinions meshing with two gears keyed to the differential shaft. A clutch is placed between the two pinions so that either can be made to drive the differential shaft, thus varying the speed in the ratio of 1 to 1½. This permits a change from 3.7 to 5.5 miles per hour and 7.4 to 11 miles per hour.

Intermediate speeds are obtained by introducing resistances in the motor circuit. To make the controller as simple as possible all arrangements for restoring power to the battery on a down grade are left out.

The battery consists of two groups of 22 cells each, of the Fulmen make. Each group is in a separate box, one under the driver's seat and the other in a box at the back of the carriage. These receptacles may be opened by sliding up one of the panels.

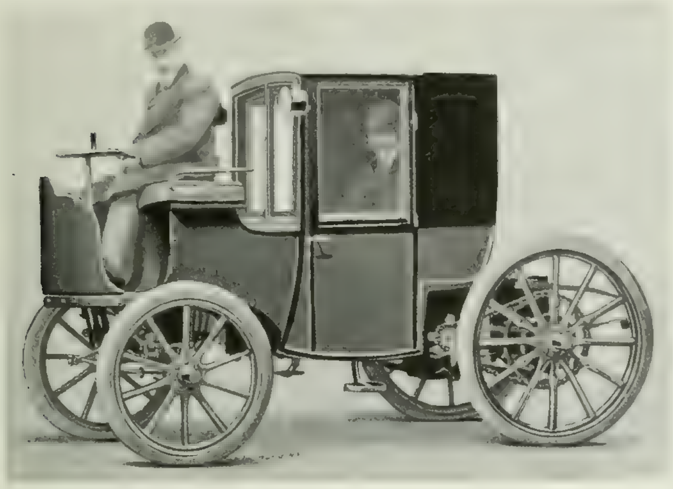


FIG. 13.—JEANTAUD COUPE.

The driver steers with a lever arm which acts on the forward wheels through a system of rods and hinges, turning the wheels about independent centres to which they are pivoted at the extremities of the forward axle-tree.

The brake pedal controls the band brakes acting on the differential axle. In addition to these a lever controls two shoe or spoon brakes, acting directly on the tires, and intended for use should the chain give way and render the others useless.

JEANTAUD CAB

This vehicle, shown in the initial illustration and in Fig. 11, was built by Jeantaud, the fashionable carriage builder, and intended for two passengers. It is listed at 14,000 francs ($2800). It is shaped something like a hansom cab, the place of the horse being taken by the accumulator case supported on the forward axle. The driver sits behind, as in horse-drawn cabs, and has ready to his hand the steering wheel, controller, a pedal controlling a starting switch and the electric brake, and a lever controlling two band brakes acting on hubs made fast to the wood spokes of the wheels.

The useful or live load is about 10 per cent. of the total and the accumulator load is 29 per cent. of the total. The wheels are of wood, with metallic hubs and pneumatic tires. The motor and the reduction gears are encased; only the extremities of the shaft carrying the chain gears protrude. The motor, rated at 3½ to 4 horsepower, is bipolar, and has shunt and series field coils. Speed-reduction gears and chains are used to connect the motor with the rear wheels. Forty-four Fulmen cells, weighing 880 pounds, enclosed in two boxes in the case on the forward truck, form the battery. The controller will give four speeds, 4.3, 7, 9 and 11 miles per hour. Intermediate speeds can be provided by introducing resistance in the circuit with the electric brake pedal.

The steering is done by a hand wheel which turns a standard, the motion being communicated to the front wheels through rods and swivels. The axles of these wheels are pivoted at the extremities of the forward axle-tree. One turn of the hand wheel will deflect the steering wheels through an angle of 35° from their normal position, this being the limit. The vehicle is provided with band brakes, shoe brakes and an arrangement whereby the motor can be used as a brake.

Another Jeantaud vehicle drives through the steering pivots by means of bevel gears, shown clearly in Fig. 12. The vehicle itself is shown in Fig. 13.

THE KRIEGER CARRIAGES.

The carriages of this maker are arranged with bodies separate from the frames, so that it is possible to alter the character of the carriage without changing the frame or truck.

The coupé (see Fig. 14) and victoria are arranged for three or four passengers without baggage, and are sold for 12,000 francs.

The driver's seat is over the front axle-tree. The driver is required to look after the steering wheel, the band brake pedal, and the controller which controls the speed and the electric brake. An ammeter and voltmeter, both dead-beat instruments, are placed on the top of the controller. The forty-four accumulators of the Fulmen type are in two cases, one under the driver's seat and the other behind the carriage. They can be got at by taking out a movable side panel.

Each carriage is supplied with two motors driving the front wheels, weighing 143 pounds each. The gears are single-reduction, the ratio being 16½ to 1. The motors are mounted on the steering pivots at the ends of the axle-tree (see Fig. 12a) and turn with the wheels when the direction of the vehicle is to be changed. The motors have four poles, one pair being series wound, while the other is shunt wound.

The large gear is mounted directly on the hub of the wheel instead of on the spokes, because in this way it is easier to make the gear run true, which obviates the necessity of using a flexible joint between the armature shaft and the pinion. It seems possible that the position of the motor would lead to its injury from the vibration of the wheel on rough pavement, but the experience gained in the competition proved that the pneumatic tire was all-sufficient for its protection.

The motor armatures are ordinarily connected in series and when so connected the same torque is given to both, even at different speeds, when rounding curves. This arrangement obviates the necessity of a differential gear, which is indispensable to motor vehicles driven from a single motor. When the higher speeds are reached, where the motors are connected in parallel, this automatic balancing of the torque is lost, and the driver is under the necessity of correcting with the steering gear any tendency shown by the vehicle to deviate from a straight line.

The controller is arranged for the following speeds: First Speed—1½ to 3⅔ miles per hour. Two groups of the battery in parallel and all four field coils in operation. Armature speed, 600. Second Speed—5 to 6 miles per hour. Battery as before. Shunt fields cut out. Armature speed, 900. Third Speed—7 to 7½ miles per hour. All the cells of the battery in series and all four field coils in operation. Armature speed, 1200. Fourth Speed—10 to 10½ miles per hour. All the cells of the battery in series shunt field cut out. Armature speed, 1600. Fifth Speed—12½ miles per hour. The motors are now connected in parallel and the full field is in operation. The cells remain all in series. Armature speed, 2050. Sixth Speed—15½ miles per hour. This speed corresponds to an armature speed of 2550, and is obtained by cutting out the shunt fields.

On a down grade the motor is generally used as a generator feeding back to the battery. If the hill is long enough there will be a quite noticeable recuperation of the battery. As the band brake does not act when the carriage is running backward, it is necessary to rely on the motor to check any inopportune tendency to go down hill backward. This is done by keeping the controller moving alternately from rest to Notch 1.

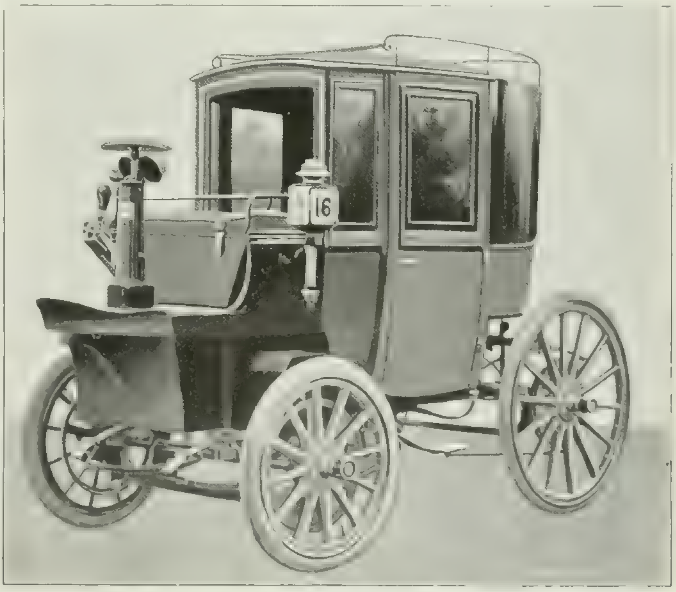
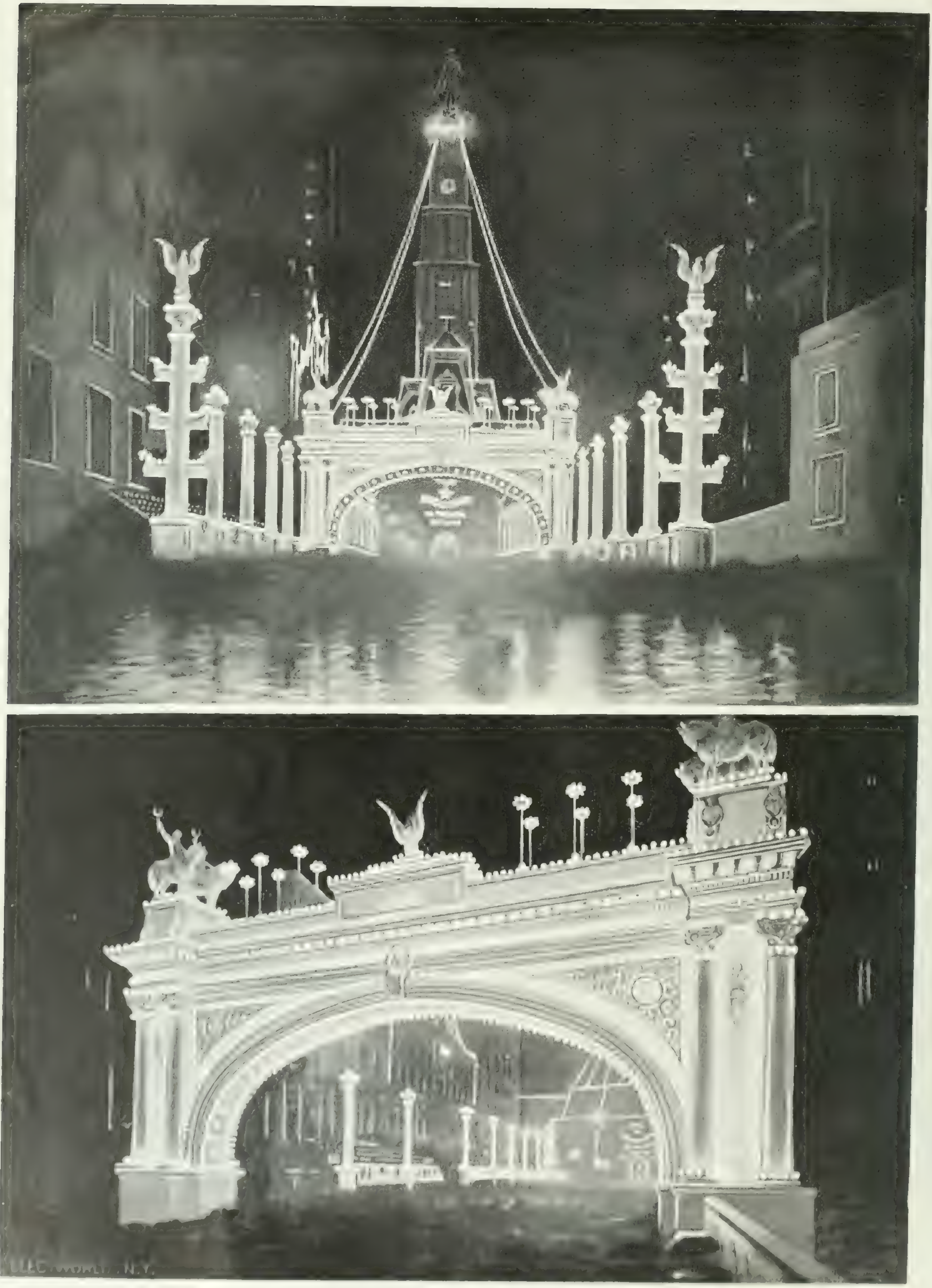


FIG. 14.—KRIEGER COUPE.

(To be Continued.)



The Court of Honor and its Arch at the Philadelphia Peace Jubilee

The Peace Jubilee in Philadelphia.

THE peace-loving citizens of Philadelphia devoted three days of last week to the expression, in the form of a "peace jubilee," of their joy over the termination of hostilities between the United States and Spain. Philadelphians are sometimes accused of being somewhat slow, but a stranger coming to that city on this occasion with that idea in his mind would certainly find it difficult to reconcile the reputation with the observed facts. If the Quaker spirit exercises any control over the actions of Philadelphians it is evidently overcome when, in the course of human events, it becomes necessary for the citizens to give expression to their love of country. The awakening of their patriotism on this occasion was as genuine as it was at the period 122 years ago which culminated in the declaration of independence, and they may well be proud of the success they attained in their latest effort.

As usual on such occasions, electric light for night illuminations constituted a very important feature of the celebration. By far the most elaborate effect was that at the Court of Honor on Broad Street. This extended for two blocks, and was a masterpiece of design and of exquisite artistic taste. Next to the Court of Honor in extent came the City Hall illumination. The 500-foot tower of this building afforded a means, which was readily utilized, of producing some extraordinary illuminating effects. The Court of Honor and the City Hall were the only illuminations in which the city itself was concerned. There were many private displays, however, that were very appropriate and artistically designed.

THE COURT OF HONOR.

The two blocks on Broad Street, between Walnut and Chestnut, were given up to a special feature, which was the centre of attraction and by all odds the most pretentious of all illuminations on this particular occasion. On it the greatest efforts of the city authorities were centralized, and it was here, directly opposite the building in which it has been stated that Presidents are made, that President McKinley and his cabinet, on Thursday, reviewed the great military parade from a grand-stand. This particular locality was very appropriately designated the "Court of Honor."

In design the Court of Honor was elegant and artistic in the extreme. Equidistant on each side of Broad Street, between Walnut and Sansom, were erected six white columns. The two end columns, at the corner of Walnut Street, were more conspicuous than their mates, both in size and design. They were somewhat taller, and from their opposite sides projected six ship-beaks, three on each side of the column. At the tops of the capitals of the columns were spheres, and on the tops of these stood large figures of the war bird, the American eagle, with spread wings, as if having just alighted for rest after leading the American forces to victory. The inner columns were plain, round shafts set on rectangular pedestals and surmounted with the graceful capital of the Corinthian order of architecture. The plainness of the shafts was relieved somewhat by two lions' heads placed diametrically opposite to each other on the surface a little below the base of the capitals. The framework of all the columns was of wood and the finish of plaster. The capital of each column was surmounted by a white sphere.

Next to the two innermost columns on this block was erected a most beautifully designed arch, which spanned Broad Street from sidewalk to sidewalk. The arch was 80 feet long and 45 feet high, the crown being 35 feet from the street and the swing of the arch about 12 feet. Its frame was constructed of wood. This was covered with plaster previously made up into sections from the plans. The various decorative pieces and figures were constructed and erected in a similar manner.

On the other side of the arch—north—were disposed sixteen columns precisely like those on the south side, and already alluded to. There were, therefore, twenty-eight columns in all, with the arch in a position midway along the line. The Court of Honor was illuminated by 4000 16-cp incandescent lamps, 2500 of which were used on the arch and 1500 on the twenty-four columns. In wiring the arch the feeders were carried up through the interior of each base, the branch circuits being brought out to the outside just at the spring of the arch, and laid down in place on the surface, underwriters' wire being used for this work. The seventy separate circuits were measured off and made up in the loft of a near-by building, the lamp sockets being at the same time properly spaced off and connected. All that was necessary then was to lay the circuits in their proper places on the arch. The longest of these ready-made circuits was 310 feet.

The feeders were carried from the underground mains to the columns in iron pipes laid along the gutters on each side of Broad Street, and the branch circuit for each column was carried up the shaft on the outside and encased in loricated tubing to the top of the pedestal. Each of the inner columns was illuminated by fifty-five 16-cp lamps with clear glass bulbs, each of the four large or end columns containing ninety similar lamps.

As to the arch itself, the distribution of the lamps was well designed and the bright points of light, with their reflections gradually receding to dark areas upon the arch structure, gave a most beautiful and charming effect to the beholder. The scene was truly fairylike, and the photo-engraver's art is weak in results in its efforts to portray such a picture as the eye sees it. There is only one way to appreciate the beauty of such a scene, and that is to see it. Since, however, few of the readers of this account were privileged to witness this fairy-like scene, an endeavor is made on page 476 to present views which will in a measure convey some idea of the beautiful effects produced by the night illumination of the Court of Honor, which was wired on the two-wire system, the feeders consisting of No. 0000 and 0 wire on one side and 00 and 0000 on the other. Besides the three main switches at the distributing points, each branch circuit was provided with a cut-out. There was a cut-out on each of the inner columns, and on each of the end columns two cut-outs were provided. Under the curve of the arch bare wire was used, while insulated wire was used on the rest of the work. The wiring here, as well as that of the sign on the south front of the City Hall, was done by the Sawyer Electrical Company, of Philadelphia, under the supervision of its chief engineer, Mr. W. Bartine. The work was one of considerable magnitude, and required the constant labor of a large force of wiremen for three or four days and nights. The result reflects great credit upon the resources of the Sawyer Company.

The current for the illumination was supplied by the Edison Electric Light Company from its Sansom Street plant for five hours on each of the three nights of the celebration. The Edison Company also furnished the lamps used. As the extra load upon the Edison station came after the peak, it was not necessary to make any extraordinary arrangements to provide the necessary power beyond, possibly, the service of an extra dynamo tender.

The committee on illumination for the peace jubilee consisted of Mr. Frank Miles Day, Mr. J. M. Huston, the architect of the arch, and Mr. G. H. S. Young, engineer, and much credit is due these gentlemen for the excellent manner in which they accomplished the peculiarly trying duties they were called upon to perform.

The Importation of Foreign Dynamos.

It may surprise American electrical engineers who have been congratulating themselves of late on the use of American electrical machinery in foreign lands to find that three large direct-coupled alternators have been built by Messrs. Brown, Boveri & Co., Baden, Switzerland, for an American gold mining company. The machines are of the fly-wheel field-magnet type,* mounted on the shafts of three cross-compound horizontal Allis-Corliss engines.

Sine Waves on Ocean Cables.

The Crehore and Squier synchronograph has recently been tested on the submarine cable of the Commercial Cable Company running between New York city and Canso, Newfoundland. A simple sinusoidal wave of impressed electromotive force is expected to give higher speed on cables with the same dielectric strain as it does on overhead lines with the same impressed electromotive force.

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*See THE ELECTRICAL WORLD, January 8, 1898, page 60.

DIGEST OF CURRENT ELECTRICAL LITERATURE AMERICAN AND FOREIGN

By Carl Hering.

Dynamos, Motors and Transformers.

MODERN TRANSFORMERS. Rhodes. Lond. "Elec. Rev.," Oct. 14; reprinted in "El'ty" (N. Y.), Oct. 26.—A short article pointing out the importance of the proper choice of transformers, and the great necessity of keeping the regulation under full control. Some American cases are cited showing the advantage of replacing small by large transformers. Attention is called to the fact that so many alternating-current stations fail to pay a dividend, and this is thought to be due to the fact that the management of alternating currents is not sufficiently well understood and their application is not manipulated with sufficient skill; he emphasizes the necessity of a sound theoretical training in this branch, as well as a practical knowledge. The question of regulation is most important of all; he claims that the alternating current is the proper one to use if it is properly managed; it is an admission of incompetency to allow such a station to be a failure.

CARBON BRUSHHOLDERS.—Lond. "Elec. Rev.," Oct. 14.—After referring to portions of the article in THE ELECTRICAL WORLD, July 23, some figures are given for carbons made by "Le Carbone" Company. For the "special quality" of their brush the pressure on the commutator should be 100 grammes per sq. cm. of contact surface, while for their "electrographitic" carbon it should be 50 grammes; the special quality is a fine, close-grained carbon, which will carry currents up to 10 amperes per sq. cm. of contact, while the electro-graphitic carbon has been transformed into graphite by submitting it to the temperature of the electric arc; the conductivity is then four to five times greater than of the preceding brush, and it will carry currents at the rate of 20 amperes per sq. cm. A table gives the prices of these brushes of various sizes. Another table gives the prices of the Partridge self-lubricating brush, which is extensively used on electric railways in the United States.

ALTERNATING-CURRENT MOTORS. Guilbert. "L'Eclairage Elec.," Oct. 8.—Brief, illustrated descriptions of various systems taken apparently from patent specifications, with special reference to the methods of starting them.

Lights and Lighting.

ARC LAMP CARBONS.—"L'Elec.," Oct. 8.—The results of some measurements made of the resistance of the Henrion carbons, five of which were homogeneous and five cored.

ELECTRICITY FOR LIGHTING.—"Elec. Eng.," Oct. 14.—Three short essays on the practical advantages of electricity for lighting purposes.

THEATRE LIGHTING.—"El'ty," Oct. 26.—A reprint of the article noticed in the "Digest" Oct. 22.

ECKMUEHL LIGHTHOUSE.—"El'ty," Oct. 26.—An illustrated description of this large French lighthouse, taken from foreign articles recently noticed in the "Digest."

Power.

KERKA WATER-POWER PLANT. Giovanenilli. "L'Eclairage Elec.," Oct. 8.—In this continuation of the description of the [illegible] the electrical features are described. Multiphase alternators of 1100 kw at 8000 volts are proposed; the [illegible] distinguished [illegible]

MINING PLANT. Holzner. Lond. "Elec.," Oct. 14.—An abstract of a translation of his article from an Austrian journal, describing the electrical power transmission plant in the Ziegler shaft; [illegible]

ELECTRICAL REFRIGERATION. Fay. "Elec. Eng.," Oct. [illegible] "Digest" Oct. [illegible] [illegible] not seem to be included (presumably this means for producing 1 [illegible]

[illegible]

Traction.

SURFACE CONTACT SYSTEM. Thompson and Walker. [illegible] ishes the complication of interconnections and the cars may be run in either direction; the loss of leakage through the shunt coils is therefore quite unimportant; the coils take only 3 per cent. of the average current of the car. The true leakage at the distant end at the surface of the ground in dry weather is too small to be measured; even in wet weather it is quite small. In reply to his preference to the Diatto system they claim that a very large number of ampere turns of exciting current are continually required in that system for very weak mechanical forces; in their system the mechanical forces to operate the switch are twenty times as great as in the Diatto system, while the number of ampere turns required is less than one-fifth.

GLASGOW.—Lond. "Elec. Eng.," Oct. 14.—A brief reference to the recent opening of this electric railway. The description is chiefly introductory in character; illustrations are given of the new type of cars, the entrances to which are in the middle.

COST OF OPERATING ELECTRIC RAILWAYS.—"L'Elec.," Oct. 8.—An abstract of an article on the Koppel system of transportable electric railways, with tables of the calculated costs.

TRAMWAY OVER CHILKOOT PASS. Burkholder. "Jour. of El'ty," Sept.—An illustrated description of the construction of the rope tramway over that pass leading to the Klondike. It consists of a traction cable on which run two buckets like coal conveyors and pulled by means of a cable, which latter is drawn by a 15-hp two-phase induction motor, the current for which is generated at a distant station. It is used for freight only.

LONDON CENTRAL RAILWAY. Hall. "Elec. Rev.," Oct. 26.—A brief description of a visit to this plant, which is under construction.

Installations, Systems and Appliances.

SUBDIVIDING CENTRAL STATIONS.—"Elek. Zeit.," Oct. 13.—An editorial discussing the question of whether a city should be supplied from one or several central stations, the latter having been urged in order to guard against cases of fire in the station, such as recently occurred at Chevres. It is thought that the claims for using several stations have been exaggerated, and that to duplicate a station or divide it into two independent ones would increase the cost of the current so much that the advantages of the cheaper power would be lost. There is no more reason to duplicate the lighting stations than the water, gas, telephone and other similar works, on which the city is dependent. When a station becomes very large, however, or when a water-power station has a steam reserve, certain precautions to divide it by fireproof partitions into parts are recommended.

VIENNA.—"L'Ind. Elec.," Oct. 10.—An abstract of the statistics noticed in the "Digest" Oct. 8.

Electro-Physics and Magnetism.

CONTINUOUS CURRENT IN THE ALTERNATING ARC. Eichberg and Kallir. A reprint under separate cover of a paper read before the Imperial Academy of Sciences in Vienna, Vol. 107, May.—A description of researches made with the apparent continuous currents produced in the alternating arc between different kinds of electrodes. If an alternating arc is established between a metal rod and a carbon, then a tangent galvanometer in the arc circuit shows a continuous current in the arc from the metal to the carbon, and a voltmeter at the arc shows a continuous voltage in the direction of carbon-metal. This phenomenon occurs when there is a drop of molten metal on the metallic electrode and when the arc burns quietly; cored carbons were used; iron, aluminum, copper and nickelline were used as electrodes, but the observations were difficult with the aluminum. Measurements of all the factors were carefully made, and the results are given in tables; for all the different metals the continuous current and voltage have approximately the same values. It has been shown that in a continuous current arc there will be a lower voltage when the current is from the metal to the carbon than when in the opposite direction, and that the voltages are different for the different metals. The current and voltage curves were also measured in the case of the alternating arc, the results being given in curves, which show that the formation of the arc from carbon to iron involves the production of a [illegible] but whether it is a true resistance or a counter e. m. f. was not apparent; this explains the almost complete interruption of the current in the direction of the carbon to the iron, [illegible] current but allows the other to pass. The phase shifting produced is quite appreciable with a machine of high self induction. The fact that the arc from the carbon to the iron was not formed was shown photographically, the illustrations being reproduced for six phases, differing by 60°. The curves show that [illegible] affected by the alternat[illegible] and the phase [illegible]. The almost complete inter[illegible] the direction carbon-iron produces remarkable phenom[illegible] connected in series or in parallel, the latter [illegible] experiments with an exploring carbon introduced in the arc. An alternating arc between a metal and carbon therefore acts like a valve, allowing a current in only one direction to pass; they connected a battery of accumulators with such an arc and found that about the best efficiency of conversion of the alternating into direct current was 30 per cent. They then made tests of the arc between carbons of various kinds and positions, and found direct currents; when the upper was cored and the lower homogeneous or the reverse, or when they were horizontal, a continuous current was produced, the largest when the cored carbon was the upper; in all three cases the continuous current was from the cored to the homogeneous carbon, the latter being positive to the former; some numerical results of the observations are given. These direct currents seem to be the resultants of two continuous currents, one dependent on the position and the other on the constitution of the carbons.

ALTERNATING CURRENT CALCULATIONS. Lyle. Lond. "Elec.," Oct. 14.—The first part of a series of articles in which he endeavors to deduce a theory of currents produced by harmonical varying e. m. fs. in branched and mutually inducing circuits, to something of the simplicity of the theory of steady currents in branch conductors. He assumes a knowledge of the method of representing by means of a diagram the relations between the amplitudes and the phases of such e. m. fs. and currents in a connected system of conductors; he also assumes a knowledge of the principle of the composition of vectors in a plane. He shows how to deduce the modified forms of Kirchhoff's laws that apply to a network with resistance, self-inductance and capacity; the form of the modified laws is exactly the same as that of the usual and better known laws. He applies his method to the Wheatstone bridge and a transformer with a moderate amount of hysteresis, which latter he reduces to practically the same form of solution as the simple case of a transformer in which hysteresis is neglected; he also solves, in a few lines, the problem of determining the winding and constants of the conductor for the alternate poles of the stator of a rotary field motor when the remaining poles are wound with a continuous conductor, which, in parallel with the other, will split the current to produce a rotating field. His analysis is applicable to a variety of problems. He introduces letters to symbolize certain definite portions. Editorially the method is said to be a distinct advance on our previous means of attacking these important problems.

DETECTORS OF ELECTRIC WAVES. Pochettino. "L'Elettricista," Sept.; abstracted in "L'Ind. Elec.," Oct. 10.—A classification of all the known processes for detecting electric waves; each of them is separately discussed; he finds that there are twenty-one, which are briefly as follows, the specific processes being numbered in succession: Among the spark detectors there are those which are due to the luminous effects; at the ordinary pressure, the Hertz resonator (1) and the Righi mirror (2); at low pressure, the Geissler tube (3). Chemical effects: In an explosive medium (4), with sensitive iodide of potassium paper (5). Ionization of air: At the ordinary pressure, the battery and bell (6), the dry cell and electroscope (7), the condenser and telephone (8); at low pressure, the Zehnder tube with accumulators (9), the Zehnder tube with dry cell and electroscope (10), the Righi tube (11). Detectors without sparks: Physiological effects (12), ponderomotive effects, electrostatic (13), electrodynamic (14), magnetic effects (15), thermic effects, dilatometer (16), bolometer (17), thermo-electric pile (18), diminution of the resistance of contact (coherers, etc.), metallic contact (19), "reseau" (20), tubes of filings (21).

ELECTRO-MAGNETIC WAVES. Turpain. "L'Eclairage Elec.," Oct. 8.—A long abstract of several of his papers from the Transactions of the Bordeaux Society of Physical and Natural Sciences. In the first he reviews the various processes of observing electrical resonance and describes another discovered by him. The second is on the Hertz resonator, it being an application of the above mentioned process for studying the field produced by an exciter and two parallel wires. This is followed by a discussion of this system by Duhem. The next is on the investigation of the field produced by a single wire.

NEW ELECTRO-THERMAL RELATION. Wiedeburg. "Wied. Ann.," No. 9; abstracted briefly in Lond. "Elec.," Oct. 7.—He discovered a new relation between the electrical and the thermal properties of metals; the metals can be arranged according to their emissivities in a series which corresponds to their thermal and electrical resistivities—that is, the higher the specific resistance the greater is the power of radiating heat; the law is only approximate.

TWO PHYSICAL HYPOTHESES. Juppont. "L'Ind. Elec.," Oct. 10.—A short article in which he advances two hypotheses, the object of which is to connect more intimately work, kinetic energy, heat, the law of conservation of energy and the law of the inverse square of the distance; the deductions are theoretical, from the equations of the dimensions. The first hypothesis is that temperatures and the square of the velocity are homogeneous quantities—that is, the temperature of a body is proportional or equivalent to the square of the velocity of its molecules. The second hypothesis is deduced from the comparison of the static and dynamic equations of force, and is that the square of the time of the revolution of a gaseous molecule is inversely proportional to the density of the gas; or the square of the velocity is equivalent to a potential; the temperature of a body thus represents the relative potentials of its molecules.

DISSIPATION OF INCANDESCENT PLATINUM WIRE.—"L'Ind. Elec.," Oct. 10.—When a platinum wire is heated to incandescence in a vacuum bulb, particles of the platinum are projected on the walls of the bulb, forming a sort of mirror; an analogous phenomenon occurs with the carbon filaments of incandescent lamps. Stewart investigated this phenomenon and found that at atmospheric pressure this dissipation is less as the incandescence is prolonged; the humidity of the air has no action on the phenomena; the dissipation diminishes with the pressure; for platinum it is reduced to two-thirds between the atmospheric pressure and 1.25 mm; in nitrogen and hydrogen it is insignificant, but in oxygen it is much greater; it is thus shown that oxygen is the chief cause. If this is also the cause for the action of carbon it would indicate that in exhausting the lamp bulbs an inert gas should be introduced, which, in being pumped out, will carry off the last traces of oxygen.

APPLICATIONS OF ELECTRO-MAGNETIC SCREENS. Du Bois. "L'Eclairage Elec.," Oct. 8 and 15.—A long French translation in abstract of his paper which was noticed in the "Digest" July 9.

GEOMETRIC THEORY OF THE MARINE COMPASS. Ravier. "L'Ind. Elec.," Oct. 10.—An abstract of a French Academy paper.

ELECTRICAL PROPERTIES OF ARC VAPORS. Merritt and Stewart. "Phys. Rev.," Sept.—Oct.—A long article describing experiments which were undertaken to study in detail the conducting power possessed by the vapors from the electric arc between carbons; the difference between these vapors and those ionized by X-rays are compared. The chief conclusion is that these vapors possess the power of discharging electrified bodies, and that in general the properties of these vapors are similar to those of gases which have been acted on by X-rays or the gases from a flame.

TERRESTRIAL MAGNETISM.—"Terres. Mag.," Sept.—Reprints in the original languages of the papers presented at the recent International Conference on Terrestrial Magnetism and Atmospheric Electricity, other reprints or abstracts of which have already been noticed in the "Digest." The same issue also contains a communication by Abbe on Eschenhagen's elementary magnetic waves, with a reply from the latter.

Electro-Chemistry and Batteries.

COPPER-DEPOSITING PROCESS. Kershaw. Lond. "Elec. Rev.," Oct. 14.—A brief, illustrated description of the plant at Widnes, England, where the Dumoulin process is used for making copper tubes and sheets. The copper is deposited on a revolving mandril like in the Elmore process, from which it differs merely in the method of obtaining smooth, dense deposits with currents of high densities; in the Elmore process agate burnishers were used, but in the present one strips of sheepskin are held over the top of the revolving drum so as to prevent any roughness in the deposit. Formerly the plant was used only for making sheets, but now tubes are also made. The solution contains about 7 per cent. sulphuric acid and 40 per cent. of cupric sulphate; the electrolyte is maintained in violent agitation by the revolution of the mandril, which is a hollow cylinder of copper 16 inches in diameter; the mandrils are horizontal, and only the lower half is immersed; the continual rubbing of the sheepskin keeps the deposit smooth; the anodes are thick copper plates; the mandril is revolved at a high speed, thus keeping the electrolyte in rapid circulation. Normally it requires about ten hours to deposit 44 pounds of copper, and the tube thus formed on the mandril weighs about 14 ounces to the square foot; the current density is between 35 and 40 amperes per square foot of cathode area, whereas 20 amperes is the maximum now obtained in electrolytic refineries; the output is greatly increased by the use of rotating cathodes; the voltage required is 1.6 per vat. The tube formed by the deposit on the large mandril is then slit longitudinally and rolled into a plate; the stripping, when it is desired to keep it a tube, will be done by means of hydraulic pressure. The plant, at its full capacity, can produce sixty sheets per day. It is essential to filter and cool the electrolyte after each passage through the vats.

PRIMARY BATTERY. O'Keenan. "L'Ind. Elec.," Oct. 10.—An illustrated description of his new primary battery, the positive plates of which are recharged by the air; the cost of the energy is said to be less than for any other primary battery. The positive plates are made of spongy lead like the negatives of a lead accumulator; when exposed to the air these are oxidized, and if then placed in dilute sulphuric acid a sulphate of lead is formed, after which the plate is ready for use. It is then placed in a vessel containing water with some sulphate of zinc, the other pole being a zinc plate; the sulphate of lead plate contains the necessary acid for the electrolytic action in the form of inert sulphate of lead; there will be no action on open circuit, but when the circuit is closed the sulphate of lead will be reduced to metallic lead and the zinc will be dissolved at the rate of 1.22 grams per ampere hour per cell. In constancy this battery is like the Daniell cell, the reactions of which are almost identical; the two chief qualities of the Leclanché and the Daniell cells are therefore united in this (except the high voltage of the former). When the lead plate is discharged it is recharged by exposing it to the air and then sulphating it in the acid; instead of exposing it to the air it may be left standing in rather concentrated acid. Occasionally some of the liquid will have to be drawn off from the bottom of the batteries and fresh water added. The zinc sulphate which is formed is an excellent disinfectant and may be used as such. A capacity of 20 to 30 ampere hours per kg of lead is obtained; it is even greater with frames of aluminum; several discharge curves are given; for a weight of the lead plate of 7 kg the following was obtained: e. m. f., 0.5 volt; available difference of potential, 0.5; current, 6 amperes; capacity, 187 ampere hours or 91 hectowatt hours, 26.7 ampere hours per kg and 13 watt hours per kg. The retaining cells are made of tinned iron in the form of rectangular boxes; these are protected by the device of connecting the zinc plate with them, the action being that, owing to the couple formed, the zinc protects the tinned iron, while at the same time it is claimed that the zinc is not consumed (if, however, a local current actually flows it is evident that the zinc must be consumed in proportion); such retaining cells are light, durable and cheap. In conclusion an illustrated description is given of the practical form of such a battery. With a weight of 7.5 kg of lead plates the internal resistance is about 0.0025 ohm; the normal discharge rate is up to 10 amperes with a useful voltage of 0.5; at 60 amperes it is 0.4, but there is no deterioration of the plates, although the efficiency is not so good. He calculates the cost of operation; for an output of 4.8 hectowatt hours the cost is at the rate of about 53.2 cents per kw hour on the basis of a useful voltage of 0.48; allowing 10 per cent. for the fragments of unconsumed zinc brings the cost up to about 60 cents, which is claimed has never been reached by any other primary battery.

MARQUAND ACCUMULATOR.—Lond. "Elec.," Oct. 14.—A brief description of this accumulator, which is being introduced in England. The plate is a sort of compromise between the Planté and the Faure plate, the advantages of both being claimed to be combined. A ribbed but unperforated plate is cast in lead and then packed in sulphur, and subjected to heat up to the melting point of lead, at which temperature it is kept for about an hour. The surface is thus converted into a sulphide, which is then formed into spongy lead in an electrolytic bath of dilute sulphuric acid; the positive plates are formed by reversing the negatives. The parts of the plate which are not to be formed are protected from the action of the sulphur. It is claimed that under the conditions which promote sulphating in the ordinary plates the initial presence of the sulphite in this plate encourages the formation of an easily reducible sulphide in preference to the irreducible sulphate. A brief reference is made to a report by Thompson on tests of these cells. The plates weigh 28 pounds and the acid 5.5 pounds, each plate having an area of 45 square inches on each face; the limiting charging and discharging voltages were 2.4 and 1.8 with a constant current of 10 amperes; the mean ampere-hour output was 49.66, and the watt efficiency 87.8. At 20 amperes the capacity was 37.5 ampere hours and the efficiency 75.6. The elements can be made, formed and finished with twenty-four hours, as compared with a week for most other types.

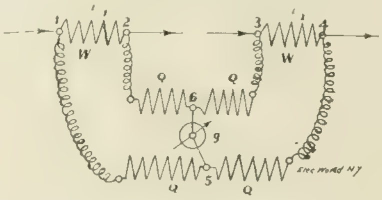
COST OF REFINING COPPER.—"Eng. and Min. Jour.," Oct. 22.—A note stating that the cost of 1.3 cents per pound for refining copper electrolytically, which was given in a report of the Anaconda Company, was a very high one. It is stated that the charge by the custom works rarely exceeds 1 cent per pound, and that it is frequently done at ⅞ cent; as this naturally involves a profit, the cost must be less. The charge for refining cathodes is as low as ⅛ cent per pound, and 0.15 cent is not an uncommon [illegible]

ASHCROFT PROCESS. Ingalls. "Eng. and Min. Jour.," Oct. 22.—An article on this electric process for the treatment of mixed [illegible] sulphide ores.

Units, Measurements and Instruments.

INSULATION INDICATOR FOR DISTRIBUTION WIRES. Kallmann. "Elek. Zeit.," Oct. 13.—The first part of the reprint of a long paper read before the Union of German Electrical Engineers last summer. After a long introduction, in which he points out the advantages which an instrument would have for indicating by direct reading the conditions of insulation of mains and distributing wires, he describes the principles of an instrument which he [illegible]; no such instruments exist at present. He discusses the disadvantages of the system used so much in the United States, consisting of two incandescent lamps in series between the two mains, with their junction point grounded, thus forming the usual ground detectors; if one or the other of the two wires is grounded the lamp connected with the other will burn more brightly; [illegible] can be applied only to the outer wires, and even then the indication is not certain, as the earth connection of the middle wire will affect the indication; even in the [illegible] the indication is not reliable [illegible] indication that the [illegible] detector therefore [illegible] applied to [illegible] replaced by two volt[illegible] with the instru[illegible] [illegible] ways, that further information can be obtained from which [illegible]

otherwise. In practice he suggests several different forms; in one of these there is a resistance in each of the mains, from the terminals of which wires are led to the differential galvanometer, suitable balancing resistances being placed in the four galvanometer circuits. In place of the differential galvanometer, the Thomson double-bridge method, shown in the adjoining figure, may be used (this seems to be the preferred method), in which case the galvanometer has only a single winding, it being connected between two points in the middle of two resistances which are connected somewhat like the coils of a differential galvanometer in the above-described case, except that each resistance is connected between the positive indicator wire from the one main and the negative indicator wire from the other main, as shown, instead of between the positive and the negative indicator wires from the same main, as it would be in the case of the differential galvanometer. He then begins to describe the chief applications of his system with reference to the following cases: As applied to a single wire; to show the stray currents in the rails of an electric railway; to a two-wire system to indicate the total earth current; to a three-wire system; to a two-wire transmission, to indicate the earth currents from the transmission line and from the sub-station, separately. In the application to a single line a series resistance is placed at the beginning, and an exactly equal one at the end of that single line; from these resistances the wires are led to the indicator; any current loss to earth between these two will thus be indicated in the instrument; in this way it can be applied to single-line circuits like those for trolley lines. To apply the system to the leakage from rails of an electric railway he connects the instrument to two points at the beginning of the line of rails, and to two points at the end, thus using definite portions of the rails as the series resistances mentioned above; an example is worked out showing that if the length of rail which is used as a resistance at each end is 30 metres (about 100 feet), and the distance between them several kilometres, the current through the rails being 100 amperes, a direct-reading Weston galvanometer would give a deflection of about 5° for a loss of current of 20 amperes; a d'Arsonval galvanometer will give about ten times this deflection. The paper is to be concluded.



MEASURING THE FALL OF VOLTAGE. Leconte. "L'Elec.," Oct. 8.—A note describing a practical process for measuring directly the fall of voltage in distribution wires; he has used the method with success. An assistant at the switchboard notes the voltage every five minutes and then suddenly breaks the circuit, noting the time; the second, with a watch and voltmeter which have been carefully compared with the others, measures the voltage at the distant end. The results obtained agree very well. He suggests that a bell might be used on circuits containing inductive resistances, and which should therefore not be opened. (Why not simply insert a slight resistance into the circuit instead of breaking it, thus giving a signal without breaking the circuit? If the watches have been compared, even this seems unnecessary.)

HYSTERESIS AND FOUCAULT CURRENTS. Niethammer. "Elek. Zeit.," Oct. 13.—The conclusion of his article (see "Digest" last week). In magnetizing an iron ring whose radial depth is not very small the distribution of the induction through the cross-section is not uniform, as the lengths of the magnetic paths, and therefore the permeability, are different; he gives some curves illustrating this for two cases. The determination of the hysteresis losses with flat voltage curves showed nearly the same coefficient as with sine curves, while the pointed curves, always for the same maximum induction or equal area of the voltage curve, gave lower hysteresis losses than in the above two cases; that for the same effective voltage the pointed curves are better is well known. To simplify the calculation of the area of the hysteresis curve the following formula is often used—namely, that the hysteresis energy is equal to the coercive force multiplied by the maximum induction and divided by 3.1416; he gives a table showing that for inductions between 3000 and [illegible] this can be used as an approximate method, but for smaller or greater inductions the differences are quite great. In some new forms of alternating current and rotary-current generators in which both windings are stationary, the [illegible] is not induced by the change from the maximum positive induction to the maximum negative, but by a change of induction between two positive inductions; this case he discusses and shows that the same magnetizing force corresponds to a much smaller induction than half of the maximum induction for a complete cyclic magnetization; the iron is therefore not utilized nearly as rationally; the values of the hysteresis coefficient are given, and it is shown that they are all higher than those for a full, complete cyclic magnetization; the hysteresis losses for the same induction are appreciably greater than for a full cycle, and the Steinmetz law is then [illegible] the coefficient has not only quite different values, [illegible] at all constant. The calculation of the hysteresis [illegible] for rotating magnetization is discussed in connection with the [illegible] of a continuous-current armature; the Steinmetz law cannot be applied to such rotating hysteresis; the hysteresis per [illegible] become lower again after a certain high induction. He then discusses the deduction of what he calls the rotary hysteresis from the linear (see "Digest" last week); rotary magnetization may be assumed to be made up of two perpendicular linear magnetizations. He gives a table showing the Foucault current energy in percentage of the total magnetization energy for different thicknesses of the sheet iron, as determined from experiments; in the same way the Foucault currents in the copper conductors of a dynamo may be calculated, as he shows.

REPRESENTING MAGNETIC QUALITIES OF IRON. Kath. "L'Eclairage Elec.," Oct. 8.—A translation in abstract of the article noticed in the "Digest" July 16, in which he proposes a uniform method for representing such qualities.

CONSTANCY OF RESISTANCE STANDARDS OF MANGANIN. Jager and Lindeck. "Elek. Zeit.," Oct. 13; an abstract of a contribution from the Reichsanstalt, published in the "Zeit. f. Instrumentenkunde," 18, p. 97.—An article on the investigation of the manganin resistances of that institution. The investigations extended over a period of more than five years, and show that the constancy of the manganin resistances, whose temperature coefficient is very small, is even better than was expected, and in this respect exceeded the mercury copies of the resistance. The wire and band resistances during this period changed only by a few hundred thousandths; within this limit, therefore, manganin resistances which have once been determined can be depended upon for that period of years. Formerly bands 35 mm in width and 0.1 mm in thickness were used for resistances of 0.01 ohm, but now the bands are made 1 mm thick, 10 mm in width and of a corresponding length. The small resistances have also been very satisfactory, the largest change in six resistances of 0.1, 0.01 and 0.001 ohm was only a little more than 0.01 per cent. in 2.5 years. The institution is now ready to guarantee the calibration of manganin resistances to the following accuracy: From 1 to 10 ohms, 0.01 per cent.; 100, 1000, 0.1 and 0.01 ohm, 0.015 per cent.; 10,000 and 0.001 ohm, 0.02 per cent., and 0.0001 ohm, 0.03 per cent.

E. M. F. OF STANDARD CELLS. Taylor. "Phys. Rev.," Sept.-Oct.—A long description of investigations undertaken some years ago to determine the e. m. f. of the cadmium cell as compared with the Clark; he also endeavored to find whether the e. m. f. of the cadmium cell is invariable when the cell is made by different individuals and with materials from various sources; about twenty cells of each kind were made. For the current measurements a newly constructed electro-dynamometer, which is described, was used, but it seems that the absolute determinations are not reliable; he claims, however, that there is no reason to doubt the correctness of the relative values; for the ratio of the Clark at 15° to the cadmium at 21.7° C. the ratio was 1.4077; the value of this ratio obtained by Jaeger and Wachsmuth, with the cadmium cell at 20°, was 1.4063. He found no more difficulty in constructing cadmium than Clark cells; their e. m. f. is as uniform as with the best Clark cells.

Telegraphy, Telephony and Signals.

WIRELESS TELEGRAPHY.—Lond. "Elec.," Oct. 14.—A report of the meeting of the company owning the patents. The leading editorial is devoted to this subject; a number of illustrations are given in which the system could be applied to advantage, as, for instance, to and from or between ships; it is thought that there is a good field for the use of such methods.

GUTTA PERCHA. Combanaire. "L'Elec.," Oct. 15.—An article on "the coming disappearance of submarine cables," in which he discusses the question of the supply of gutta percha.

MOTOR GENERATORS FOR FIRE-ALARM CIRCUITS.—"West. Elec.," Oct. 22.—A brief description of the small motor generators used in connection with a storage battery in that plant.

COAST SIGNAL SERVICE IN WARTIME.—"West. Elec.," Oct. 22.—A brief description of the recent service, from the New York "Tribune."

ELECTRIC BALLOON SIGNALING. Bruce. "Elec Eng.," Oct. 20.—A reprint of the Brit. Assn. paper noticed in the "Digest" Oct. 22.

Miscellaneous.

MANUFACTURING WORKS.—Lond. "Engineering," Oct. 14.—The beginning of an illustrated description of the works of the Elektricitaets-Actiengesellschaft at Nuernberg, Germany, which was formerly known as the Schuckert Company, founded by the late Schuckert. The illustrations include interior and external views, besides some illustrations of some of the machines. This is one of the largest electrical manufacturing companies in Germany.

CARBONS. Jehl. Lond. "Elec.," Oct. 14.—In this continuation of his long serial he gives hints to carbon manufacturers and electric light engineers. The testing room of a carbon factory and the methods of making the tests are described.

ALUMINUM FURNACE.—Lond. "Elec. Rev.," Oct. 14.—An abstract of Goldschmidt's article noticed in the "Digest" May 28, in which he describes the furnace in which aluminum is used as fuel.

BRITISH ASSOCIATION.—Lond. 'Elec.," Oct. 9 and 14.—A number of communications in reply to the criticism of that journal noticed in the "Digest" Oct. 15.

ACTION OF ELECTRICITY ON PLANTS. Cooke. "Elec. Eng.," Oct. 20.—A reprint of an abstract of the paper noticed in the "Digest" Oct. 22.

An Improved Dynamo for Three-Wire Circuits.

Up to a few years ago the three-wire system was employed in all large isolated plants and small low-tension stations by reason of the large saving in copper over the two-wire system. It was found, however, that where the all-day load was less than the capacity of two of the standard units employed, the losses in operating the small or lightly loaded machines offset the saving in copper at full load. Therefore, in most plants recently installed the simple two-wire system has been adopted, and many small stations are now using this system with 250-volt lamps, although the higher price of such lamps and their lower efficiency largely offsets the saving in copper.

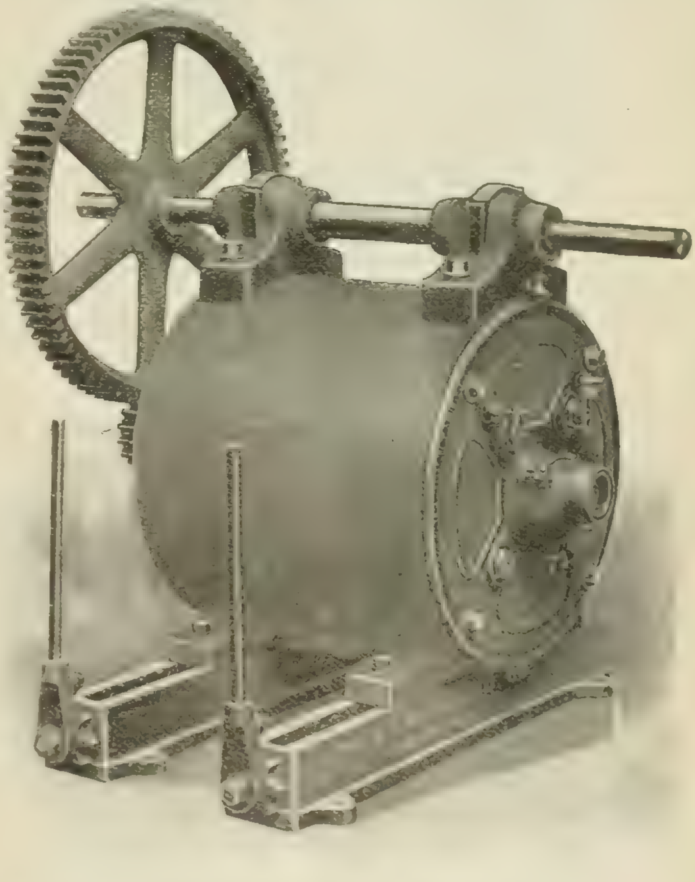
Several methods have been devised for supplying a three-wire system from a single machine, with small motor-generators to balance the system, a few machines having been built with double armature windings and two commutators. All of these methods, however, have been more or less complicated, and none will operate when the system is considerably out of balance.

There has lately been placed on the market a machine that, it is claimed, will supply a three-wire system and maintain the voltage with any distribution of load. It is of the usual multipolar construction, with single armature winding, single commutator, etc. It differs from ordinary machines only in the manner of exciting the fields, which is a modification of the multi-circuit system developed by Mr. Rushmore in his multi-voltage dynamos, motor dynamos and multi-circuit arc machine, and described on page 183 of The Electrical World of February 5, 1898.

There is now running at the Rushmore works in Jersey City a 30-kw machine supplying a three-wire system, that fulfills all the conditions of two 110-volt machines in series. It will deliver its entire output at 220 volts, or at 110 volts, and one side may be loaded to 75 per cent. of the total kilowatt capacity of the machine without loss in efficiency and without interference with the other side, which may or may not be loaded. The brushes are fixed, and there is no sparking with any distribution of load. One side of the system may be kept constant at any voltage, and the other raised or lowered to any extent without the least interference.

Inclosed Motors and Generators.

The E. G. Bernard Company, Troy, N. Y., is manufacturing and installing inclosed apparatus of the barrel type, an example of which is shown in the accompanying illustration. The various improved details, excellence of workmanship and high grade of material have resulted in the production of machines which are claimed to be unsurpassed. They are especially adapted for direct connection to shafting, machinery, elevators, pumps, exhaust fans, etc., and for use in all places where moisture exists or economy of space is desired.



Inclosed Multipolar Motor, Back Geared.

They are built for all voltages and speeds, and are claimed to be unequaled for launch or steamer lighting, when direct connected to vertical high-speed engines. A recent installation was made at Dobler's brewery, Albany, N. Y. Two 5-hp motors were placed in a very wet racking and cleaning room; one fastened on the ceiling and belted to the washer, the other on a post and geared with sprocket wheel to the keg hoist. One motor of 5 horse-power is direct connected to a beer pump and placed in the refrigerating cellar; one of 3 horse-power is placed in the open air, for operating washing machines, and one of 15 horse-power is direct connected to a Graves elevator. In addition to these there are two direct-connected generating units, one of 16 kilowatts and the other of 35 kilowatts.

A New Circuit Breaker.

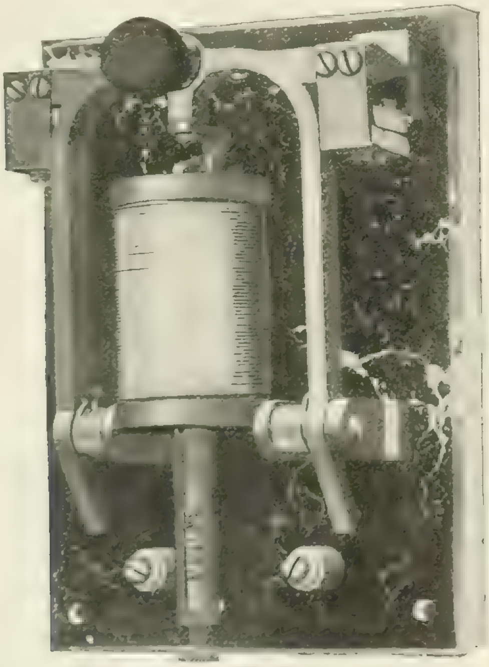
The cut shown herewith illustrates a new type of single-pole circuit breaker manufactured by F. A. La Roche & Co., Thirteenth and Hudson Streets, New York City.

This circuit breaker is also made with overload and undervoltage attachments for motor work. It is especially adapted for high voltages, ranging in the neighborhood of 2000 volts, and is guaranteed to break 2000 volts successfully without arcing at the clips.

This feature is accomplished by the method of attaching the carbons to the breaker. It will be noticed that the carbons are parallel to the clips, and as the breaker opens the carbons attached to the blades open with a cam motion, which keeps a rubbing contact on the stationary carbon until the blades themselves are well out of the clips and at a safe distance; then the circuit is finally broken through the carbons and below the clips, so that no burning of the clips or blades can possibly take place. The blades are of the wedge type and close into V-shaped lips. These are laminated and flexible to an extent, so that they adapt themselves to the shape of the blades, and an absolutely tight contact is thereby formed.

The latch and trigger are made of case-hardened steel, and are of the compound-lever type, so constructed as to permit the use of a very weak solenoid, as the force of the blow required to operate the breaker will be very small. This method of construction is new in this style of instrument.

The hinge posts and blade arms do not carry any current. There are two phosphor-bronze springs in each hinge. These springs are quite weak, and only sufficiently strong to give the switch a sharp and quick break. Owing to the peculiarly shaped blades and clips it is an absolute impossibility for the circuit breaker to stick, the construction of the clips tending to throw the blades out. This breaker would really operate without these springs in the hinge, which are placed there only to assist in quickening the motion.



Improved Circuit Breaker.

[illegible] which are parts of the [illegible] so that when the breaker is [illegible] on the hinge post is reduced to [illegible]

[illegible] which is attached the cable. [illegible] the end of this tube is a milled head screw and nut, which permits of adjusting the circuit breaker to open at any desired point within its guaranteed high and low ampere ratings.

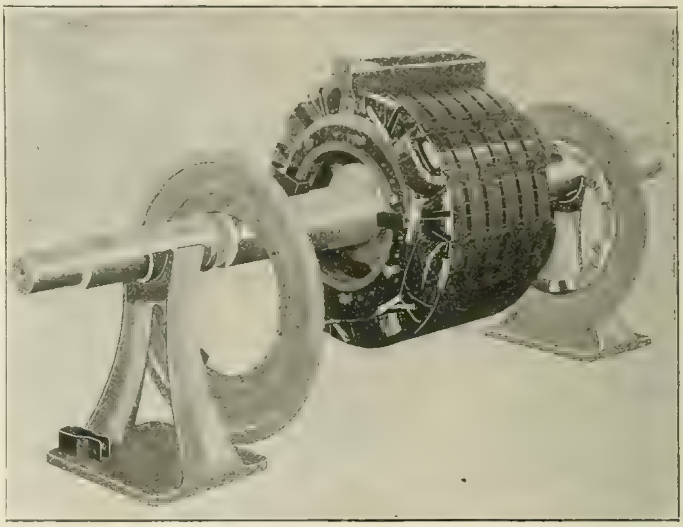
[illegible] inches.

[illegible] mends the "Victor" No. 1 circuit breaker or the "Ideal" circuit breaker, both [illegible]

Sixty and One Hundred and Twenty-five-Cycle Single-Phase Alternators.

[illegible]

The General Electric Company manufactures alternators with a frequency of 60 or 125-cycles in both revolving-armature and revolving-field types. Revolving-armature machines of 125 cycles are built in five standard sizes, 30, 60, 90, 120 and 180 kilowatts, each size wound for 1040 or 2080 volts. The low-periodicity alternators are wound for 1040, 2080 or 3120 volts, and are built in capacities of 60, 90, 120 and 180 kilowatts. All are arranged for belt driving, and are set on slides.

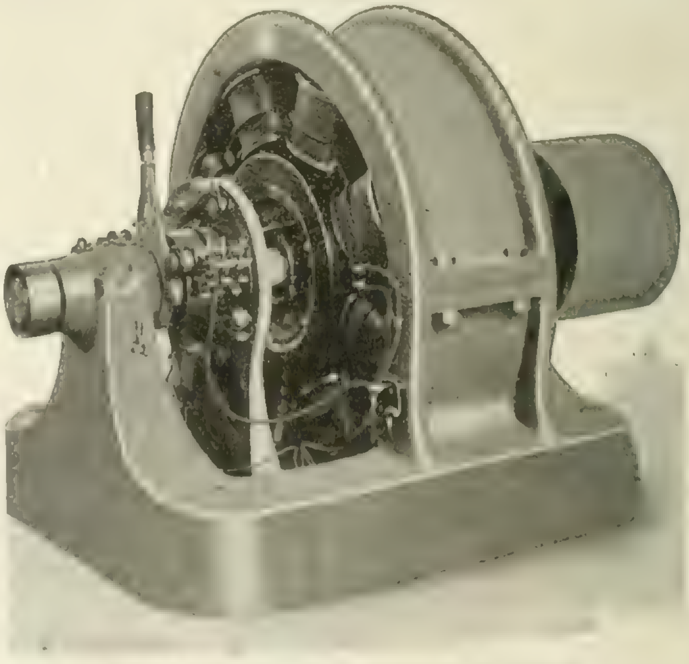


Armature of 60-Cycle Alternator.

As has been proven desirable by many years of successful service, the fields are composite wound, part of the main alternating current being rectified for the series excitation. The current for the separate excitation of the fields may be derived from any constant-potential direct-current source, commonly a small exciter, driven by belt from a pulley on the end of the armature shaft. The two windings allow the adjustment of the fields to automatically compound with change of load, giving at the terminals either a constant potential or a rising pressure to compensate for line loss.

The external field yoke is a cast-steel ring flanged outwardly for stiffness and fitted with inwardly projecting poles of laminated iron. The armature is unitooth, with the same number of coils as poles, the soft-steel laminations being japanned, while to guard further against eddy currents thin paper sheets are interposed between adjoining plates at frequent intervals. The form-wound coils are secured in the parallel-sided slots by insulating blocks and binding wire. They are protected at their ends by rings of light metal. This method allows the ready removal of any coil when necessary.

The rectifying commutator and the collector rings are underhung on a separate metal hub keyed to the shaft. The collector brush holders are supported on a cast-iron standard from the base, and insulated from it by hard-



Single-Phase 90-Kw Alternator, 60 Cycles.

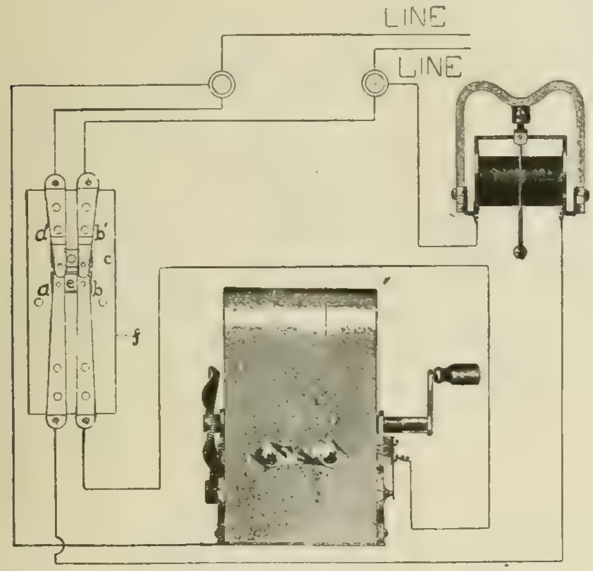
[illegible] bushings. The commutator brush holders are supported on a yoke carried by the adjoining pillow block. The bearings are spherical, self-oiling, self-[illegible] and of ample length to insure cool running.

Each alternator [illegible] is subjected to a most thorough test. The insulation of the [illegible] field coils is tested at [illegible] volts after [illegible] and the [illegible] and armature at pressures at least double the [illegible] operating voltage.

New Non-Infringing Multiple Toll-Line System.

The accompanying illustration shows a new and unique way of connecting in multiple telephones on a toll or party line. It is claimed by the manufacturer, the Williams Electric Company, Cleveland, Ohio, that it is more efficient than the Carty bridging system, and absolutely non-infringing. The company has applied for letters patent on this system.

The principle of the system, as will be seen from the illustration, is to connect the generator and ringer of every instrument in series with one another, while the different instruments are bridged across the line in multiple. This is accomplished by means of a double-acting double-circuit push button, where *f* is a fibre or hard-rubber block, which has riveted to it contact springs *a* and *b*, *a′* and *b′*, which connect to the terminals of the ringer and generator and to the two line wires, respectively. There is also a contact plate *c* upon which contact springs *a* and *b* normally press, thus short circuiting them or connecting together the free terminals of the generator and ringer. The other terminals of the generator and ringer are connected to the opposite line wires, respectively. To operate the bell in sending a call a button (not shown in illustration) is pressed, which removes contact springs *a* and *b* from contact plate *c*, and connects them respectively to contact springs *a′* and *b′*, thus communicating directly with the opposite line wires. This operation throws the ringer and generator, while in the act of sending a call, into direct multiple connection with the line wires, so that the current impulses from the generator are not weakened or retarded by having to ring through resistance coils, but on the contrary are delivered to line in their full strength. The ringers are high wound and the generators are low wound, and the added self-induction and resistance of the generator coil—the latter being in series with the ringer coil—have the effect of making the self-inductance and resistance of each station or instrument that is bridged across the line considerably more than would be the case were they bridged directly to line under all conditions, as in the Carty system. This being the case, the ringing current will have a tendency to divide more equally along the line, thus giving better service than by the old method. The advantage of this system is especially noticeable on long lines of iron wire where the resistance, leakage and static capacity all combine to the detriment of good service. The ringers are wound to a resistance of 1000, 1600 or 2500 ohms, as may be specified. The new Williams single-core ringer employed in this system gives to the latter a very high efficiency, inasmuch as its construction gives to it a large coefficient of self-induction.



Ringing Circuit of Multiple Toll-Line System.

A New Pump Packing.

A specialty in hydraulic packing is the new one known as Goodsell's "'98." It consists of a high grade of fine pump packing in square form finished by a seam of wax-cord stitching, parallel to the wearing edge, which is intended to successfully prevent the possibility of separation or splitting of the piles of duck when in contact with the plunger or cylinder. There has been room for such an addition to the holding qualities of rubber friction as usually provided, and operators of pumping plants will welcome any real improvement in this direction.

An Improved Form of Packing.

This new article is exclusively made by the Goodsell Packing Company, 33 South Canal Street, Chicago, which has installed special machinery for its production, and whose other specialties hold a prominent place in the market.

The Columbia Electric Automobiles.

THE first Columbia electric automobile was placed on the market about a year and a half ago, and was described in The Electrical World of May 15, 1897, since which time the Pope Manufacturing Company has been steadily experimenting, developing and improving this line of horseless carriages to such an extent that a further article on the subject is warranted. Many ingenious improvements have been developed by the skilled engineering staff of the company and incorporated in the vehicles, the description and illustrations of which appear below.

Three styles of electric vehicles manufactured by this company are now on the market, one being the single-seated phaeton, designated as Mark III.; one a double-seated carriage, Mark IV., and one a two-seated back-to-back trap, Mark VI. While many interesting features are common to all three vehicles, in each there exist certain special points which are well worth notice.

Mark III. is a form of hooded phaeton intended to seat two persons. The body (see Fig. 1) is mounted on three Brewster springs hung from the side bars of the running frame, which is made of 0.50 carbon steel tubing, graceful in outline and designed to give the greatest resistance to strains with the least weight. These side bars are made up of two tubes braced together by struts at the points of spring support to give a stiff beam and brazed at their ends into the forged corner joints of the frame. The member of the frame running across the front of the vehicle consists also of two tubes arched downwardly, as shown in the initial illustration, supported by a horizontal fore-and-aft swivel, allowing the bow-shaped axle-tree of the front wheels to oscillate in a vertical plane across the carriage to take up any irregularities that the carriage may pass over without straining the frame. This obviously gives a sort of tricycle construction, the frame proper being supported at only three points, and therefore never distorted as must be a frame supported at four points.

Individual wheel steering is used with all these carriages, each end of the axle-tree being brazed into a forked bracket, which affords bearings for a pivot inclined slightly backward from the vertical, and forged in one piece with the wheel spindle and a rearwardly projecting lever arm. The inclination of the pivot causes a tendency to maintain the wheels in a straight-ahead direction, and renders the operation of steering less fatiguing than would otherwise be the case. The rearwardly projecting lever arms are connected by two tubular rods to two arms of a three-armed forging pivoted on ball bearings at the centre of the axle-tree (see Fig. 2), the function of this device being to cause a greater angular movement of the inside wheel in turning, thereby maintaining all four wheels tangent to concentric circles, which is an essential for rolling around a curve that would not be fulfilled were the forward wheels maintained parallel with each other. The third arm is connected through a tubular rod and ball and socket joints to a vertical lever attached to a spiral gear sector meshing, with a corresponding gear keyed to the steering post running up through the middle of the carriage and controlled by the steering handle within easy reach of the driver's hand.

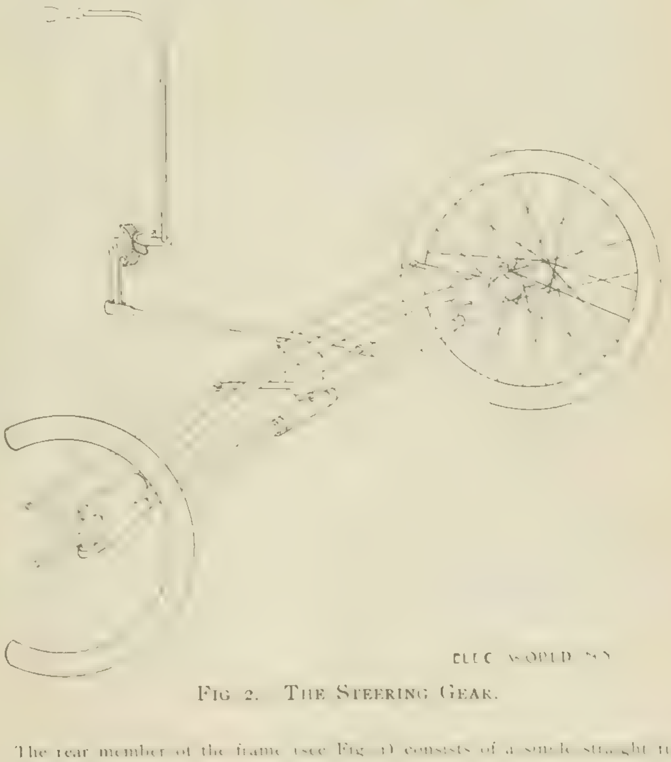


Fig 2. The Steering Gear.

The rear member of the frame (see Fig. 1) consists of a single straight tube carrying forged-steel hangers, affording ball-bearing supports for the motor shaft and the driving axle. The two rear driving wheels are axle-driven and mounted on two separate axles, both terminating in the balance gear, by which both wheels are driven with the same force, but one is allowed to turn faster or slower than the other in going around corners. This balance gear is of the ordinary bevel gear type, with four intermeshing pinions, one on each drivthe axle and two on a spindle at right angles to the driving axle and driven by the casing. The casing is supported by ball bearings in the two adjacent hangers, and is driven by a double-reduction gear exactly like the back gear on a lathe. the motor itself being mounted with its hollow armature shaft concentric with the axle of the right-hand wheel. The motor is of special design, intended for the maximum attainable efficiency and capacity, with minimum weight, and specially adapted to heavy overloads. It is a four-polar, series-wound, designed for a normal load of 2 horse-power at 75 volts and 1000 r. p. m., and capable of readily withstanding 100 per cent. overload for half an hour and heavier loads for shorter periods. Operating under normal-load conditions it shows an efficiency of 82 per cent., and maintains almost as high a figure when run at overloads as high as 150 per cent. Its weight is but 127 pounds. The field frame is fastened at each end to hangers from the vehicle frame above, which also provide ball bearings for the hollow armature shaft.

The brake is a very powerful form of the band type, and consists of a cast bronze strip, rigidly fastened to the rear upper tube and encircling the drum which forms the balance gear casing. The band is split diametrically opposite to the rear tube, and by a simple lever connection is clamped about the rotating balance gear drum through the medium of a foot lever located on the floor of the body immediately in front of the operator. Not only is this brake powerful enough to stop the carriage on the steepest hill and to bring it to rest on the level within its own length, but it affords great delicacy in manipulation and absolute control in obtaining any desired rate of retardation. A ratchet and pawl is used in conjunction with this foot lever, giving the operator the means of setting the brake at any desired tension, the release of the pawl being effected by a slight movement of the foot.

The question of storage battery capacity is one of prime importance, but the Pope Company has realized from the outset the necessity of sacrificing nothing in the durability or life of the battery, and, before developing the present type of cell, subjected almost every known variety to an extended and rigid series of tests best adapted to show their ability to withstand the excessively severe and arduous service required in this work. The batteries used in the Columbia carriages are of a particularly light construction, the positive plate being of "Planté" formation, and the negative having its active material efficiently distributed in masses. The carefully studied reduction to a minimum of the weights of the grids and connecting parts and the excellent proportioning of the cell has resulted in a capacity of 3.8 ampere hours per pound of cell, all complete with connecting lugs for carriage use, this capacity being obtained at a discharge rate of 25 amperes or 1.25 amperes per pound of cell complete, as above. The excellent design of this cell and the "Planté" formation of the positive plate admit of a very rapid charge, which, under ordinary conditions, can be completed from empty to full in three hours, if desired. Abnormally heavy discharge rates have no more effect upon this cell than has rapid charging, and hills requiring an average expenditure of 70 or 80 amperes for several minutes and 100 amperes or more for shorter periods have been habitually climbed without the slightest ill effect upon batteries of this type which have been in constant daily use for eight months. The construction of a high capacity cell is not a difficult matter, but such a cell is useless for motor carriage service unless also possessing the unusual characteristics of life and durability, and the makers of the Columbia carriages confidently assert that while the capacity of their battery may be equalled or even surpassed by those of makers of other automobiles, in none of these seemingly high-capacity cells can equal reliance be placed upon their continued good performance, [illegible]

The complete carriage battery consists of forty-four cells assembled in four separate boxes of eleven cells each. These four boxes can be connected in multiple, two in multiple and two in series, or all four in series, by means of the controller, thereby obtaining the three speeds, 3, 6 and 12.25 miles per hour [illegible] total resistance. The controller lever is unobtrusively placed at the left of the operator, and acts directly through one set of gears on the cylindrical controller placed beneath the seat. On the drum corresponding to the three speeds are three series of contacts, which are brought successively against stationary fingers, giving the cir [illegible]

The minor electrical features have been carefully worked out with a view to [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

The tires on this and all Columbia carriages are a special pneumatic cushion type 3 inches in diameter, in which the strength and durability of the cushion tire has been combined with the manifest advantages of the pneumatic. The best air pressure at which these tires can be run is from 100 to 120 pounds; pressures as low as 40 pounds, readily obtainable with the crudest form of hand pump, are practical without injury to the tires or rims, but not recommended, as abnormally flabby tires cause an increase in current consumption and are not conducive to the efficient operation of the carriage. Wherever possible ball bearings have been used, so that not only are the wheels, motor and countershaft journaled in this way, but such bearings have been introduced in the steering connections and controller with beneficial effect.

Much care has been given to the design of a wheel which should combine lightness and rigidity as well as neatness in appearance. The rear or driving wheels have steel rims, hot rolled, fitted and tangent spokes, and are 36 inches in diameter. The forward wheels are 32 inches in diameter and of similar construction.

The Mark III. carriage is capable of a mileage of 35 miles over ordinary suburban roads, the current consumption on a hard level road being approximately 21 amperes. It will climb grades of 12 and 15 per cent. readily, although it may be seen, from the fact that the current consumption on a 12 per cent. grade is in the neighborhood of 85 amperes, that hill climbing carried to an excess will materially reduce the capacity of the batteries and consequently the mileage of the carriage. The total weight of the carriage complete is 2000 pounds.

The double-seated carriage, Mark IV., differs considerably in some of its mechanical features from Mark III. The running frame is made up of two straight side tubes diverging toward the rear, where they are brazed into forged joints fastened to the rear axle, which forms the rear member of the frame (see Fig. 4). The axle is stationary, and does not act as a driving shaft. The forward member of this frame is a transverse tube arched slightly to the rear and equipped with the same method of pivot support as in the case of Mark III. Two transverse tubular struts, together with a central longitudinal piece of tubing binding the rear strut to the rear axle, complete the running gear. Substantially the same arrangement of individual steering and wheel support is employed here as with the carriage previously described. Instead of a mechanical balance gear, however, an electrical balance between the two driving wheels is maintained by two motors mechanically separate, but with armatures series connected, each independently geared to its own driving wheel through a single reduction, with annular gears fastened to the hubs of the driving wheels.

Each of these motors is of [illegible] horse-power capacity, wound for [illegible] volts at 1000 r. p. m., and is capable of standing the same severe overloads as the Mark III. motor. Since they are connected in series, the same torque is developed in each, and so long as there is no tendency for one wheel to move faster than the other, there is an equal division of the total applied voltage from the battery between the two motors, and the speed is the same. In turning curves, however, the inside wheel slows down and the voltage of its motor is lower and that of the other correspondingly raised, resulting in the proper increase in speed of the outside driving wheel.

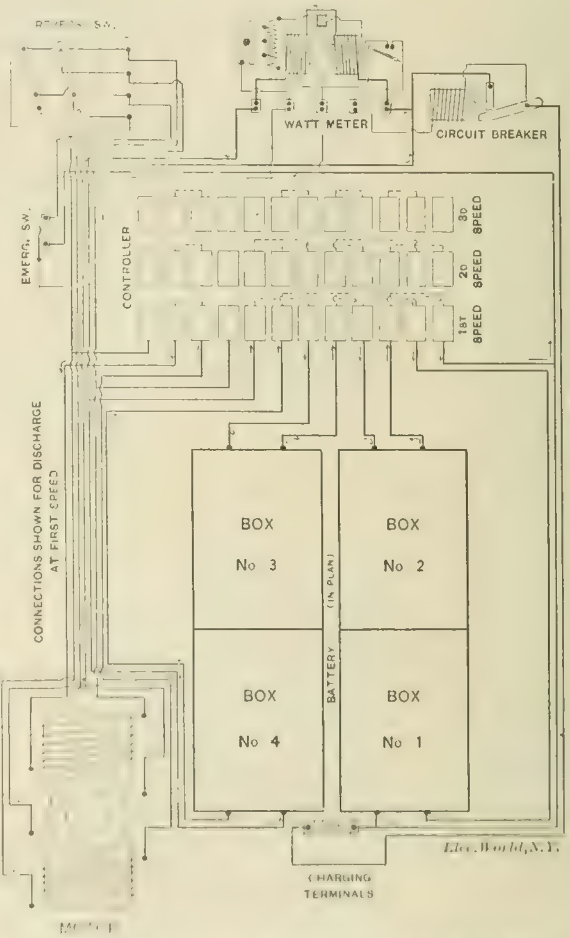


Fig. 3.—The Controller Connections of Mark III.

The brake is foot operated, with the essential characteristics of the one above described, save for the fact that the pressure is divided through an equalizing lever between two small drums mounted respectively upon the armature shafts of the two motors.

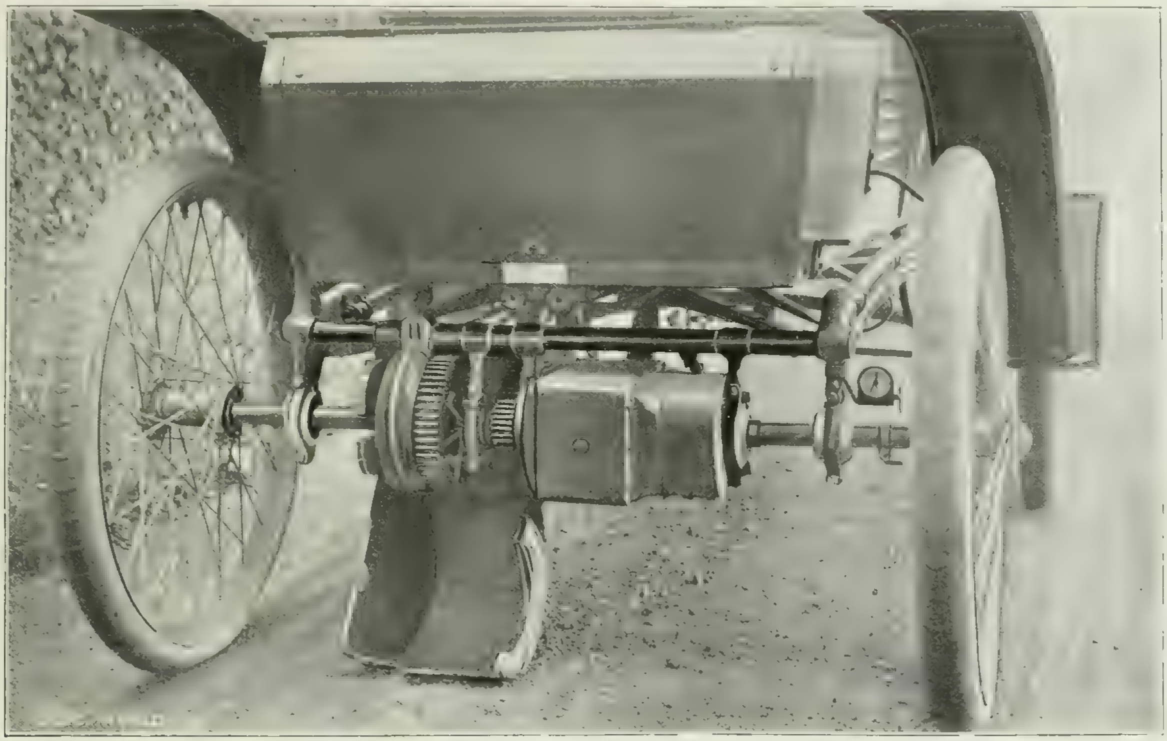


Fig. 1.—Rear View of Mark III.

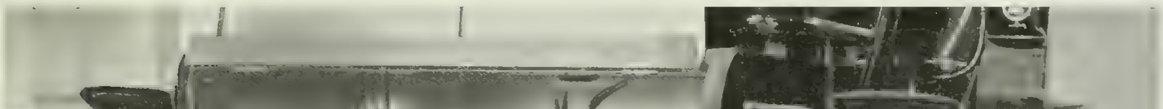


Fig. 4.—Mark IV., from the Rear.

The suspension of the body is through two fore and aft half elliptic springs, supported directly upon the rear axle, and one similar transverse spring having its support directly over the front horizontal pivot on the front tube of the running frame. The eye-bolts of these springs are fastened to strong forgings bolted to the underside of the body. The construction of the wheels, tires, steering gear and electric controller is similar to that adopted in Mark III. so far as the essential features are concerned.

The same charging equipment, including wattmeter and automatic cut-out, is used, with the addition of a combined voltmeter and ammeter placed upon the dashboard under the immediate inspection of the operator. This is a special instrument with a high and low voltage scale, the high scale being that ordinarily used, and showing the voltage of the batteries at all times, whether under charge or discharge, the low scale being valuable when investigating the condition of individual cells. The ammeter scale is double reading, having its zero at the centre of the scale, permitting its use during the discharge when upon the road, as well as when the carriage is at rest and the batteries charging with the current in the other direction.

The battery employed is of the same type, but larger and more powerful than that of Mark III. The weight of the individual cell all complete for carriage use is 32.5 pounds, and it yields [illegible] ampere hours at a discharge rate of [illegible] amperes, which admits of a mileage of 35 miles over fair suburban roads. These cells are arranged in six groups of seven cells each—a total of 42 cells—two or which groups are placed under the forward seat and four under the rear. The controller admits of four combinations of connections resulting in the following speeds:

3 miles per hour. 2 groups in series. 3 groups in multiple. Fields in series.
[illegible] " " " 3 " " " 2 " " " " " "
21 " " " [illegible] " " " " " "
13 " " " [illegible] " " " Fields in multiple

The total weight of the vehicle fully equipped with batteries is 3100 pounds.

The third and latest type of carriage, Mark VI., the back-to-back trap, exhibits several points remarkable for their novelty and radical departure from previous methods. It may be said to have no running frame, being mounted, through the medium of four elliptical fore-and-aft springs, directly upon separate front and rear frames, capable of being independently removed and having no connection with one another save through the body itself. (See Fig. 5.)

The most interesting feature in the construction of this carriage from a mechanical standpoint is the method of mounting the motor and the transmission gearing From the method of suspending the body, it will be seen that the driving of the body and forward springs is done through the two rear springs, giving great simplicity in construction and such an independence of the other carriage working parts as to make it perfectly feasible to remove the entire rear frame with its attached mechanism and apply the same to any other form of body desired. Projecting from the lower rear corner of the motor frame are two lugs recessed to fit the square rear axle-tree and fitted with caps by which they are securely bolted to the same, placing the motor in such a position that the centre line of its armature is parallel to, but above and in front of, the rear axle. Each rear wheel is driven through a small pinion meshing with an internal gear fast to the wheel hub. The right driving-pinion shaft has its outward bearing in a bracket extending from the rear axle just [illegible] gear. From there it passes through the hollow armature

tionate capacity and a carriage mileage of 35. The total weight of the carriage complete is 2600 pounds, and it requires a current consumption on the level of 25 amperes when carrying four persons.

Each carriage, as soon as mechanically and electrically complete, but before receiving its final finish and upholstery, is subjected to a twofold test. It is first run over obstructions and subjected to repeated strains, which are equal to the severest likely to be received upon the road, and the yielding or alteration of any part is carefully noted by a series of previous and subsequent measurements accurately made. Following the obstruction test, each carriage is given a road run of 20 miles over a specially selected rough, hilly road. This not only forms one of the severest continuous hill-climbing tests which can be made in the vicinity of Hartford, but acts supplementary to the obstruction test in bringing to light structural weaknesses of such a nature as to be more readily affected by the multitude of slight vibratory strains received upon the road than by the sudden heavy shocks occasioned by the obstruction test.

While ability to stand the severest conditions of ordinary road service is perhaps all that might be demanded of any motor carriage, it has been very gratifying to the makers of the Columbia carriages to learn from their behavior in accidents and under abnormal conditions that the factor of safety in the construction of the vital features has been ample. As an example of the strength of the wheels might be mentioned a recent trial of the carriage which took place upon level asphalt to ascertain the efficiency of the steering gear at a high speed. A speed of 14 miles per hour having been reached, it was attempted to turn the carriage sharply around in a 30-foot circle without throwing off the power, and the attempt would have succeeded had not the asphalt been wet and the consequent slippage of the tires too great. The effect was to slide the carriage sideways at full speed until the wheels struck the curb, when it overturned, but without affecting even the alignment of the wheels.

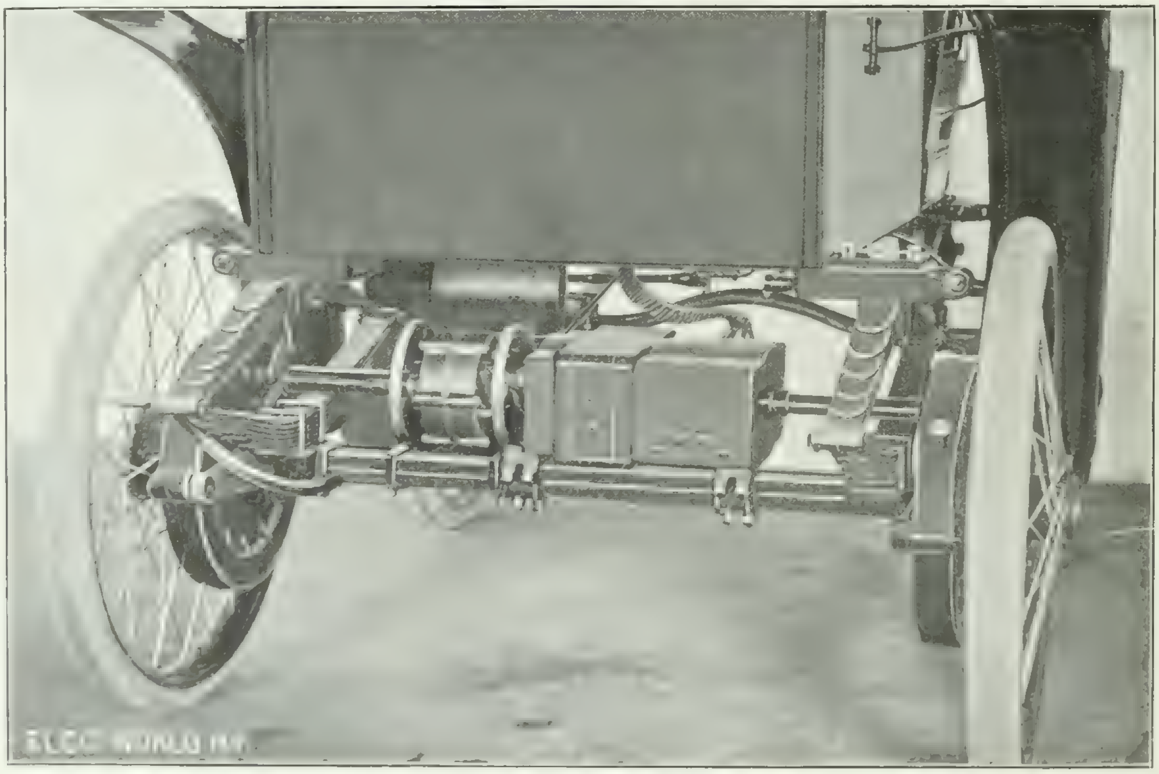


Fig. 5.—The Rear Frame of Mark VI.

[illegible]

[illegible]

[illegible]

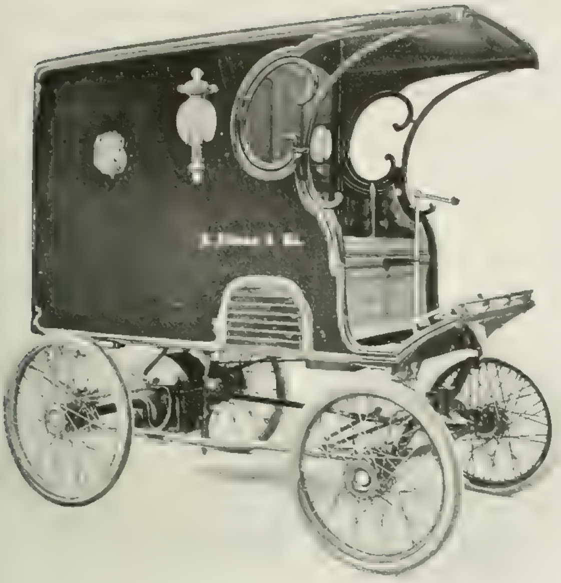
[illegible]

[illegible] the city mains of central lighting stations that the cost for each full charge [illegible] prices on the amount of current consumed, the user of a carriage employing [illegible] which cost is still further reduced if the carriage owner possess his own private plant.

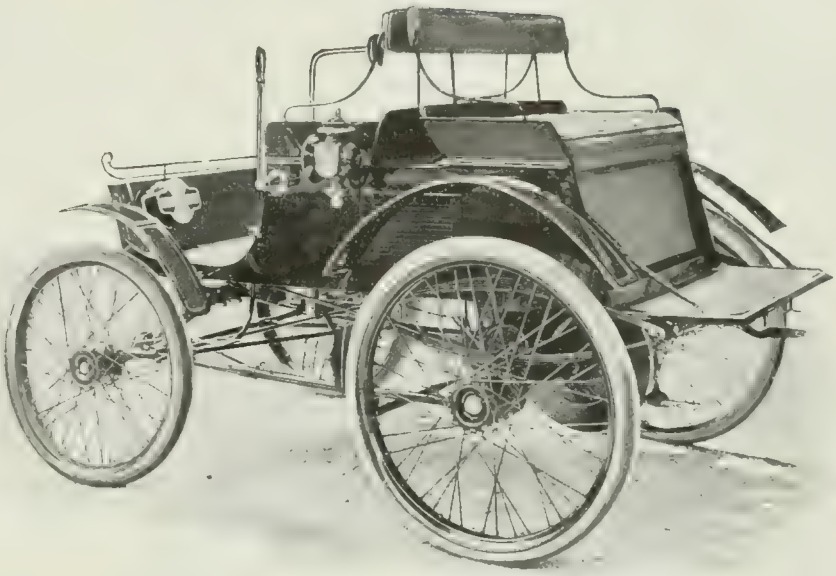
Electric Automobiles of the Riker Electric Motor Company.

[illegible] Riker Electric Motor Company has been [illegible] these by elliptic springs at the rear and reverse elliptics at the front, the latter giving the equivalent of a centre swivel, which reduces the strain on the body [illegible]

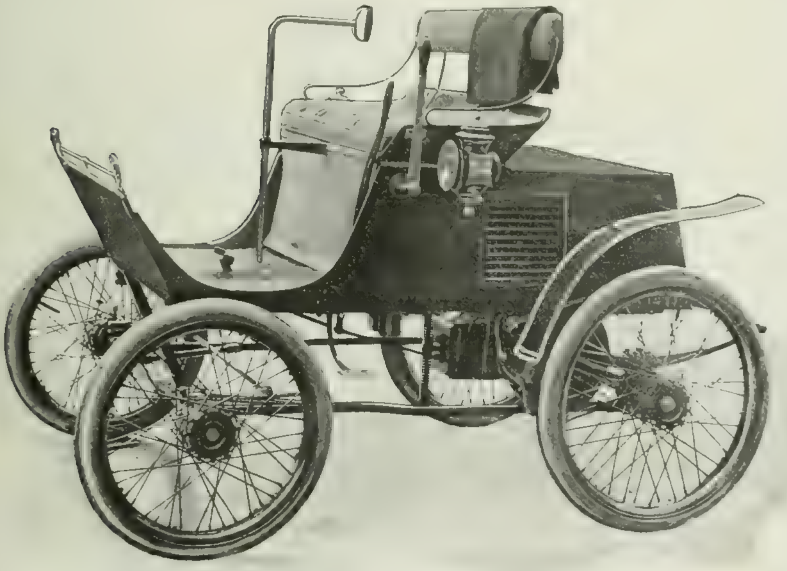
[illegible] Electrical World of September [illegible]



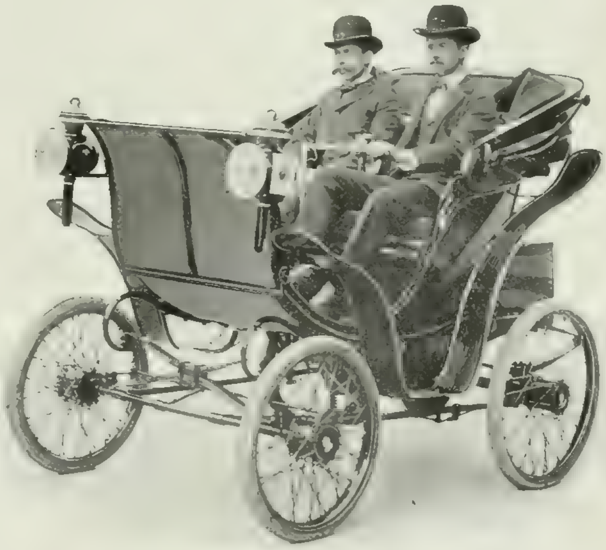
Delivery Wagon.



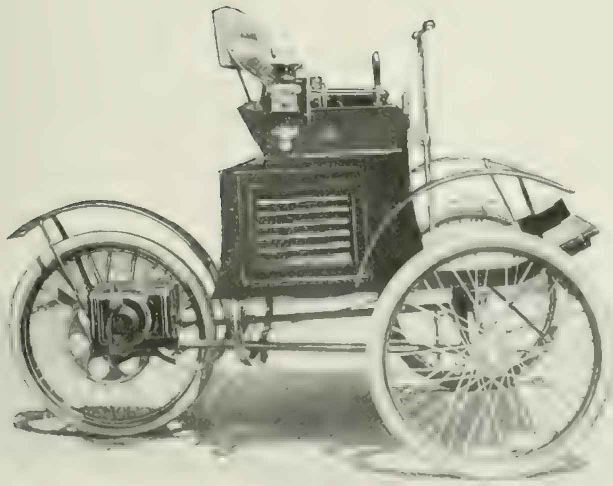
Dos-à-Dos.



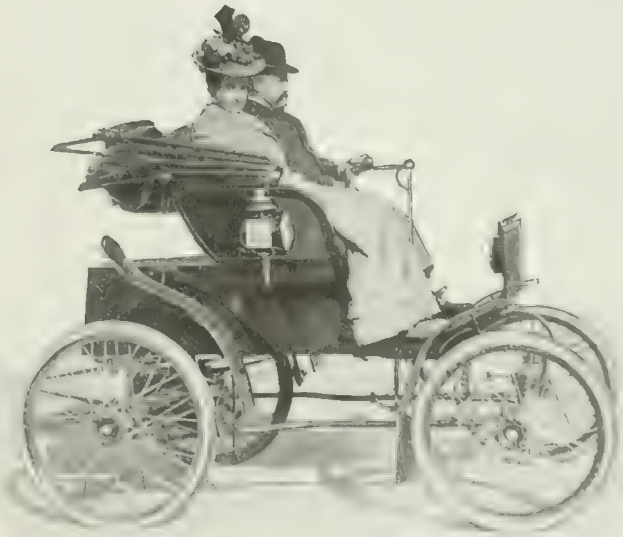
Two-Passenger Trap.



Victoria.



Tricycle.



Phaeton.

Some of the Riker Electric Vehicles.

By the side of this main gear and within the same case is a pulley on which acts a band brake, besides which shoe or spoon brakes are also fitted to the rear tires.

The "Jack-in-the-box," differential or compensating gear, to give its various names, is located inside one of the cylindrical hubs, its four intermediate bevel pinions being driven by a sleeve from the main gear meshing with the motor pinion. This gives a solid inner axle clear from this hub to the hub of the other wheel, instead of an axle divided at the compensating gear, as is the case with most other vehicles. Ball bearings are used in the lighter vehicles and roller bearings in the heavier. The steering is effected by the usual hub pivot arrangement, the pivots being placed, however, within the hollow hubs of the forward wheels. These pivots are vertical, and with cone-shaped ends. A proper increased deviation of the inside wheel when turning is obtained by the non-parallelism of the pivot cranks.

Perhaps the most interesting features of these vehicles are the ingenious details of the controlling mechanism. The ordinary cylindrical controller under the seat is used, giving by means of a series-multiple combination of the batteries three speeds forward and two to the rear. In the main circuit is an automatic circuit breaker, which opens in case the motor is given more than 400 per cent. overload. This is reset simply by restoring the controller handle to the off position. On the footboard or dashboard is a combined voltmeter and ammeter, showing at all times the pressure of the cells and the load on the mechanism. An automatic switch in the charging circuit prevents the connection of the batteries with the wrong polarity, and cuts off the batteries when fully charged.

The electric tricycle is rather interesting, as it is one of the lightest vehicles yet developed and weighs only 800 pounds. It has a 4-foot wheel base and a 4-foot tread, with wheels 28 inches in diameter, fitted with 2½-inch pneumatic tires. The motor is rigidly suspended, meshing directly with a gear on the hub of the single rear wheel, the steering being effected by the usual forward hub pivots. The motor is rated at 1 horse-power at 40 volts, and weighs about 60 pounds, the gear ratio being 8 to 1.

The Vehicles of the General Electric Automobile Company.

The types of vehicles of which this company is now completing its first equipments are delivery wagons, physicians' and pleasure phaetons and broughams or coupés.

The electrical equipment upon these several vehicles is substantially the same and is described below. The delivery wagons are provided with a fifth wheel steering gear on the front wheels, controlled by a small hand wheel on horizontal axis and operating through gearing a worm or tangent screw, which works in a worm-gear segment fixed to the pivoted axle. This method of steering delivery wagons is preferred, because by it the axle is always locked, and excessive strains and jars cannot come upon the operator. It is found by experience that this steering gear works most satisfactorily. It furthermore enables the most approved customary type of spring-body support to be em [illegible] required to carry heavy loads. The batteries are arranged in trays and placed within a compartment under the rear of the body, and furnished with a spring floor to reduce the jarring upon the battery when traveling over rough roads or crossing railroad tracks. The wheels are fitted with anti-friction bearings, and the rear wheels are independently driven by separate motors. The wheels are of wood, with solid rubber tires. Pneumatic tires will not be used. The accompanying figure shows one of these wagons.

[illegible] design between a doctor's carriage and a stanhope, consisting of a seat for two persons, with handsome upholstery and cushions side and back. The battery compartment extends under the seat and backward, with a drop-hinged door at the rear. Handsome lamps, both for electric light and candles, are provided on the sides of the body. The running gear consists of two large rear and two smaller front wheels, all of wood, and having solid rubber tires. The front axle-tree is [illegible] from the body, and the wheels are turned for steering by knuckle joints or side pivots, and moved [illegible] similar set of springs. The wheels are all furnished with ball bearings. These [illegible]

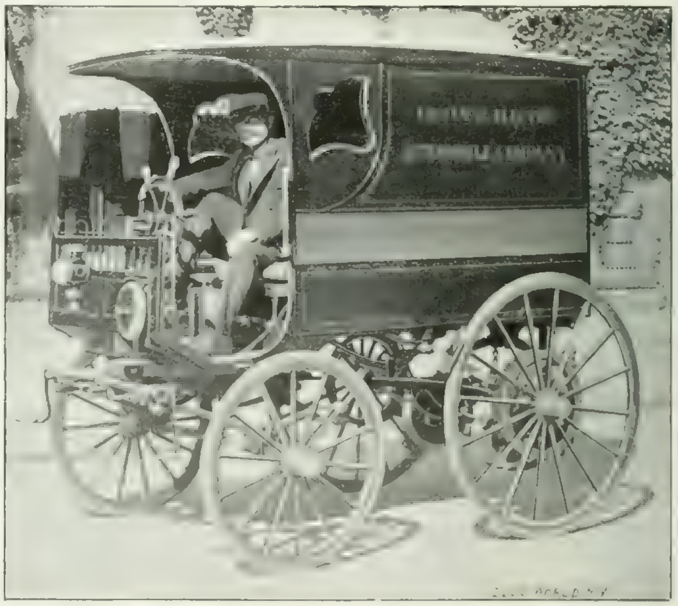
[illegible]

[illegible]

automatically coupled up with the motor circuits on the vehicle, through the media of contact switches, by simply sliding the trays into the compartments. While the batteries are adapted to be removed from the vehicle for charging, sockets are provided for attachment plugs, so that the batteries may be charged while in place, and these plugs are so constructed that it is impossible to make a wrong connection or reverse the polarity.

The motors are two in number and develop 2 horse-power each on normal running, but may be worked up to twice that power at 800 r. p. m. for a considerable period without excessive heating. They are four-polar, with the armature shaft carried in roller bearings, and operate on eighty volts. The field windings are divided into two coils, so that those of each motor may be thrown in series or multiple. The motors are hinged to the rear axle near the outer ends thereof, and are supported from the vehicle body. The armature shafts extend close to the wheels, and are fitted with pinions of 3½-inch diameter, working on annular gears of 22-inch diameter, fastened to the spoke arms. The gears are of phosphor bronze and carefully cut. The ratio is 1 to 6.28.

The controller is placed under the floor in the phaetons, and under the operator's seat on the box in the broughams, and is operated by a hand lever. It is of the series-multiple type, adapted to give four speeds and one brake position. The first notch puts the two motors in series with the field-magnet coils also in series. The second notch maintains the armatures in series, but with the two sets of field coils of each motor in multiple. The third notch throws the two motors in parallel, but connects the two field coils of each motor in series. The fourth notch maintains the motors in parallel, but also throws the two field coils of each motor in parallel. The brake is set by moving the controller lever the other way, and throws the fields and armatures all in series on a short circuit, causing the machines to act as braking dynamos. This is only resorted to in case of emergency or in descending steep grades. A foot brake is provided when desired for ordinary uses. In all of the working notches, one to four, of the controller the batteries are connected with all of the cells in series, giving a maximum voltage of 88. On the fourth or parallel notch the speed is 19.8 miles per hour. In addition to the series-multiple controller there is an electric switch for throwing the battery cells in two series of 22 cells each and these two in parallel with each other; and this is employed in connection with the parallel arrangement of the motors, namely, the third [illegible] is lowest. This connection is only used in starting heavy loads or climbing steep grades.



General Electric Automobile Company Delivery Wagon.

In addition to these switches for controlling the speed and braking there is a separate hand-controlled switch to reverse the armature connections for running backward. [illegible] and the controller lever are arranged at the left-hand side of the seat and extend up through the [illegible] for steering and avoiding collision with passing vehicles.

[illegible]

[illegible]

[illegible] vehicles. It further proposes to introduce small isolated charging stations at [illegible]

The "Petite" Enclosed Arc Lamps.

The Western Electric Company, Chicago, has recently placed upon the market a line of enclosed arc lamps of particularly handsome design.

The incandescent lamp for a long time held undisputed sway in the field of decorative illumination, but the enclosed arc lamp has become a strong rival in this department through its adaptability to decorative application. In its development it is growing shorter in length, which is an added feature of importance when contemplated from a decorative standpoint.

The "Petite" lamp, which is the subject of this article, is of very small proportions, and can be used in rooms having low ceilings. The direct carbon feed is adopted, and as a consequence the number of working parts are reduced to a minimum.

A novel feature of design is found in the lamp frame. The current, which is fed from the upper carbons to the lower carbons, returns to the negative binding posts by passing through three side rods placed at the angles of an equilateral triangle parallel with and equidistant from the carbons.

It is claimed that the joint magnetic action of the current flowing through these rods keeps the arc balanced so that the carbons are consumed evenly. The effect of this arrangement is to give a very steady light.

Another novel feature is the form of automatic circuit opener. It consists of a short piece of No. 18 or 20 bare copper wire attached at one end to a clip fixed to one of the rods above referred to, the other end being slipped into a similar clip at the top of a short post on the base of the lamp. This wire is stretched across the diameter of the inner space so that it comes into close proximity to the lower carbon. When the lower carbon is burned down to the limit the wire is burned in two and the current is thus cut off. This automatic cut-out is equally effective, whether the lamp is burning normally or whether the current is reversed.

The enclosing globe of the "Petite" indoor lamp is made in three shapes, and serves as well for the outer globe as for the inner. The out-door lamp is provided with outer globes, one design of which is shown in Fig. 2 of the accompanying illustrations.

Fig. 1 represents an indoor lamp with the "Standard" globe, which is cylindrical in shape, with one end rounded. Another design, the stalactite globe, gives a very graceful form and is very ornamental, and the same may be said of the egg-shaped globe.

The "Petite" lamps are designed to burn in or out of doors singly on 110-volt circuits; two in series on 220-volt, or 5 in series on 500-volt circuits, and singly on 220 volts. They are finished in polished brass and old copper, and the globes come in three varieties, viz.: clear, for outside use; opal, for inside use, and redtag for inside use for lamps burning singly on 220 volts.

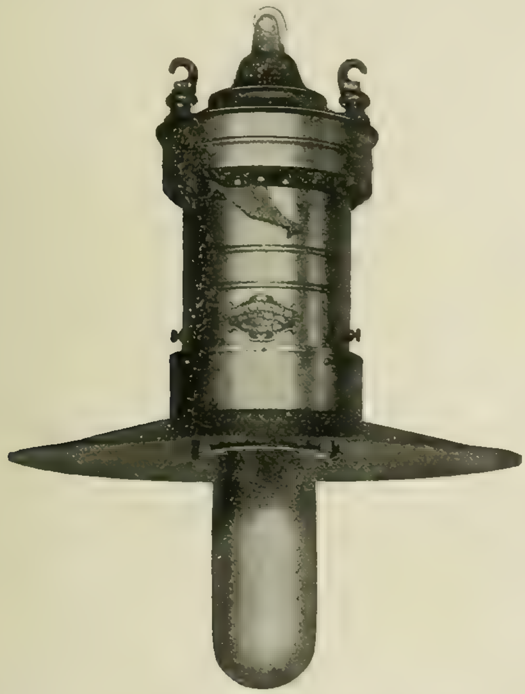


FIG. 1.—PETITE LAMP WITH STANDARD GLOBE.

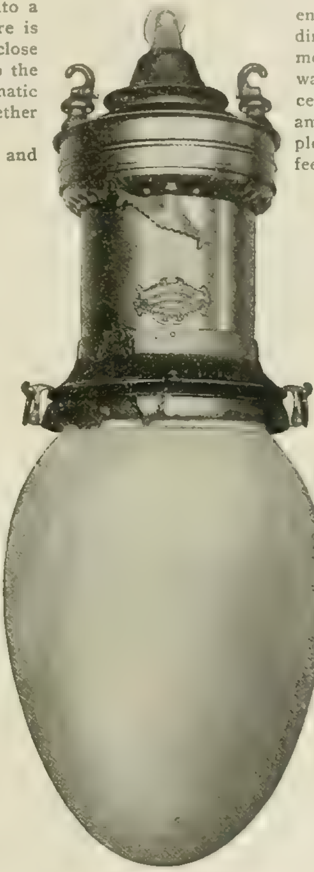


FIG. 2.—LAMP WITH EGG-SHAPED GLOBE.

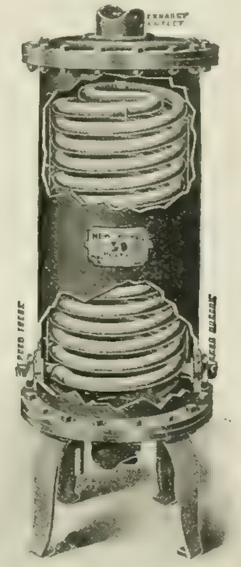
The American Electric Vehicles.

A line of motor-driven automobile vehicles is being developed by the American Electric Vehicle Company, associated with the Indiana Bicycle Company, of Indianapolis. The essential points of these vehicles, which are designed for runabout, stanhope, trap, brake, brougham or delivery wagon bodies, are as follows: The steering is effected by the usual side pivots on the forward wheels, the running gear being made of cold-drawn, seamless steel tubing, with brazed joints. All wheels have ball bearings, with tangent-wire spokes and single-tube pneumatic tires on the lighter, and wooden spokes and cushion tires on the heavier running gears, and are made up in three sizes fitted for the various weights. The motor (one only being used per vehicle) is multipolar, rigidly mounted on the running gear, its armature being on the sleeve attached to the casing of the balance or differential gear, which in turn drives pinions meshing inside enclosed gear cases with gears on the wheel hubs, one of these pinions from the balance gear running, of course, through the armature sleeve. Three sizes of motors are used, rated at 1½, 2½ and 3½ horse-power, respectively. The battery consists of forty-four polarization cells, varying in size from 60 ampere hours to 125 ampere hours, the weight of the lightest being 9 pounds per cell. These are placed in four trays of eleven cells each. A Thomson storage-battery charge-indicating wattmeter is used in the battery circuit. The three speed variations are obtained by connecting the four battery trays all in multiple, in multiple series and all in series, this being accomplished in the controller placed under the seat. The reversal is effected by a separate handle which is removable to render the carriage inoperative. Braking is effected by a band brake on the periphery of the compensating-gear case. For delivery wagon service the company estimates the average cost of a two-horse delivery wagon, exclusive of the driver's wages, with a 33 per cent. depreciation, at about $1100 per year, and an electric delivery wagon, with the same depreciation, at about $700 per year.

A New Copper-Coil Feed-water Heater.

The accompanying illustration represents the "New World" return copper-coil feed-water heater, which is made by the Robertson Manufacturing Company, 203 Fulton Street, New York City.

Steam users who study the economical running of their plants are constantly looking around for means to reduce their running expenses. Fuel represents a large percentage of loss, owing to the great amount of heat units lost by permitting the exhaust steam from the engine and pumps to be wasted when discharged direct to the atmosphere. To avoid this loss experiments have been made from time to time, but not always with successful results. Appreciating the necessity for some means of utilizing the maximum amount of heat from what otherwise would be complete loss, the Robertson Company has designed this feed-water heater.



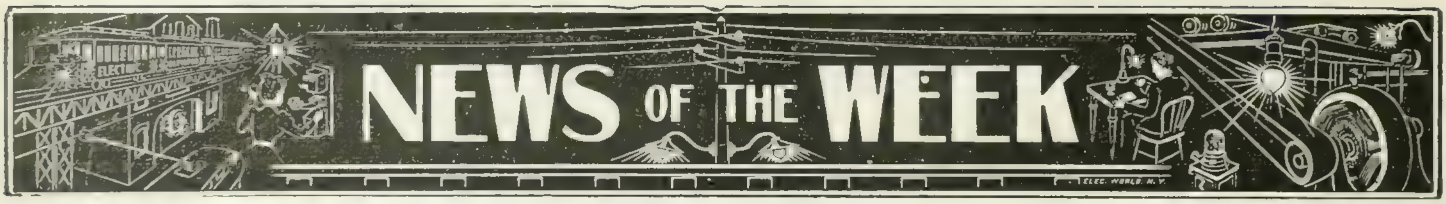
NEW FEED-WATER HEATER.

The water inlet and outlet to this heater are both located at the lower part of the shell, but on opposite sides, thus doing away with the many objections to the piping-up of heaters in which the outlet is generally at the top and on the same side as the inlet. The coil is made of the best seamless drawn copper tubing, and is of the proper dimensions to give ample surface to heat the feed water rapidly to a temperature of 210 degrees Fahr., or within two degrees of that of the exhaust under ordinary conditions.

The feed water is carried through the coil to the top of the heater, and by means of the company's patent expansion return (which is so constructed that it does not in any way retard the flow of water or increase the friction) again passes down to the point of discharge at the bottom of the shell, there meeting the exhaust steam where it is hottest, and thus getting the benefit of the hottest steam as it enters and leaves the heater. The water in passing through this heater does not come into contact with any metal but copper, therefore there can be no rusting out, and it is stated that all galvanic action is avoided.

Other features of the "New World" heater that commend themselves are the freedom allowed for expansion and contraction both lengthwise and spirally. Both the inlet and outlet connections being at the bottom of the shell give the body of the coil freedom to expand and contract, while at the same time the coil is so brazed that chafing or vibration is impossible. Where it is found necessary to join the tubing it has been done by expanding and lapping the tubes and then brazing them with No. 6 hard brazing solder. By this means the chance of leakage is reduced to a minimum.

All the coils are tested hydraulically to 600 pounds pressure to the square inch before being placed in the shell. The heater shells on all sizes up to 300 horse-power, inclusive, are made of the best gray cast iron and in the larger sizes of steel, and tested to 50 pounds to the square inch. Each shell is provided with a stuffing box and gland nut, where the coil connects with the same. The stuffing box is so arranged on the outside of the heater that it can be packed while the heater is in use.



Financial Intelligence.

THE SPRAGUE ELECTRIC COMPANY has declared a dividend of 3 per cent. on its preferred stock, payable on November 1.

DIVIDEND.—The directors of the New England Telephone & Telegraph Company have declared a regular quarterly dividend of $1.50 per share, payable on November 15 next.

THE METROPOLITAN STREET RAILWAY COMPANY, of New York, reports for the quarter ended September 30, gross earnings, $2,907,562, an increase over the same period last year of $689,620; operating expenses, $1,466,641, an increase of [illegible]; net earnings, $1,440,921, an increase of $437,329; other income, $181,737, increase $17,352; total $1,622,658, increase $454,681. After deducting interest, taxes, etc., the surplus is $551,809, an increase of $167,622. It is stated that the report does not fairly represent the real status of the affairs because for much of the time the Sixth and Eighth Avenue lines of the company earned nothing. The operating expenses during the quarter increased 21 per cent. in money, but were 50.6 per cent. of the gross, against 54 per cent. in 1897. The charges increased 36 per cent.

THE GENERAL ELECTRIC COMPANY DECLARES A DIVIDEND.—On October 24 the directors of the General Electric Company, at their meeting in Boston, declared a dividend of $11.66⅔ per share on the preferred stock of the company, as reduced, payable on and after November 15 next. This dividend, it is stated, is equal to $7 per share of the preferred stock, as it existed prior to the reduction. It is on account of the unpaid accumulated dividends on the preferred stock and is equivalent to one year's dividends at the rate of 7 per cent. on the unreduced preferred stock. Checks for the dividend will be mailed to all preferred stockholders who shall have exchanged their old certificates of unreduced stock for new certificates of reduced stock prior to the closing of the books on November 5. The entire amount of the unpaid dividends on the preferred stock from July 1, 1893, when the last dividend was paid, to August 17, 1898, the date of the reduction of the capital stock, amounts to $1,527,885, which is $59.89 upon each share of the reduced preferred stock. President C. A. Coffin has issued a circular to the stockholders, notifying [illegible]

Special Correspondence.

NEW YORK NOTES.

THE INCOME OF ELECTRIC VEHICLES.—The Electric Vehicle Company has stipulated the minimum amount which its cabmen must bring in per day. This must average $4, or the men will lose their places. As an in[illegible] offered above the wages of $2 a day, this [illegible] turned in over an average of $[illegible]

ELECTRIC VEHICLES IN A PARADE.—In the jubilee parade of wheel[illegible] there were many automobile vehicles, nine of which were electrically propelled. Four of these were vehicles of the Riker Electric Motor Company and five those of the Electric Vehicle Company, the latter being quite elaborately illuminated with colored incandescent lamps.

THE THIRD AVENUE RAILROAD COMPANY has awarded the contract for the electrical equipment of its lines. The Westinghouse Electric & Manufacturing Company will furnish the electrical apparatus to the value of [illegible] Conduit & [illegible] received the contract [illegible] poles, handholes, etc., will be supplied by the Pennsylvania Steel Company.

[illegible] M. Maurice Hutin, well known to electrical scientists through his joint inventions with M. Leblanc [illegible] this country on business connected with the reorganized work of the Panama Canal. M. Hutin states that he has been forced to abandon his electrical work, [illegible]

[illegible]

CELEBRATING THE OPENING OF THE EIGHTH AVENUE ELECTRIC ROAD.—One night last week a leader of one of the West Side Assembly districts gave a "trolley ride" to his constituents in celebration of the opening of the Eighth Avenue conduit road. Twenty-five cars, brilliantly illuminated, and decorated with flags, etc., started from the corner of Fourteenth Street and proceeded to Harlem. The head car of the procession contained a brass band, which enlivened the occasion with music, and attracted thousands of people to the avenue. The trip was attended with unbounded enthusiasm, as was also the return ride to Seventeenth Street and Eighth Avenue, where a meeting was held.

RECEIVER FOR THE JOHN STEPHENSON COMPANY.—Mr. Charles H. Davis, president; Leander M. Delamater, secretary and treasurer, and A. L. Phillips and B. F. Flint, directors of the John Stephenson Company, the well-known car builders of this city, have begun an action to dissolve the corporation. Justice Cohen, to whom the application was made, appointed as receivers Mr. Albert A. Wilcox and Louis Stern. The petition states that the company cannot meet its maturing obligations. The company is carrying out a number of important and valuable contracts, from which, if they can be completed, considerable profit can be realized which will be of benefit to the creditors of the company. The assets, it is stated, amount to $1,175,776, and the liabilities to $788,782. The capital stock of the company is $150,000 and its pay roll amounts to about $4000 a week. The principal stockholders are H. C. Valentine, $80,000; C. H. Davis, $23,000; J. A. Tackaberry, $14,900; L. M. Delamater, $13,400; N. C. Rogers, $3200, and D. S. Egleston, $2800.

THE MEETING OF THE NEW YORK ELECTRICAL SOCIETY.—The New York Electrical Society met on Wednesday evening, October 26, in the Pearl Street sub-station of the Kings County Electric Light & Power Company, where the general manager, Mr. W. S. Barstow, made a short address on the multiphase generating and distributing system built by the Brooklyn Edison Company, and now owned by the Kings County Company, after which the members and their friends were shown as much of the system as could be seen in one evening. The company was divided into six parties and taken about the circuit of the three stations, namely, the union generating station, station A and the Pearl Street station, at different times and in different order, being transported from station to station in special cars provided by the Brooklyn Heights Railroad Company. Refreshments were served in the stock room of station A, after the visits had been completed. The occasion was perhaps the most instructive and entertaining meeting ever held by the society, and will probably be followed by meetings of the same society in other similar ways and by the visits of other societies to the same system. The following named gentlemen were elected members of the society: Charles E. Spiers, D. Van Nostrand Company, New York; H. Ward Leonard, Bronxville, N. Y.; Harold P. Davis, 918 Union Street, Brooklyn, N. Y.; John C. Slack, 123 Oak Street, Greenpoint, Brooklyn, N. Y.; James H. Mason, 152 East Twenty-third Street, New York; W. F. D. Crane, Reynolds Terrace, Orange, N. J.; Dr. F. S. Kolle, 273 Prospect Avenue, Brooklyn, N. Y.; William A. Brown, Jr., assistant chief electrical engineer Pennsylvania Railroad, Philadelphia, Pa.; Frank D. Sweeten, junior member Vallee Brothers & Co., 625 Arch Street, Philadelphia, Pa.; William A. Brown, chief electrical engineer Pennsylvania Railroad, Broad Street station, Philadelphia, Pa.; Charles Shirley, manager Postal Telegraph Cable Company, 253 Broadway, New York; Albert Eckert Chandler, Postal Telegraph Cable Company, 253 Broadway, New York; Edward J. Powers, 45 Cedar Street, New York; B. F. Hamilton, 510 West Twenty-third Street, New York; Mortimer Lewis Newman, 107 East Ninetieth Street, New York; Lawrence Strauss, 120 East 117th Street, New York; G. Herbert Condict, chief engineer Electric Vehicle Company, 1630 Broadway, New York; James Appleton, chief engineer construction department Electric Storage Battery Company, Drexel Building, Philadelphia, Pa.; Dr. Jean F. Chauveau, Jr., [illegible] Street, New York; George N. Moore, assistant superintendent Edison Electric Illuminating Company, Fifty-third Street station, New York; James J. McKenna, Maintenance Company, St. Paul Building, New York; H. B. Kirkland, 120 Liberty Street, New York; Adolph L. Goldschmidt, 425 East Fiftieth Street, New York; John J. Breslawsky, Leonard & McCoy, 118 Liberty Street, New York, 1735 Madison Avenue, New York; John T. Hunt, Zimdars & Hunt, 127 Fifth Avenue, New York; William M. Stewart, [illegible] Telephone Company, [illegible] Street, New York; Horace [illegible], 363 [illegible] Avenue, Brooklyn, N. Y.; [illegible], Jr., Riverside, N. J.; [illegible] Light & Power Company, Newark, [illegible] Light & Power Company, Newark, N. J.

THE MEETING OF THE AMERICAN INSTITUTE.—The one hundred [illegible] meeting of the American Institute of Electrical Engineers [illegible] October [illegible], the pa[illegible] through the Borough [illegible] read by A. A. Knudson. The [illegible] tween the elevated railroad columns and the water hydrants being about 0.15 of a volt. In the neighborhood of the Brooklyn Bridge considerable differences of potential were found, indicating a flow from the Brookyln end toward the New York end, and thence via the many available routes back to the Kent Avenue power station. This might be expected, as the Brooklyn end of the bridge is in a very congested trolley district, and current would tend to flow from this in almost any direction outward, sweeping around eventually to return to the power station. Further tests made since the trolley cars were put on the bridge showed, if anything, a slight rise of this current instead of a return current from those cars sufficient to balance it. The maximum difference of potential between the bridge structure and ground was found to be about 2¾ volts. The paper discussed the possible effect of this potential difference on the cast-iron bridge anchorages, but no conclusions on the subject were reached. One interesting point shown in the paper was the reduction of rail-cross section on some of the Union Railroad Company's track, showing, as William Maver, Jr., aptly expressed it in the discussion, a notable case of the "biter bitten." President A. E. Kennelly announced that the association had appointed a committee on co-operative research to undertake the work proposed at the general meeting in Omaha in the line of classifying and coordinating the results of thesis work in electrical lines undertaken at the various engineering schools. The committee requests suggestions from the members of the institute and others as to questions of practical importance needing scientific investigation, and will transfer these suggestions to the heads of departments in the institutions, afterward collecting the results obtained and publishing them in the institute's transactions. At the meeting of the executive committee in the afternoon the following associate members were elected: John McL. Murphy, electrical engineer, Safety Third Rail Electric Company, 5 Beekman Street, Room 223, New York; F. K. Vreland, second assistant engineer, Crocker-Wheeler Electric Company, residence, 228 Orange Road, Montclair, N. J.; J. E. Woodbridge, editor The Electrical World, 9 Murray Street, New York. The following associate members were transferred to membership; C. H. Wordingham, city electrical engineer, Manchester, England; William Stanley, electrical engineer and inventor, Pittsfield, Mass.

ELECTRICIANS AT A THEATRE PARTY.—The theatre party referred to in last week's issue of The Electrical World proved so satisfactory and enjoyable that a permanent organization was promptly formed to arrange for similar entertainments in the future. The committee which looked after the details connected with the affair was paid the compliment of being unanimously elected to continue the work. It is probable that the next event will be announced for just after the close of the Lenten season, and it is safe to predict that those who were present on October 25 will endeavor also to attend it. For the benefit of the brethren in other cities who may wish to give themselves a similar treat, it may be mentioned that the idea of the theatre party originated during luncheon one day in a well-known downtown restaurant much frequented by those engaged in electrical pursuits. Two or three of those present were arranging for a theatre party, and the suggestion was made that several others be invited to join, the final result being the appointment of a committee, of which Mr. Harris W. Baker was made chairman, Mr. H. B. Kirkland secretary, and Mr. John H. Dale treasurer, the other members being Mr. E. S. Keefer and Mr. F. W. Harrington. A list was prepared with care of those whom it seemed desirable to invite, and preliminary notifications sent out. As soon as responses were received the committee selected the opera of "The Fortune Teller," and arranged to have electric carriages to convey the party from Wallack's Theatre to the Waldorf-Astoria, where a cosy suite of rooms had been engaged for the evening. A dainty and excellent supper was also ordered, a string band being engaged to add to the gaiety of the occasion, the evening winding up with dancing. The arrangements were so well planned that when the time came everything passed off most pleasantly. The opera was thoroughly enjoyed, so was the exhilarating ride in the electric carriages, and likewise the supper and the sociable reunion at the Waldorf-Astoria. A novelty in the way of a bouquet of roses studded with miniature electric lamps with a dry battery as the source of current was prepared by the committee and presented to Miss Neilsen during the performance. This bouquet was evidently much appreciated both by Miss Neilsen and by the audience. The attendance at the theatre party was not wholly confined to New Yorkers. Mr. and Mrs. Henry B. Cutter were present from Philadelphia, and Mr. and Mrs. A. T. Clark and Col. R. B. Edes cames over from Boston. The others present were: Mr. F. C. Bates, Mr. and Mrs. Harris W. Baker, Mr. and Mrs. C. A. Benton, Mr. Murray Burtis and Mrs. E. A. Lowe, Mr. and Mrs. John H. Dale, Mr. J. S. Douglass, Mr. and Mrs. D. E. Drake, Mr. and Mrs. P. M. Fletcher, Mr. and Mrs. N. W. Gage, Mr. and Mrs. Victor C. Gilpin, Mr. and Mrs. F. W. Harrington, Mr. and Mrs. Charles H. Howard, Mr. and Mrs. Alex. Henderson, Mr. and Mrs. J. C. Hatzel, Mr. and Mrs. T. M. Hartyn, Mr. and Mrs. John T. Hunt and Miss Hunt, Mr. and Mrs. Oscar Hoppe, Mr. E. W. Irwin and Miss J. E. Buckingham, Mr. J. Jones, Jr., and Miss E. J. Jones, Mr. and Mrs. W. J. Johnston, Mr. and Mrs. Philip H. Klein, Jr., Mr. and Mrs. E. R. Knowles, Mr. H. B. Kirkland, Mrs. Mary F. Kelly, Mr. and Mrs. E. S. Keefer, Mr. F. A. Muschenheim and Miss Clementine Denito, Mr and Mrs. John T. McKeever, Jr., Mr. and Mrs. E. P. Morris, Mr. George D. Pitman, Mr. and Mrs. Leonard F. Requa, Mr. Leonard F. Requa, Jr., Mrs. Herman Simon, Mr. and Mrs. W. C. Turner and Mr. W. B. Van de Water and Miss Alice Smith.

New England Notes.

MESSRS. R. S. HALE & J. S. CODMAN, engineers, have formed a partnership under the above title for the practice of steam, electrical and other engineering. The new firm will make a specialty of boiler and engine testing, report on rented power and the value of steam coals, and will carry on a general business of drawing plans and specifications, making estimates, inspections, reports, tests, etc. The offices of the firm are at 31 Milk Street, Boston.

MR. R. L. WHITMAN, of Whitman & Couch, Boston, the well-known telephone manufacturers, has just started on a four weeks' business trip, during which he will cover the principal points in New York State, Pennsylvania, Maryland and Delaware, and visit Western cities. We bespeak for Mr. Whitman a favorable reception wherever he may call, not only because of the excellence of the telephone manufactures and specialties of his firm, but also because of his many admirable personal qualities.

THE BIBBER-WHITE COMPANY, Boston, is increasing its office facilities and accommodations, an addition having just been made to the building adjoining its establishment, and the two connected. A large and magnificent private office has been fitted up for Mr. C. E. Bibber and his associate, Mr. Henry W. Burgett, for the management of the numerous electric railways with which these gentlemen are identified. When it is understood that Mr. Bibber only a little over a year ago took up the business of contracting, constructing and financiering of electric railway enterprises it is remarkable that in this time he has completed roads in Maine and Vermont, and is constructing different branch lines connecting Norton, Attleboro, Taunton, Easton and Mansfield, Mass. These represent a system of 38 miles, nearly all of which is completed and the balance will be finished before December 1. The most important contract he has made, however, is for the building of the Albany, Helderberg & Schoharie Railroad, 48 miles long. This is certainly a creditable record of indomitable energy and activity.

BURTON ELECTRIC TANNING PROCESSES.—This was the subject of an address by Mr. George D. Burton, president of the United States Electrical Leather Process Company, at the Electric Potential dinner, held at Hotel Thorndike, Wednesday evening, October 26, and notwithstanding a heavy downpour of rain quite a number of members were present. The preliminary proceedings having been duly disposed of, Colonel Hewins, president of the club, in a few well-chosen remarks introduced Mr. Burton, who proceeded to illustrate and describe by the aid of lantern slides the various apparatus and processes employed. Before commencing his address Mr. Burton placed in a tank, set up in the room and connected to the ordinary 110-volt Edison circuit, a number of kangaroo skins, from which the hair was removed by the Burton process in about twenty minutes during the progress of his remarks. The process of unhairing hides is effected by means of a vat or tank containing suitable solution, in which the hides are suspended and through which the current is passed by means of electrodes partially immersed therein. These electrodes may be of carbon and lead or of lead and copper or of copper coated with platinum. Screens are provided to protect the hides from actual contact with the electrodes, and there are also means for agitating the liquid. Various forms of apparatus embodying these general features were illustrated and explained by Mr. Burton. He said that the effect of the current was to raise the hair from the skin and thus render the hair pores or cells more accessible to the action of the solution than was the case with the existing methods. He further explained that the comparative rapidity of the electric treatment did not injure the leather, but that in some electrical processes heretofore employed undue haste and excessive currents had been the cause of such injury. In this method the temperature of the solution was not materially raised. The effect of this mode of treatment was to plump the skin, rendering it a trifle smaller and finer and firmer. The tanning process, he said, was substantially similar as to apparatus and procedure, a suitable solution for the purpose, of course, being employed. The operation of the current, Mr. Burton considered, was mainly to open the pores of the material, thus affording the tanning solution better access to the pores. He further stated that the matter has progressed beyond the experimental stage, as the tanning processes were already being used commercially in fifteen or sixteen tanneries. Among the principal advantages claimed are saving of time involved and consequent tying up of capital, some improvement in product and a considerable reduction in space occupied, as a tanner using the electrical process may dispense with at least one-third of his vats. As to the actual saving in dollars and cents information was meagre at present, but in one instance it had been found that there was a saving of 16 cents on every 60-pound hide as compared with the ordinary methods. Mr. Solomon, who is a practical tanner in Newark, N. J., at the invitation of the president also made a few remarks relative to his experience with the Burton tanning system. He stated that it appeared to him that the electric current produced a twitching or wavy movement to the material subjected to the process, which, it appeared, loosened the fibres and rendered them more readily acted upon by the tanning medium employed, thus saving time. He also said that as far as his experience had gone the electrical process not only resulted in a saving of time but also in more satisfactory product. Another point to which he referred was to the fact that under the old processes the hair received from the hides was very liable to be of inferior quality, and not so good for many purposes, owing to the long period of time during which it was subjected to the action of the liquor, whereas in the electrical process the hair was not much injured owing to the shorter time of immersion. He desired to call the attention of gentlemen interested in electrical matters to the large field which presented itself for development in connection with industrial enterprises, and more especially in connection with tanning and dyeing of leather. He said that probably 80 per cent. of the colored leather was dyed black, and logwood was employed for this purpose, which after being applied to the material was set or fixed by one of the salts of iron, producing, of course, oxidation, which had a tendency to harden and injure the surface of the leather, rendering it liable to rapid deterioration. If this oxidation could be readily effected by means of electricity without this injurious action it would be a very valuable thing for the tanning industry. He also said that the same kangaroo skins which Mr. Burton unhaired in the presence of the audience in less than twenty minutes would require eighteen days in their tanning.

Philadelphia Note.

JUBILEE ILLUMINATIONS.—In addition to the special illuminations referred to in considerable detail on another page of this issue there were several others of a private nature which are worthy of mention. A very pretty little device was shown on the front of the Odd Fellows Hall. It consisted of the well-known three-link emblem of this order, the links being in red, white and blue lamps. This design was on one side of the main entrance, while on the other side was a circle enclosing a five-pointed star. The Hotel Stratford on Broad Street made a simple yet attractive display of a large shield on one side and above the main entrance and an anchor on the other side and in line with the shield. An additional feature of the illumination at this point was the use of thirteen large brass candelabra at the front of the reviewing stand erected over the sidewalk in front of the hotel. The lamps used on the candelabra were red, white and blue in alternation, and the effect at night, when they were lighted, was very pretty. The Hotel Bellevue, which adjoins the Union League, showed its patriotism by having a waving American flag over the main entrance. The apparent motion of the flag excited a great deal of wonderment to the thousands of beholders. The Hotel Lafayette was very tastily decorated with strings and festoons of electric lights, which covered the front of the building, and above the main entrance was the word "Peace" in plain white letters.

BUFFALO AND NIAGARA FALLS NOTES.

THE TROLLEY LINE from Buffalo through Tonawanda to Lockport is to be extended to Olcott on the Lake Ontario shore. It is reported that the right of way is already secured, and that an effort will be made to build the line before winter, though it is hardly likely that it can be done.

CONTRACTS are let for the electric apparatus to be used by the McKinnon Dash Company at Black Rock. The 100-hp motor will be furnished by the Westinghouse Company, the direct-current generator motors by the Northern Electric Company, and the 60-cycle alternator and welding apparatus by the Thomson Welding Company. This is the first introduction of machinery of the sort here.

THE LEADING BAKERS of Buffalo are asking for electricity for power. As they use it so irregularly through the day it ought to prove more economical than steam. There is talk also of adapting the current for heating the ovens, which appears not to have been done anywhere as yet. The Mugridge bakery is already taking the current, and the Ovens and Collins companies are negotiating. The amount of power needed is not large.

MUCH SATISFACTION is felt over the announcement made this week that the Canadian Niagara Power Company has paid its rents. For a considerable time they have been allowed to lapse, and it was feared that this was an indication that there was doubt about the keeping up of the franchise obtained on the other side of the river. The payment of $12,500 to the Queen Victoria Niagara Park Commissioners clears up all claims to November 1, and is accepted as proof that the company is not going to give up its franchise.

THE TONAWANDA CATARACT POWER COMPANY was this week added to the many that already exist in direct connection with the power development venture. The capital stock is $100,000, and is controlled by the New York stockholders of the original company, as are all the secondary companies. The object of the company is to distribute the Niagara power current to Tonawanda and vicinity. An Albany dispatch announcing the incorporation expresses surprise that the articles do not give the company power to manufacture electricity, but only to distribute it. This is the simplest matter possible, for the manufactory is already established in Niagara Falls. Work has already begun on a transformer house for the new company.

THE UNION CARBIDE COMPANY at Niagara Falls is already at work on the enlargement of its works, and has hired Harry L. Noyes, of Buffalo, as engineer. The company is now using only 1100 horse-power from the tunnel, but has contracted for 5000 horse-power additional, with an option on 10,000, which appears to be much more than was at first reported, and indicates that very extensive operations are contemplated. Though the production of the basis for acetylene gas by the fusing of coke and lime in an electric furnace, as carried on by the company, is still in its infancy, it would appear that the sale of the product as well as the process of manufacture is assured. The company is said to have the millions of the United Gas Companies of Chicago behind it.

WITH ONE SWITCHBOARD in the new lighting station in Buffalo finished and a second to be completed this week, it is expected that some of the apparatus can be started up in a week or two. The station is to have nine switchboards in all. The finished one is a rotary transformer board for the 550-volt power service, and contains two rotary converter panels and one feeder panel. The second board is for the twelve arc machines and has three panels. The next board will be for the synchronous motor circuits, and will contain six panels. All are of Vermont marble. The eleven transformers furnished by the Conduit Company are in position, and the switchboards are in process of erection by the General Electric Company. There will be four of these boards, [illegible]

ST. LOUIS NOTES.

[illegible] the hands of the mayor awaiting his signature. It is still in doubt [illegible]

[illegible]

[illegible]

MEXICAN NOTES.

[illegible]

the purpose of establishing an electric lighting plant in the city of Tepic, Territory of Tepic.

THE CITY OF CULIACAN is now installing an electric light plant, and it is expected that its formal inauguration will take place about November 15. The electrical equipment was purchased in the United States.

THE TRUNK LINE of the telephone system of the State of San Luis Potosi, extending from the city of San Luis Potosi to the Angostura hacienda, a distance of 250 miles, has just been put in operation. Several lines of new telephone wires will soon cover that State.

ACETYLENE GAS was recently introduced into the city of Mexico, and has come into rapid favor among the smaller shopkeepers. But the explosions and consequent fires have become so numerous from the careless handling of the gas that a stringent order as to the manner in which it shall be used has been promulgated by the municipal authorities.

THE INAUGURATION of the new electric street railway line connecting the cities of Torreon, State of Coahuila, and Lerdo, State of Durango, will soon take place. This will be the first electric line to be placed in operation in Mexico. The track of the road was completed a short time ago, and it has been operated by mule power pending the installation of the electrical equipment.

A GANG OF THIEVES whose special object seems to be to steal telegraph and telephone wire, they even cutting them from the poles, have been operating in the city of Mexico for the past several weeks. Several miles of valuable copper wire have been stolen by them, and the telegraph and telephone business badly interfered with at times on account of the depredations. The thieves sell the wire to junk dealers for good prices, and are apparently doing a profitable business. If captured they will have to pay the death penalty.

CANADIAN NOTES.

MR. JAMES A. BELL has been instructed by the City Council of St. Thomas, Ont., to make a report to Council upon the cost of installing a municipal electric lighting plant.

AT A SPECIAL MEETING of the Orillia, Ont., Town Council, Mr. R. J. Parke, of Toronto, was appointed to prepare specifications for the proposed Ragged Rapids water power scheme.

THE CATARACT POWER COMPANY, of Hamilton, Ont., has connected its transformers with the Hamilton city wires of the Hamilton Electric Light & Power Company, and the incandescent lights were supplied with current developed at Decew's Falls, which are about 34 miles distant from the city.

AN IMPORTANT QUESTION is to come up at the next meeting of the Hull Electric Company, of the city of Hull, opposite Ottawa, in Quebec province. A project is on foot to alter the cars now in use so that they can be run at a speed of 40 miles an hour. By doing this less cars will, it is calculated, be required, and therefore less men will be employed.

MR. W. C. McDONALD, the millionaire tobacco manufacturer of Montreal and the generous benefactor of McGill University, of that city, has again demonstrated the interest he takes in that institution of learning by presenting to the department of electrical enginering the sum of $30,000, with which to purchase the best and most modern electrical apparatus. This gift will enable the department to acquire much needed apparatus, and it is said that when all is in place the department will take first rank among the many of its class on this continent.

IT IS confidently predicted that the valley of the St. Maurice River, which is now a densely wooded wilderness, will in ten years be a hive of industry. Three immense enterprises are already at work—the Shawinigan Power Company, Laurentide Pulp Company and the Canada Iron Furnace Company. The first-named company is preparing to develop electric power in large quantities, available for industries which will follow, and for transmission to Montreal, Quebec and other manufacturing centres. The natural lay of the land and water is such that power can be developed at a minimum of cost. The company is proceeding to install a plant which will be able to develop 30,000 horse-power, to be eventually increased to over 100,000 horse-power. The engineers estimate that 200,000 horse-power can be developed.

THE TORONTO STREET RAILWAY COMPANY is considering a scheme for a system of radial electrical roads to run out of Toronto through the Province of Ontario. The matter has been before the company's board in an informal way for some time, but a meeting was held last week to see if some practical scheme could not be evolved. The assembling in Toronto of many well-known capitalists on October 21, who are all largely identified with electric railway ventures, lends color to the report. The party held a conference at the street railway company's board rooms, but the result of the meeting [illegible] It is known that a scheme for an extension [illegible] street railway line to the outlying suburban districts was under [illegible], but there is an impression that something of greater moment is [illegible] than the local radial extension.

FRENCH NOTES.

THE LIGHTING OF THE GRAND THEATRE AT BORDEAUX.—At a [illegible] of Bordeaux approved the appropriation [illegible] for lighting the Grand Theatre by electricity. [illegible] electricity, made with the gas [illegible] the company refused to renew it. [illegible] economy, and the plan is [illegible] The generators and gas engines [illegible] the lobby. The installation all [illegible] payable in [illegible] yearly installments, and must [illegible] made at the [illegible] were thrown out because [illegible] of engine required, the require- [illegible] This naturally left [illegible] the particular manufacturer, as the sole bidder, and the contract was awarded to him at 79,000 francs. It was with this same practical engineer that the administration had proposed to treat for a private contract.

IMPROVEMENT IN THE SURFACE CONTACT SYSTEM of electric railways, by the General Electric Traction Company.—These improvements concern the roadbed of the type of railway where the car takes power from contact flush with the ground and provided with a concealed interrupting mechanism controlled by the passage of the car. It has been found extremely difficult to build these contact boxes so that they will stay tight. Moisture gets in and condenses on the surfaces of the contact pieces, with the result of keeping them electrically in connection when they should be insulated from one another. In this way the contact boxes may become a source of danger to passers in the street. To get rid of this rather serious difficulty the contact portion of the box is connected to the rail through a resistance, which is sufficiently high to render the leakage through it on the passage of the car quite small. If a film of water or ice forms between the movable piece and the contact, making the latter alive, a current is at once established and the heat generated in the film of moisture will volatilize it at once. The invention contemplates in addition a system of piping to convey artificially dried air to the contact boxes during wet weather. The pressure required to force this air through the system is quite low.

THE TEACHING OF ELECTRICAL SCIENCE IN PARIS.—The first attempt to set up a special school for electrical science in Paris was no earlier than 1894, and even then the Government took no interest in the matter. Everything that was done was at the initiative of the International Society of Electricians, which was organized in 1881, and which established a central electrical laboratory. The courses offered by this establishment, which is known by the name of Ecole Supérieure d'Electricité, last one year, and comprise lectures and practical work. The latter portion includes laboratory work, machine-shop work, machine testing, inspection of the stations and electrical works in the various districts of Paris. Graduates from certain schools, such as the Ecole Centrale, the Ecole des Mines, the Ecole Polytechnique, etc., are admitted without examination; all other students must pass an examination. The Minister of Commerce has authorized the Ecole Centrale to contribute to the support of such of its students as have passed its graduation examinations, and who wish to complete their electrical education at this school. The object of the school is to furnish to young men who intend to be electrical engineers and who have received a general technical education the means of completing their education in one year. The number of pupils that can be received is very limited, owing to the lack of funds, which makes it impossible to buy sufficient apparatus. There were twelve the first year, sixteen in 1896, and, finally, last July twenty-seven were graduated. As is the case at the Montefiore Institute, pupils from all nations are admitted. At the last voting of the budget of 1898, it was decided to furnish the Government with a special fund to establish courses in electrical science at each of the three Schools of Arts and Professions. The curriculum of these establishments has been rearranged so as to give this new study a place ranking with that which the subject has made for itself among the industries. The new programme makes it evident that great care will be bestowed on electrical measurements, the study of alternating and multiphase currents, the transmission of power, electric chemistry, electro-metallurgy, telephony and telegraphy. The last part, entitled "practical work," details the tests, experiments and manual work which the pupils will be required to take. It seems probable, and we earnestly wish, with M. E. Payen, who is an expert in these matters, that instruction in electricity in France will be put on a par with that in other countries. Moreover, private initiative will doubtless enter the field also. The University of Grenoble has announced that it will add to its faculty of sciences a chair for the instruction of the theory and practice of industrial electricity. Being situated in a country where numerous waterfalls invite the installation of electrical enterprises this course should be of the greatest service.

General News.

THE TELEGRAPH AND TELEPHONE.

PEORIA, ILL.—The Citizens' Telephone Exchange has been organized here with a capital of $200,000. The incorporators are Deloss Brown, M. F. Farwell and John Skinner.

LOCKPORT, ILL.—The People's Telephone Company has been organized in this place with a capital stock of $12,000. The incorporators are Allen G. Hawley, Charles B. Cheadle and Thomas A. Cheadle.

HAVANA, CUBA.—The central telephone station here was destroyed by fire on the night of October 17. It is stated that the electric light wires came in contact with the telephone wires, and the fire was the result.

BOSTON, MASS.—A feat in telephony, marking the farthest advance yet in the science, was accomplished a few days ago, by talking over the wire from Boston to Kansas City. The distance is about 1560 miles, and it is said to be the longest distance ever covered by a single telephonic circuit.

DANVILLE, ILL.—Danville and Indianapolis are to be connected by a copper line of telephone wires as soon as the line can be constructed. A company of Indianapolis capitalists has been formed, having plenty of money behind it, and the work has already been begun. It is called the Danville Telephone Company, with headquarters at this place. The right of way has been secured from Indianapolis to Crawfordsville, and agents of the company are now engaged in securing right of way from there to this city. It is hoped to get in full working order by January 1.

KANSAS CITY, MO.—The Standard Telephone Company bought all the lines and equipment of the Central Missouri Telephone Company a few days ago, and assumed control of the system. This gives the Standard about 1000 miles of lines in the States, and will give Kansas City communication with 150 Missouri towns. The Standard has adopted a plan very much on the order of that used by telegraph companies. In case some one wishes to telephone some town and the wire is in use a message of twenty words may be written and sent by the operator at the same rate that a telegram of ten words would cost.

LA CROSSE, WIS.—It was thought that the recent purchase by the Bell interests of independent toll lines in Minnesota, Iowa and Dakota would cripple the La Crosse Telephone Company to such an extent that it might be forced out of the long-distance business in this territory. This, however, turns out not to be the case. The La Crosse Company, it is stated, has just completed a traffic agreement with the Standard Telephone Company, with headquarters at Britt, Ia., another independent concern, whereby practically all of its former Western connections are regained and many new towns have been added to the toll line lists. A flat rate of 15 cents for five-minute talks to any point on the new system has been inaugurated.

ELECTRIC LIGHT AND POWER.

LIMA, OHIO.—The City Council has decided to investigate the cost of an electric light plant with the view of building one for the illumination of the city.

ROME, N. Y.—The taxpayers of Herkimer voted upon the proposition to bond the village for $13,000 to be used in constructing an electric light plant. The proposition was carried.

MERRILL, WIS.—Fire, originated by a spark from a heated clutch in the main shaft in the power house of the Merrill Lighting & Railway Company, destroyed that plant, together with the B. Scott Lumber Company's mill adjoining. The railway and light company's plant was valued at $10,000, and insured for $3000.

PRESCOTT, ARIZ.—Louis C. F. Lotz, Henry S. Hildreth and Charles Y. Wanpuzer have incorporated the Black Canyon Hydraulic & Electric Power Company, with a capital of $5,000,000. The company proposes to do a general mining business and to develop electric power from the Colorado River at the Grand Canyon. The incorporators are New Yorkers.

ROCHESTER, N. Y.—The construction of the electric light system in Charlotte, N. Y., was awarded by the Municipal Board of that place to the Westinghouse Electric & Manufacturing Company, represented by T. C. Frenyear, of Buffalo. Two generators will be used, capable of furnishing 125 arc lamps of 2000 candle-power each. The bid was for $8450. Work will be begun immediately, and the system will be in working order, according to contract, by January 1, 1899.

ALBANY, N. Y.—The Tonawanda Cataract Power Company was incorporated on October 26 for the purpose of distributing electricity for light, heat and power within the town of Wheatfield and the city of North Tonawanda, Niagara County, and the town and village of Tonawanda, Erie County, N. Y. The capital stock of the company is $100,000, and the directors are Charles A. Sweet and Lincoln A. Grow, Buffalo; Edward D. Adams, Francis Lynde Stetson, Edward A. Wickes and William B. Rankine, New York.

NORWAY, ME.—The electric power plant failed to furnish power a few nights ago because the water is too low to run the dynamos. Streets, stores, residences and other places in this village and South Paris were in darkness. The Supreme Court had to borrow kerosene lamps. Street cars were stalled in Main Street. The large shoe factories, newspaper offices, mills and other manufacturing plants were temporarily without power. The water system of the twin villages, which depends upon electric power, is threatened.

WASHINGTON, D. C.—The introduction of electricity in the State, War and Navy Building has brought about a great improvement in the building in the matter of furnishing light to the employees. Before this was done the average number of 16-cp gas lamps was 144; now the average number of 16-cp electric lamps is 428. The great increase in the quantity of light used by the clerks is an indication of their better facilities for work. The Executive Mansion is now also lighted from the plant in the State, War and Navy Building. The lamps in the two buildings aggregate 3400, and the motors aggregate 27.75 horse-power.

THE ELECTRIC RAILWAY.

SEDALIA, MO.—The Sedalia Electric & Railway Company has been organized, with a capital of $400,000, by C. H. Reeve, J. C. Lelong, J. C. Van Riper, E. C. Evans and A. H. Trader.

TOLEDO, OHIO.—The Toledo Traction Company, of which Norman B. Ream, of Chicago, is the principal stockholder, has purchased the Toledo Electric Company, the purchase price being $325,000.

BELLOWS FALLS, VT.—The Bellows Falls & Saxton's River Street Railway Company has been organized by J. H. Molton, of Burlington, Vt., president; A. N. Awain, vice-president, and George A. Weston, of Bellows Falls, secretary. The company proposes to do a passenger and freight business on its road.

SAGINAW, MICH.—Homer Loring, representing the bondholders of the Union Street Railway Company, who has been receiver of the two local organizations the past year, has bid in the properties for the newly consolidated company. His bid for both was $307,500. The companies will be reorganized under the control of the Boston bondholders.

SANTIAGO DE CUBA.—General Wood has forwarded to Washington a recommendation that concessions to two companies, made up of English, American and Cuban capitalists, be immediately granted. One of these companies desires to construct an electric railway in this city on the overhead trolley system, and the other proposes to build a standard-gauge railway from the city of Santiago to the western limit of the province, to connect there with the line to be built from Havana as soon as a stable government is established.

ELIZABETH, N. J.—The application of the Elizabeth Street Railroad Company for permission to change the motive power of its East Jersey street line from horse to electricity was practically killed by the Common Council. The street committee reported an ordinance granting the desired permission, but coupled it with a provision that the fare for a single ride between the hours of 5 and 7 in the morning and 5 and [illegible]

Engle announced that the company could not afford to accept the franchise under the conditions named.

PITTSBURG, PA.—Judge Joseph Buffington has appointed A. L. Sailor and Wm. A. Brown receivers of the Braddock Electric Railway Company. The bill was filed by Isaac M. Heidelberg and A. L. Sailor, president of the company, and Wm. A. Brown, a holder. The bill states that the company is insolvent, the road not in operation and the property and assets are fast depreciating in value. The bonded debt is $40,000, on which no interest has been paid since November, 1897. The company was authorized to run an electric railway in North Braddock and East Pittsburg.

CHICAGO, ILL.—Tracks are now being laid in Plymouth Place south from Polk Street, in this city, for a storage battery or underground conduit line of the General Electric Company, which has held a franchise to this territory for two years. Work was commenced at midnight on October 30, and carried on until 2 o'clock in the morning, when the Western Indiana Railroad Company determined to put a stop to it. A freight train was backed down to the place and derailed in such a way as to stop further work on the new line. The rival gangs of men clashed, and the police were called out. Injunctions have been served at the instance of the Western Indiana Railroad against the officials of the company which is laying the tracks. The courts will be called upon.

BOUND BROOK, N. J.—This place and Plainfield, which are 12 miles apart, are now connected by a trolley line, which was opened for service on October 29. The first car over the new line, which is operated by the Brunswick Traction Company, was in charge of the secretary, Edward H. Radel. The passengers were officials of Middlesex, Somerset and Union counties, and they had with them a band to enliven the occasion. When the car reached Lincoln, Mrs. Emma Engel, president of the Borough Council, took charge of the car and ran it through the town. She had with her Mrs. Flora P. Wrench and Mrs. Olivia Hazard, both members of the Council. When the car reached the station at Lincoln, Mrs. Engel alighted and drove home a nickel spike, which formally completed the line. The new line connects Plainfield and Raritan by way of Lincoln, Dunellen, Bound Brook and Somerville.

NEW HAVEN, CONN.—Stockholders of the Fair Haven & Westville Street Railway Company, of this city, have been called to a meeting on October 31, to act on a proposition for acquiring control of the properties of the New Haven Street Railway Company. The latter corporation owns lines to Fair Haven and Westville competing with the Fair Haven & Westville Company; also branch lines to Cosy Beach, Lighthouse Point, Lake Saltonstall and Morris Cove, and a cross-country line to Mount Carmel, 12 miles distant. It has $1,000,000 of capital stock issued for purchase of the roads of other companies, for construction and equipment, a first mortgage of $600,000, a purchase-money mortgage of $250,000, besides two small divisional mortgages. The company paid last year 2½ per cent. on its stock. It owns or controls about 40 miles of track and about one-half the mileage of all trolley roads centring in this city. The consolidation of the two properties will greatly facilitate traffic and transfers on the New Haven system of trolley roads, which has heretofore been marked by a good deal of friction and public inconvenience.

PERSONAL NOTE.

MR. ARTHUR CLIFTON GARRISON, secretary and treasurer of the Columbia Incandescent Lamp Company, St. Louis, Mo., is to be married November 9 to Miss Frances Billingsley, of the same city. As the executive head of one of the leading lamp manufacturing companies, Mr. Garrison is well known to the readers of THE ELECTRICAL WORLD. Under his management the Columbia Company has made rapid strides, and is turning out excellent goods. We feel sure, therefore, that our readers will join us in wishing the couple a long life of prosperity and happiness.

OBITUARY NOTE.

CLARENCE G. DAVENPORT, who was for several years connected with [illegible] and who was a corporal in Company F of the First United States Volunteer Engineers, died in Porto Rico on the night of October 26, of typhoid fever. The deceased was a son of the Rev. J. G. Davenport, of Waterbury, Conn., and was an associate member of the American Institute of Electrical Engineers.

EDUCATIONAL NOTES.

[illegible]

[illegible]

[illegible] twelve free public lectures on physics and electricity is being given by Prof. [illegible] Forty-second Street. The first one was given on October 1. Those yet to be delivered are on the dates and subjects named, viz., November 5, "The Me-[illegible]

Directory of Scientific Societies, Associations, Etc., and Meetings of the Same.

THE MARITIME ELECTRICAL ASSOCIATION.—President, F. A. Bowman, of New Glasgow, N. S.; secretary, J. H. Winfield, New Glasgow, N. S. Last meeting, Halifax, N. S., September 27-28, 1898.

THE KANSAS GAS, WATER & ELECTRIC LIGHT ASSOCIATION.—Organized at Topeka, September 26, 1898. President, L. F. Palmer, Leavenworth; secretary and treasurer, J. H. Foley, Leavenworth.

THE BROOKLYN INSTITUTE OF ARTS AND SCIENCES, Brooklyn, N. Y. Henry T. Weed, secretary. Future meetings: November 4, illustrated lecture by T. C. Martin; December 2, lecture by Prof. William E. Geyer, Stevens Institute; January 6, lecture on "The Electro-Metallurgy of Copper," by John B. F. Hereschoff; February 3, lecture and experimental demonstrations by Prof. M. I. Pupin; March 3, illustrated lecture on "Electricity in the Navy," by Captain Zalinski, U. S. N.; April 7, lecture on "Cable Telegraphy," by A. E. Kennelly; May 5, lecture by Prof. William A. Anthony.

CHICAGO ELECTRICAL ASSOCIATION.—Meetings, first and third Friday of each month, from October 1 to June 1; J. R. Cravath, secretary, Monadnock Block, Chicago, Ill. Future meetings and papers for the season of 1898-99: "Practical Points on Electrical Measurement," by W. B. Hale; November 4, "The Electrical Equipment of a Model Printing Establishment," by George A. Damon; November 18, "The Development of the Motorcycle," by F. B. Rae; December 2, "Practical Points in Street Railway Engineering," by W. A. Harding; December 16, "Wireless Telegraphy," by Arthur V. Abbott; January 6, 1899, "Telephone Engineering—Some Problems Solved and Unsolved," by S. G. McMeen; January 20, "Observations on Ventilating Fans," Gerard Swope.

FRANKLIN INSTITUTE (Electrical Section), Philadelphia, Pa.—Secretary, Wm. H. Wahl. Programme of lectures for the season 1898-99: November 8, "Concerning Electrical Instruments," by Mr. J. F. Stevens, and "The Status of Electrical Invention," by Mr. William A. Rosenbaum; November 22, "Thermoelectricity," by Mr. C. J. Reed, and "Electric Elevators," by Mr. William Baxter, Jr.; December 13, "The Kite As an Instrument in Meteorological Research," by Prof. Charles F. Marvin, of the United States Weather Bureau, and "Standards of Light for Electric Light Photometry," by Prof. A. J. Rowland; January 24, 1899, "The Practical Application of the Electric Motor to Printing Press Machinery," by W. H. Tapley; February 14, "The Electric Inspection of Street Car Equipments," by Mr. A. B. Herrick; February 28, "Some of the Larger Transportation Problems in Cities," by E. E. Higgins; March 28, "Water Power Electric Plants in the United States," by Mr. B. C. Washington, Jr.; April 25, "Design of Electromagnetic Mechanism, with Especial Reference to High Frequency Telegraphic Receivers," by Prof. Reginald A. Fessenden; May 23, "Electrical Clocks, Historically Considered; with a description of the Most Successful Applications of Electricity to Clocks and the Uniform Distribution of Time," by Mr. James Hamblett. On February 10 Mr. T. Commerford Martin will deliver a lecture under the joint patronage of the institute and the Central Branch of the Y. M. C. A. on the subject of "Electric Power Transmission."

Trade and Industrial Notes.

MESSRS. HUEBEL & MANGER, Brooklyn, N. Y., state that they have made enough bells to make a ring around the world if they were placed within hearing distance of one another.

THE WESTERN ELECTRIC COMPANY has in stock a large and complete assortment of weatherproof sockets and receptacles for T.-H., Edison and Westinghouse bases. Orders for material of this kind will receive prompt attention.

CLOSING OF ONE OF THE WALKER FACTORIES.—By the time this paper is in the hands of its readers the works of the Walker Company at New Haven, Conn., will be closed down, the work previously handled there being transferred to the works of the Westinghouse factory at East Pittsburg.

"IMPERIAL LAMP GAZETTE" is the title of a four-page sheet devoted to "a monthly discussion of timely topics on incandescent lamps." It will be published on the first of each month by the Bryan-Marsh Company, 136 Liberty Street, New York. A feature of interest in this publication will be the reproduction of circulars issued by prominent stations to their customers.

THE ELECTRIC APPLIANCE COMPANY, Chicago, Ill., is meeting with great success in the sale of its combination fuse block and lightning arrester for telephone work. It seems to fill a large demand for an efficient device for protecting telephone apparatus, and the company states that it has yet to hear of a single case where the instrument has failed to operate in an entirely satisfactory manner.

MESSRS. GOULD & EBERHARDT, Newark, N. J., are just shipping to Rock Island, Ill., eight of their improved drills for the United States Government, and some to Brooklyn, N. Y. They have a number of other government orders for their patent extension base shapers for the various arsenals, besides some for automatic gear-cutting machines. Their works have been very busy for [illegible] on orders for their improved tools.

THE AMERICAN REFLECTOR & LIGHTING COMPANY, 271-273 Franklin Street, Chicago, has issued a forty-page catalogue, illustrating its Paragon reflectors. These reflectors are adapted to electric, gas and oil lighting, and it is stated render available [illegible] per cent more light. They are made in a great variety of forms, the object being to have each reflector give the best possible results, all things being considered. It is stated that experiments have demonstrated that the increase of light varies from 300 to [illegible] per cent.

THE RASTER CARBON RHEOSTAT COMPANY, Chicago, reports that [illegible] very flattering offers for some of its [illegible] electric heaters, etc., by syndicates which have investigated and found the rheostat to be of value. The Raster Carbon Rheostat Company [illegible] considering the advisability of disposing of its [illegible] though the price offered by the syndicate is said to be large. The company believes it possible to handle these goods without foreign capital, and thus retain its right to the patents.

INSTRUMENTI ELETTRICI.—An illustrated catalogue of electrical instruments, manufactured by C. Olivetti, of Ivrea, Italy, has been received with a notice in English of the special arrangements for export to America. The instruments are largely of school and testing laboratory types, consisting of Thomson galvanometers, standard resistances, Daniell cells, mercury commutators for storage battery work in laboratories, reversing plug switches, lamps for illuminating scales, etc. Some of the instruments embody designs which show considerable ingenuity. The catalogue also states that the house will soon have on the market 12-inch-dial central station ammeters and voltmeters, Wheatstone bridges, potentiometers and a new line of switches.

INCREASING USE OF ENCLOSED ARC LAMPS.—The General Electric Company notes the increasing use of enclosed arc lamps on multiple circuits, and a corresponding decrease in the number of open arc lamps. Within the past few months the Missouri Edison Electric Light Company, of St. Louis, Mo., has placed not less than 700 General Electric single-globe enclosed arc lamps upon its alternating-current circuits. These are used for interior illumination, and it is reported are giving very satisfactory service. They replaced 18-ampere, 30-volt open-arc alternating lamps. The May Shoe & Clothing Store in Denver, Col., is now brilliantly illuminated throughout by 130 General Electric enclosed arc lamps, of both the single and double globe type, and Messrs. Boggs & Buhl, of Allegheny, Pa., have just installed not less than 200 General Electric enclosed arc lamps of the double-globe type in their dry goods department. The whiteness of the light enables purchasers to select their goods with the assurance that the colors will not prove any different when brought to the light of day.

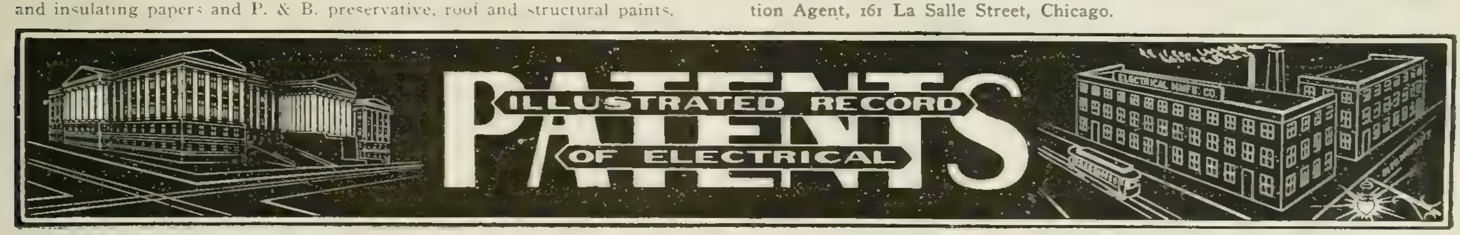
P. & B. PRODUCTS ABROAD.—The Standard Paint Company, of New York, began in July of last year the erection of a factory at Hamburg, Germany, where the same products that are manufactured at the American works of the company are now regularly manufactured for the European trade. The Hamburg factory was finished in February of this year, and is now in complete operation. Mr. R. L. Shainwald, the president of the company, has given a great deal of time and thought to the European enterprise, and states that there is a very large demand for all grades of P. & B. products in European countries. This demand refers especially to P. & B. electrical compound and P. & B. tape and armature varnish. These, it is stated, are in use by nearly all the large manufacturers and traction companies in European countries. Besides the production of the various manufactures for electrical trades the Hamburg works turn out P. & B. rubberoid roofing, P. & B. building, sheathing and insulating papers and P. & B. preservative, roof and structural paints.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY, Cincinnati, Ohio, is preparing to move to its new shops at Norwood, Ohio. The company reports that it has been so rushed with orders that it could not spare the time to build the electrical apparatus it will need in its new shops. It is now building two large generators, which are to be direct-connected to a cross-compound engine, built by the Lane & Bodley Company, of Cincinnati. These generators are to furnish power for the machine shop, which is already finished and which is to be driven entirely by electrical power. As soon as these generators are completed the company will move—probably in about two weeks. The Bullock Company has lately gotten out a new type of enclosed motor for use in factories and machine shops, for direct connection to cranes, machine tools, etc. The Pacific Coast Borax Company ordered ten of these motors, aggregating 160 horse-power, to be geared to various tools. The Midland Steel Company ordered this type of motors for its traveling cranes, and two more orders were recently received for motors to be used directly in the headstock of lathes. The New York "Sun" has just ordered from the Bullock Company another 30-hp press equipment, to be similar to the equipments already furnished to that paper. This equipment is to be used on the Bullock teaser system. The Toronto "Globe" has also ordered a like equipment of 40 horse-power for a large Hoe press, and Unwin Brothers, of London, have ordered another press motor like the one they last received from the Bullock Company. The company reports having entered orders for a couple of generators for direct connection to gas engines, and a 100-hp motor and 150-kw generator, slow speed, three bearings, for J. B. King, Roslyn, L. I. Besides the above, the Bullock Company states that it has received many orders for its standard apparatus.

Business Notices.

THE ILLUSTRATIONS **in this issue were made by the Photo-Engraving** Company, 9-15 Murray Street, New York City.

THE WAR IS OVER, and now our thoughts are all of peace and home. There are, too often, people to be found who have no home, and it is to them these few words are addressed. If you really want a home you can easily get one, but you should act at once before the relapse from the war puts prices on the advance. In Marinette County, Wisconsin, the very finest farming land is to be had now at a most modest figure. Excellent home markets are at hand to take whatever the farmer raises, and good prices are given. These lands are on the Chicago, Milwaukee & St. Paul Railway, and full information concerning them will cheerfully be furnished by C. E. Rollins, Immigration Agent, 161 La Salle Street, Chicago.



UNITED STATES PATENTS ISSUED OCTOBER 25, 1898.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

612,810. RAILWAY SIGNAL; W. Andrews, of London, England. App. filed Dec. 20, 1897. The combination of two electromagnetic indicators on the engine, one of which indicators is responsible to a strong current only, and the other to current of less strength; circuit connections, and means located at a signal station to, at the will of an operator, transmit a current of such strength as to actuate both indicators, or a current of less strength to actuate only one of said indicators.

612,875. TROLLEY STAND; W. T. Shyrock, of Allegheny, Pa. App. filed July 20, 1897. In a trolley for an electric railway, a support rotatably secured to the top of the car, a trolley pole pivoted in said support, a rod secured in said support and carrying on one end a supporting block, a tripping block pivoted to said supporting block, a sliding sleeve mounted on said rod engaging rods carried by the tripping block, rods secured to the trolley pole and to a sliding block, whereby the trolley pole is held in engagement with the current wire.

612,880. ELECTRIC CONTACT BOX; J. N. Thomas and W. M. Brown, of Johnstown, Pa. App. filed March 22, 1898. The combination with the vessel and terminal therein of the pedestal connected to one side of the circuit, the nut connecting the said terminal and pedestal and the locking pin.

612,885. ANNUNCIATOR; O. Wiederhold, of Summit, N. J. App. filed October 2, 1897. An armature formed up from sheet metal and provided with a recess in its side conforming in shape to the magnet pole, with which the said armature is to be used, and a thin wall bounding the said recess and extending at an angle to the face of the armature and adapted to be acted on by the magnet.

612,929. INSULATOR AND HANGER FOR ELECTRIC RAILWAYS; W. C. Keithly, of San Francisco, Cal. App. filed Jan. 26, 1898. An insulator and hanger for electric railways of the character described, having a depending bolt, the upper end of which is locked within the insulator, a protecting plate surrounding said bolt below the insulator and an elastic spring interposed between the plate and the insulator.

612,977. ARMATURE WINDING; A. L. Riker, of New York, N. Y. App. filed Nov. 19, 1897. A coil for armature windings composed of a number of turns of round wire forming a hexagonal figure having two straight parallel sides to occupy slots in the armature core, connecting parts in substantially the same plane as the sides, and a downward bend at each end of the coil, the latter being of a thickness of two wires across the bend, and of one wire elsewhere, substantially as described.

612,979. INDICATION BOX FOR SWITCHES; J. B. Struble, of Wilkinsburg, Pa. App. filed March 1, 1898. The combination of two contacts forming terminals of switch-indicating circuits, two movable contact blocks for closing said circuits, and means for shifting one of said blocks prior to the unlocking of the switch and other block subsequent to the locking of the switch in its shifted position, substantially as described.

613,036. TELEPHONE EXCHANGE SYSTEM; C. H. Heilman, of Philadelphia, Pa. App. filed Nov. 21, 1896. The combination with the electromagnet and the switch plunger controlled by the electromagnet of a speaking circuit, a rock lever adapted to open and close the speaking circuit and a key lever pivoted on the plunger and adapted to operate the rock lever.

613,046. AUTOMATIC LEAK OR GROUND CUT-OUT; W. L. Pratt, of Adams, N. Y. App. filed May 20, 1896. An automatic leak cut-out, comprising a hinged arm, a loop connection carried thereby, a double-armed fuse wire normally in circuit holding said arm, a branch circuit to ground, condensers and a magnet included in said branch circuit and an armature adapted to fuse said fuse wire, when the leakage of current has sufficiently accumulated in the condensers so that a discharge to ground will occur.

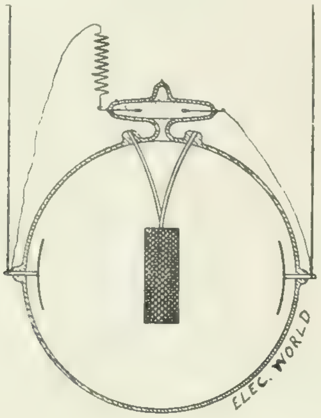
613,054. ELECTRIC FAN; D. L. Bates and R. H. Bates, of Dayton, Ohio. App. filed July 21, 1898. In an electric fan motor, the combination with a central motor support of a sleeve or tubular support for the armature, fan blades and commutator, the said sleeve or armature support surrounding the motor support and providing a bearing for the armature and fan blades substantially the length of the motor support, a combined oil cup and fan blade support attached to the upper end of said sleeve, and a stationary oil cup at the lower end of said sleeve, in which the latter has a bearing, substantially as described.

613,062. THERMOSTAT; W. E. Facer, of Cleveland, Ohio. App. filed Nov. 4, 1897. In a thermostat, in combination, a thin metal receptacle filled with an expansible liquid, and having two flexible discs forming parts of its wall, a yoke fixed to said receptacle and extending in front of one disc, a pin secured to said disc, and mechanism actuating upon said pin to draw the disc outward, a spring between the yoke and disc and actuating to press said disc inward, and a circuit-breaking device in contact with and adapted to be operated by the other flexible disc, substantially as described.

613,080. TELEGRAPHY; C. D. Royse, of Greencastle, and W. A. Royse, of Indianapolis, Ind. App. filed Aug. 11, 1897. In a telegraphic system resistance coils connected in the main line in series, a shunt around said resistance coils adapted to normally shunt out said resistance coils, and a telegraphic key adapted, when operated in its usual capacity, to break the shunt around the resistance coils at each depression of said key and throw the current through said coils, and adapted to again complete the shunt when the key is released.

613,084. UNDERGROUND ELECTRIC RAILWAY; G. W. Smith, of St. Louis, Mo. App. filed May 28, 1898. The combination of a car platform, a lever fulcrumed thereon, a conduit, a hanger operated by said lever and suspended in said conduit, a trolley wire, a flexible tube in said conduit and in which said trolley wire is located, a series of contact shoes placed in and at the top of said tube, and brushes carried by the car and in electrical connection with said contact shoes, substantially as described.

613,090. APPARATUS FOR PRODUCING RADIATION OF ELECTRICITY; C. H. Stearn and C. F. Topham, of London, England. App. filed Dec. 20, 1897. In a lamp or illuminating device for giving light by action of cathode rays on an anti-cathode, the combination with an exhausted vessel, of a cathode within said vessel, an anti-cathode also within said vessel made of material—such as refractory oxide or thorium or other refractory oxides or earths—which can be rendered incandescent by currents which are practically available for lighting purposes, substantially as described.

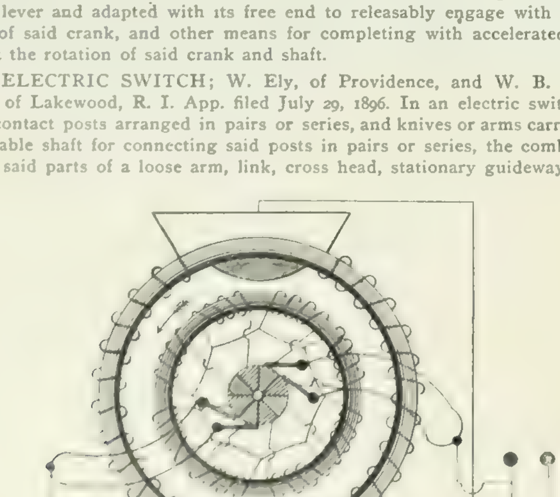


No. 613,090.—Apparatus for Producing Radiation of Electricity.

613,116. DYNAMO-ELECTRIC MACHINE OR MOTOR; S. G. Brown, of London, England. App. filed April 9, 1898. A dynamo or motor having a commutating field separate from and at a higher potential than the rest of the magnetic field, substantially as described.

613,128. ELECTRIC SWITCH; William Ely, of Providence, R. I. App. filed Sept. 5, 1896. In an electric switch having a rotatable shaft, contacts carried by said shaft, and a crank or arm secured upon said shaft, combined with said parts, the described means for imparting initial movements to said crank and shaft in one direction only, said means consisting of a lever pivoted at one end, and a pawl pivoted at one end to the pivoted end of said lever and adapted with its free end to releasably engage with the free end of said crank, and other means for completing with accelerated movement the rotation of said crank and shaft.

613,129. ELECTRIC SWITCH; W. Ely, of Providence, and W. B. Bernardini, of Lakewood, R. I. App. filed July 29, 1896. In an electric switch having contact posts arranged in pairs or series, and knives or arms carried by a rotatable shaft for connecting said posts in pairs or series, the combination with said parts of a loose arm, link, cross head, stationary guideway, crank [illegible]



No. [illegible].—Alternating-Current Electric Motor.

[illegible]

613,[illegible]. ALTERNATING-CURRENT ELECTRIC MOTOR; [illegible]

of the said commutator and devices intervening between the said core and the said brushes, whereby the latter are automatically shifted forward on the said commutator by the action of the said solenoid when the speed of the rotor approaches synchronism, substantially as described.

613,140. CIGAR LIGHTER; A. C. Gruhlke, of Waterloo, Ind. App. filed Jan. 19, 1898. In a cigar lighter, the combination, with a body, a lever carried by the said body, and a tongue pivotally connected with the said lever, being limited in its movements in direction of the said body, of a receptacle, a spout for the same, the spout being a conductor of electricity and being provided with a gas chamber above the said spout, and conducting wires connecting with the body and with the said tongue, as described.

613,175. UNDERGROUND ELECTRIC RAILWAY SYSTEM; F. D. Robb, of Hot Springs, Ark. App. filed July 2, 1897. A conduit comprising a sectional casing, hooks and studs on opposite sections for uniting the same, the upper part of one side of the curved body of each section being cut out to form an opening communicating with the interior of the casing, curved hinged doors adapted to close said openings, and means for securing the door in a closed position, substantially as described.

613,177. SAFETY DEVICE FOR SUSPENDED CONDUCTORS; J. N. Thomas, of Johnstown, Pa. App. filed Jan. 20, 1898. The combination of a main feeder in connection with one side of the circuit, a bared conductor, an electromagnetic switch connected to the main feeder and to a central portion of said conductor, and an energizing coil composed of two accumulative windings, one of which is connected to one end of the conductor and the other to the other end of the conductor.

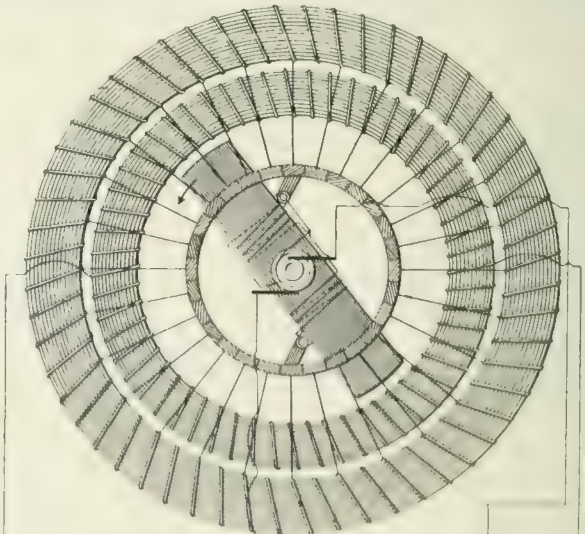
613,181. TROLLEY POLE; J. Walsh, of Elyria, Ohio. App. filed Nov. 2, 1896. The combination with a car of a pivoted trolley pole provided at its upper end with a cross-head having guides, a sliding rod situated within said guides, and a rotatable trolley wheel through which said rod extends.

613,203. ALTERNATING-CURRENT MOTOR SYSTEM AND METHOD OF OPERATING SAME; M. Hutin and M. Leblanc, of Paris, France. App. filed April 10, 1897. The method of starting a single-phase alternating-current motor from rest under load, which consists in supplying multiphase e. m. f. to the circuits of its induced windings from an external source.

613,204. ALTERNATING-CURRENT ASYNCHRONOUS MACHINE; M. Hutin and M. Leblanc, of Paris, France. App. filed May 4, 1897. In an asynchronous dynamo electric machine, the combination with the inducing member of an induced member and a phase-regulating dynamo machine of the direct-current type, having an alternating field of force, connected thereto.

613,205. ELECTRIC-CURRENT LEVELER; M. Hutin and M. Leblanc, of Paris, France. App. filed Dec. 16, 1897. The combination of a magnetic, laminated core, a high resistance metal spool thereon, a winding on the spool and a series of annular iron laminæ surrounding the core to close its magnetic circuit, substantially as described.

613,206. METHOD OF AND MEANS FOR SYNCHRONIZING; M. Hutin and M. Leblanc, of Paris, France. App. filed Dec. 30, 1897. The method of synchronizing two or more alternate current dynamo electric machines, electrically connected together, which consists in varying an extra load on one or more of those machines by and in accordance with any departure from synchronism, substantially as described.



No. 613,209.—Alternating-Current Dynamo-Electric Machine.

613,209. ALTERNATING-CURRENT DYNAMO-ELECTRIC MACHINE; M. Leblanc, of Paris, France. App. filed April 10, 1897. The method of operating an electric motor, which consists in supplying its field magnet windings with direct current and its armature with alternating current through the same line.

The Electrical World.

VOL. XXXII. NEW YORK, NOVEMBER 12, 1898. No. 20.

PUBLISHED EVERY SATURDAY BY

THE W. J. JOHNSTON COMPANY,

9 Murray Street, New York.

Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York.

New England Office, 620 Atlantic Ave., Boston.
Western Office, 936 Monadnock Block, Chicago.
Philadelphia Office, 929 Chestnut Street.

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THE ELECTRICAL WORLD,

9 Murray Street, New York.

VOL. XXXII. NEW YORK, NOVEMBER 12, 1893. No. 20.

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FIELD EXCITATION OF ALTERNATING-CURRENT DYNAMOS.

The regulation of the voltage of direct-current generators with variable load is most readily accomplished by means of series windings which, as the load increases, build up the field magnetization to balance the drop in voltage which would otherwise occur, owing to various causes, such as the drop in speed, the ohmic drop in the machine, the reaction and distortion of the armature magnetization, etc. As a rule, the compounding effect is even made greater in order to balance out also the line drop. With alternating-current machines of large sizes this system is impractical, and what is worse, the drop in an alternating-current machine is likely to be considerably greater than in a direct. This is due in part to the fact that the self-induction of the armature winding adds to the ohmic drop, and if, for any reason, such as the use of motors, the load becomes inductive, there is a demagnetizing tendency of the armature which does not exist to any extent with direct-current machines.

Combined light and power alternating systems, especially those competing with Edison installations, wherein the voltage regulation is commendably perfect, are clamoring for closer and closer regulation, and insist of late on a 5 per cent. drop in a machine as a maximum between no load and full load non-inductive. Even with this their troubles are not ended, as with increase of load, the various drops of speed, machine, line and transformer impedance combined necessitate a wide range of the field-resistance adjustment to give constant potential at the lamps; so that a quick change of load or of the power factor of the load, such as may occur with induction motors driving elevators, for example, causes a noticeable variation of the candle power, no matter how quick and expert the switchboard attendant may be. Any means of reducing this necessary variation of the exciting-current strength offers an improvement in such machinery even if the actual regulation of the machine remains the same. Such a means is the expenditure of the magneto-motive force of the exciting coils on the air gap instead of the iron of the magnetic circuit. In other words, a machine with a high-reluctance air gap and an unsaturated magnetic circuit will give better regulation with combined light and power loads than will another machine of the same capacity with the same watts in the exciting coil, but with a narrow gap of large area and a saturated field.

The reason of this may be explained somewhat as follows: The demagnetizing action of the same load on the field magnets of the two machines would be the same and would require exactly the same increase of ampere turns in the two fields, but the reactive drop in the armature, the drop in the speed and the drop in the line would require a much smaller variation of the exciting current and a consequently smaller change of rheostat in the case of the machine with the wide air gap, as this machine would work on a much steeper portion of the magnetization curve, and a given percentage variation of the exciting current would cause, therefore, a greater percentage variation of the voltage than in the case of the other machine. Incidentally also a wide air gap reduces the self-induction of the armature somewhat, a gain which can also be made use of by the finer distribution of the windings by the use of narrower teeth and slots and more of them.

As between two machines with the same iron, the one having a wider air gap than the other, the same principle applies at a given density; the one with the wider air gap has a steeper magnetization curve and its voltage is consequently adjusted with a smaller variation of the series resistance in the field circuit. In this case also the proportion of the field to the armature ampere turns is greater, because of the increased field magneto-motive force necessary, and on this account any increase of the energy load or addition to the reactive load causes a smaller internal drop. As between two machines of the same gap, but with different cross-sections of iron, the one with the lesser iron running above the bend of the magnetization curve and the other below, that with the over-saturated iron will require a greater exciting current, and will therefore have a greater ratio of field to armature ampere turns, which is an advantage; but that with the more iron will have a steeper magnetization curve, which in itself is an advantage. The best combination for regulation purposes seems to be that of a wide gap—from one-half to three-fourths of an inch—with unsaturated iron, and the design of a machine that requires a very small percentage of its output for the excitation purposes is not a thing in the present state of the art to be proud of, as many take to be the case. Such a machine with a wide gap is expensive, good regulation in alternating-current machinery being with present methods much more expensive than in direct, requiring under any circumstances a high ratio of field to armature ampere turns, which means a large amount of material and unfortunately a large iron loss for a given output, since in general this ratio is obtained not by any change in design or construction but by the simple process of scaling down the rated output 25, 30 or 50 per cent. below that imposed by the heating limit.

HIGHER TROLLEY VOLTAGES.

Whenever a street railway system extends to points so far from the power house that the copper required for proper feeding begins to alarm its management, recourse is usually had to one of several makeshifts; new power plants are installed, boosters or storage-battery sub-stations are put in, or a three-wire system or an alternating-current rotary-transformer system is installed. There are numerous excellent interurban and suburban railway projects under discussion whose realization is hampered by the short reach of the ordinary 500-volt distribution, and whose projectors are daunted by the disadvantages of each of these various alternative plans. A simple, but so far untried, solution of these difficulties is the raising of the voltage.

This [illegible] dangerous cutting of the Gordian knot of difficulties which [illegible] too large to be properly worked from a single source of current supply, say 500 volts, and [illegible] sub-station [illegible], but [illegible] to solve the problem than any [illegible]. There are difficulties [illegible] but there are [illegible]. [illegible] It [illegible] high as its adopters dared to go, and great were the difficulties it led them into at that time. But conditions are different now, so [illegible] by 75 per cent., or allowing the same cars scattered over lines of [illegible] with the same copper. The disadvantages for cross-country lines are by no means as great as they seem.

The matter of the danger of high trolley voltages has recently been brought up in Switzerland in connection with the proposal of Messrs. Brown, Boveri & Co. to use 750 volts alternating on several three-phase trolley lines, the conditions of which are even worse in some respects than those of direct-current work, owing to the fact that there would be two trolley wires close together with a pressure of 750 volts between them. To dispel the fears of the Swiss Railway Commission, advice was obtained of three experts, Messrs. Gisbert Kapp, Silvanus Thompson and H. F. Weber. The first considered that 750 volts was no more dangerous than 500, as the latter had been known to give fatal effects, and argued that on account of its apparent security it was really more dangerous than the higher voltage, which would secure greater respect, an argument that would perhaps not appeal to American workers on tower wagons who are never seriously hurt by 500 volts, but would be likely to be by the other. Professor Thompson also considered that the satisfactory working of trolley pressures up to 1500 volts was only a question of careful engineering. The third expert considered these high pressures perilous, but small compared with the other dangers of high-speed railroad running, and justified by the advantages which might be derived.

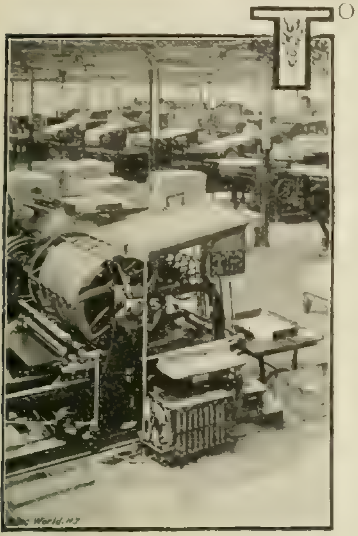
Insulation is not a real difficulty. Of course, more strain insulators would be needed in the line and more care in the insulation of the motors. For long-distance work the latter, however, are generally of large size, running double-truck cars at high speeds, and the insulation is comparatively easy with the increased room. To manage large currents at these high pressures, the controllers might require further modifications, but there are ample opportunities for quick-break devices and other improvements to solve this problem. The greatest difficulty would be to obtain a system whereby the same cars could be run at high voltage in interurban and suburban work and at low voltage in the city streets. On account of the desired difference in speed the same motors might work well at 750 or 1000 volts on suburban lines and at 500 volts on the city streets, the only difficulty being with the electric lighting of the cars, a detail which might be worth abandoning on account of the advantages to be gained. Now that four-motor equipments are coming into considerable use for heavy, long-distance service it would be a simple matter to arrange the motors in pairs, the two of each pair to be worked in series on the 1000-volt lines and in multiple on the 500-volt lines, by means of a single throw-over switch, the two pairs to be worked together with the ordinary series-parallel control.

THE ENTERTAINMENT ACCOUNT.

A pernicious custom apparently inseparable from competition, and one which is perhaps followed to a greater extreme in the sale of electrical apparatus than in any other line of transactions, is the practice of treating. The prospective buyer of a boiler, engine or dynamo, his engineer, architect or agent, is transported about the country nominally to inspect similar installations, dined and wined and made the object of an outrageously wasteful expenditure of money in many other ways. Unfortunately, this process in the case of large orders is a cheaper method of obtaining business than the use of high-grade material and workmanship in the construction of the apparatus. It thus gives unprincipled manufacturers an advantage which must be met by those attempting to maintain a high standard by similar tactics, necessitating either an increase of prices or a deterioration of the quality. The commonsense purchaser must realize that a manufacturer who does not stoop to such practices can supply a better equipment at the same price with the same profit than the one who spends a considerable percentage of the contract price in "blowing off" the prospective buyer, but more often the one treated is an agent or consultant who cares more for this petty form of bribery than he does for his employer's interests. The practice is a degrading one both morally and industrially, but for its eradication we will probably have to wait until the millennium.

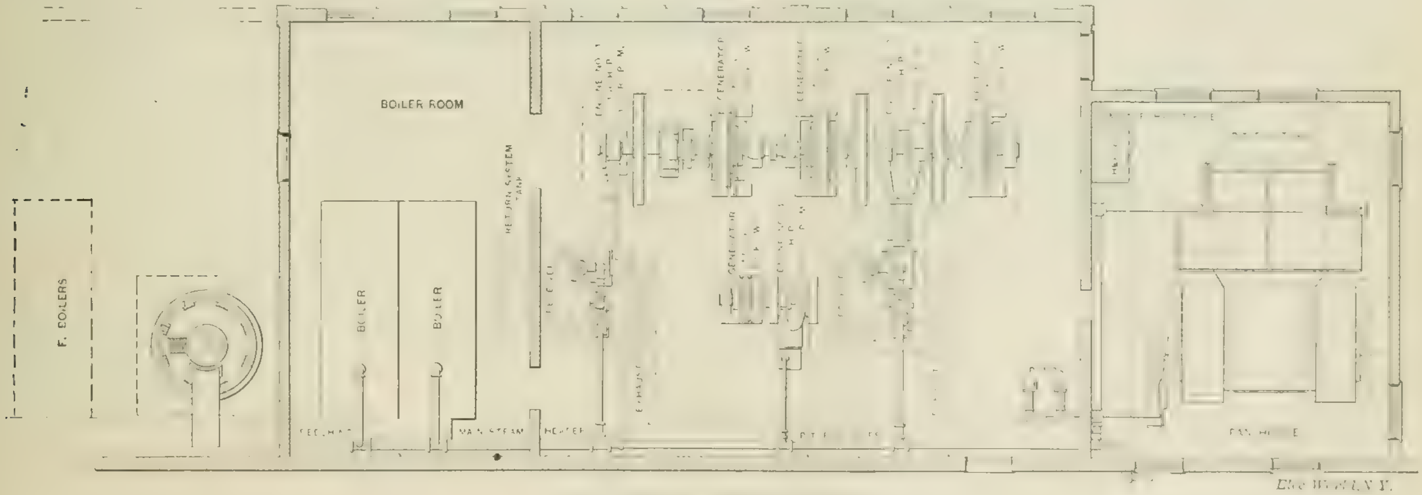
The Electrical Equipment of a Model Printing Establishment.

BY GEORGE A. DAMON.



To even a casual observer the part which electricity is playing in industrial movements is an interesting study. The concentration of great manufacturing establishments about water powers and the opening up of vast suburban districts about our cities by means of the rapidly moving electric car are everyday instances of the influence of electrical development upon constantly changing industrial conditions. Perhaps less evident, but none the less important, are the changes which are brought about by the use of the electric motor in the operation of manufacturing establishments, a notable example of which is described below in a reprint, slightly abstracted, of a paper read before the Chicago Electrical Association, November 4, 1898:

There are few instances where the adoption of electric power has led to such a radical departure from ordinary methods or where greater advantage has been taken of the possibilities of electrical operation, than in the model printing establishment of the W. B. Conkey Company, at Hammond, Ind. The operation of this immense plant in its former location, the centre of a great city, presented many disadvantages. Taxes were necessarily high, insurance rates oppressive, and the cartage of raw material and finished product to and from the depots through a congested business district was slow and expensive, while its movement by the railroads was unsatisfactory. The mill construction of the buildings, their location with respect to surrounding structures, and the extent of floor space employed made it necessary to supply artificial illumination to many parts of the factory during the entire period of operation. The relative location of the buildings made it necessary to maintain two distinct plants for power, heat and light. Power was transmitted from the engine flywheel to the various machines by means of belts and rope drives. By actual tests fully 45 per cent. of the power delivered by the engine to the main driving shaft, at average load, was used to run the shafting, and this transmission loss was, of course, much larger at lighter loads.



Plan View of Power Plant.

A consideration of these disadvantages led the company to seek a new location with more advantageous conditions. Hammond is practically a suburb of Chicago, being connected to it by an electric road and six lines of steam railways. The belt line makes direct connection with fourteen trunk lines centering in Chicago. A special car leaving Chicago every night delivers small local freight upon the shipping platform of the plant at Hammond every morning. With the same freight rates as formerly, it has been found that the cost and time of handling shipments have been materially reduced in the new location.

The plant is located on a stretch of rolling prairie land, and the building covers about four acres of ground space. It is 520 by 450 feet in size, and consists of but one floor, which makes it possible to pay especial attention to the lighting, and, as a result, the whole roof resembles a vast skylight. The windows of the roof are glazed with frosted glass, and are placed at an angle looking toward the north. Owing to the angle of the roof the direct rays of the sun are kept out of the building, which is thus lighted by the soft reflected rays from the northern sky. It would be hard to conceive of a more evenly or more thoroughly lighted factory building.

The arrangement of the power plant is shown below. The boilers are of the horizontal water-tube type, with 3472 square feet of heating surface and 60 square feet of grate surface per boiler. At the present time two boilers are installed, and the stack is situated so as eventually to be flanked on either side by two boilers of the completed battery of four. The breeching from the boilers to the stack is of sheet steel.

The stack is a self-supporting steel chimney 125 feet high and 54 inches in diameter inside the gas flue. A unique feature of the stack is the method used of inverting each section so that the top end of each section comes outside the section immediately above it. This prevents the soot washing through the joints and down the outside of the stack, as is too frequently the case with steel chimneys.

The engine, shown upon the left end of the row of generating machinery, is an 11½-inch and 18-inch by 30-inch tandem-compound non-densing Corliss engine, and runs at 125 r. p. m. This speed is rather high for a Corliss engine, but indicates the tendency of modern practice where the engine is directly connected to a generator. When properly designed there seems to be little reason why an engine with releasing valves should not be run at this speed, and if successful at this number of r. p. m. we probably will not be satisfied until the speed is again raised. As long as the cost of electric generators of a given size increases in proportion as their speed is decreased there will be greater pressure brought to bear upon engine builders to produce a successful engine of the Corliss or similar type running faster than the ordinary 80 to 100 r. p. m. For power plants of this character the Corliss type of engine, in the minds of a great many engineers and purchasers, has advantages of economy in steam consumption and low cost of maintenance which engines of the high-speed type do not possess. The objection when directly connected to a generator is the cost of the unit.

This engine is fitted with double eccentrics and governors on both cylinders, the governor being of the Porter type. The special design of the double-ported admission valves permits a quick cut-off, while the operation of the steam and exhaust valves by separate eccentrics gives the engine a long range of cut-off and large reserve capacity for overloads.

With 120 pounds initial steam pressure and a back pressure of three pounds the engine is rated at 160 indicated horse-power, and is guaranteed to develop each indicated horse-power hour on a consumption of 21 pounds of steam. It has an economical range of power between 100 indicated horse-power and 225 indicated horse-power, but is designed in all its parts to operate continuously on an overload of 100 per cent., or at 320 indicated horse-power. Provision has been made in the piping to carry this overload by admitting high-pressure steam to the low-pressure cylinder.

The generators are compound wound, and are designed to deliver 100 kw output at 225 volts when running at 125 r. p. m. The field frame is split through the centre in a horizontal plane, so that the upper part can be removed. This operation will not be necessary, however, in case repairs are required on the armature windings or field coils, as provision has been made to slide the entire armature frame parallel to the shaft, along cast-iron footings, a sufficient distance to clear the armature.

The arrangement of machinery in the power plant is shown on page 499. It will be seen that this plan calls for two engines and three generators. The second engine is also a tandem-compound, non-condensing engine, but is of the centre-crank type, with overhanging flywheels. This engine is of twice the horse-power of the side-crank engine; that is, it can develop sufficient power to operate economically two of the 100-kw generators, though when necessary it will be able to operate all three of the generators.

The whole line of machinery is connected on the "Arnold system" of power-station construction. In this system each generator armature is mounted in such a way as to be perfectly independent of the remaining machinery, and by means of a suitable coupling can be put in operation or thrown out of service at will. The shaft upon which each generator armature is mounted is made hollow, so as to allow a solid shaft to be carried through it. This solid shaft is supported in two independent bearings near its middle and extends from engine to engine, but under normal operating conditions it is independent of the engines and of the generator shafts and lies idle in its bearings. Each end of this shaft is provided with a suitable coupling, so that it can be operated by either engine or by both working in unison. The result of this ingenious arrangement of shaft, hollow quills, bearings and couplings, is that each generator can be operated by more than one engine. In a plant arranged with direct-coupled units this feature is a decided additional advantage, for the units can be operated in much the same maner as in a belted plant. Ordinarily in a direct-coupled plant the stopping of a generator will shut down its driving engine, or if an engine breaks down its generator must necessarily be [illegible].

[illegible] has been adopted to provide for an increasing demand for power in this plant may prove of interest. At the present time engine No. 1 and generator No. 1 have been installed and are now handling the load. A smaller 50-kw high-speed unit is being placed in position for the purpose of carrying the load when the press-room is working all night. It may also be [illegible] for the lighting circuits when the combined power and lighting load becomes too large for the Corliss engine and 100-kw unit. Eventually, as the load is increased in size, engine No. 2 and the two additional generators will be installed, and the plant will then be ready to furnish economically all demands for power over a range of from 75 to [illegible] horse-power. It will be capable of handling a load of 400 horse-power, with a reserve unit for operation in case of accident. The provision for admitting high-pressure steam into the low-pressure cylinder and the capability of the engine for standing an overload have already been mentioned. By taking advantage of these arrangements the smaller Corliss engine can be made to carry double its rated horse-power and take the load of the larger engine.

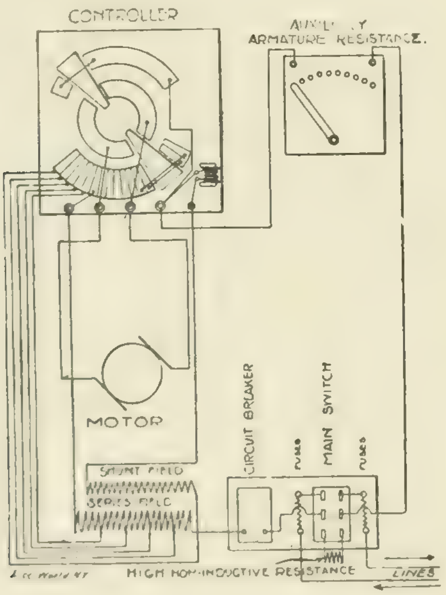
The engine and generator foundation consists of a solid monolith of concrete 8 feet deep and of sufficient width to give ample footing for the machinery. Water-tight iron pipes run through this foundation and under the cement floor of the engine-room to the back of the switchboard for the purpose of carrying the generator leads. These leads consist of stranded rubber-covered and braided lead-encased cables of 600,000 circular mils cross-sectional area.

The switchboard is of highly polished black enameled slate, 1½ inches in thickness, with the usual indicating and regulating instruments. Separate omnibus bars are provided for the power circuits and the lighting circuits. Each generator is furnished with two main switches, by means of which it may be operated on either the light or the power circuits, or upon both at the same time.

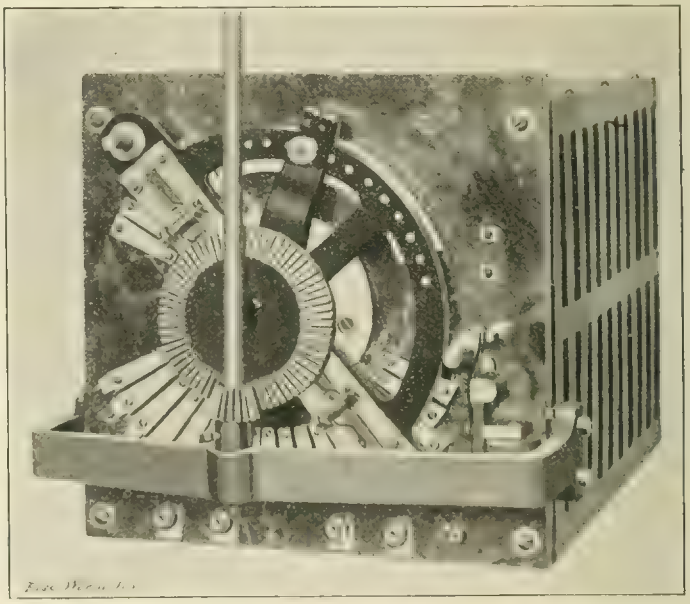
Each feeder leaving the board passes through a fuse, the cut-outs being fastened in a row upon a special fuse block at the top and back of the board. From this block the feeders pass directly through the wall of the engine room into the factory. The power and lighting distributing systems throughout the plant are independent of each other. In the factory two main distributing centres are located in central positions. These centres consist of small switchboards fastened to the wall and surrounded with a hardwood asbestos-lined cabinet. The main feeders are carried on the under side of the iron roof truss on porcelain insulators fastened to iron beams, which are firmly bolted up against the angle iron of the roof. The distributing circuits are carried upon porcelain insulators attached directly to the under side of the wooden roof beams and above the iron trusses. All the feeders and mains are thus installed in the "open-work" style of construction. A workmanlike job has been done, however, and the wiring presents a very neat appearance.

The leads to the various motors and the wires to the arc lamps and switches are carried in iron-armored insulating conduit. In the case of a press motor, for instance, a porcelain cut out in a suitable box is placed at the top of an iron column 12 feet from the floor. From the bottom of this cut out box a single run of conduit is led down the side of the column, and thence along a groove in the floor to the motor. All the wiring about the presses, between the main switch, the controller, and the motor, is carried in iron conduit in such a way as to be thoroughly protected from mechanical injury.

The lighting of the plant is accomplished by means of constant potential enclosed arc lamps. Experience has shown that a very satisfactory illumination can be obtained by hanging a lamp in the middle of each bay and from every other roof truss. This makes each



Controller Connections.



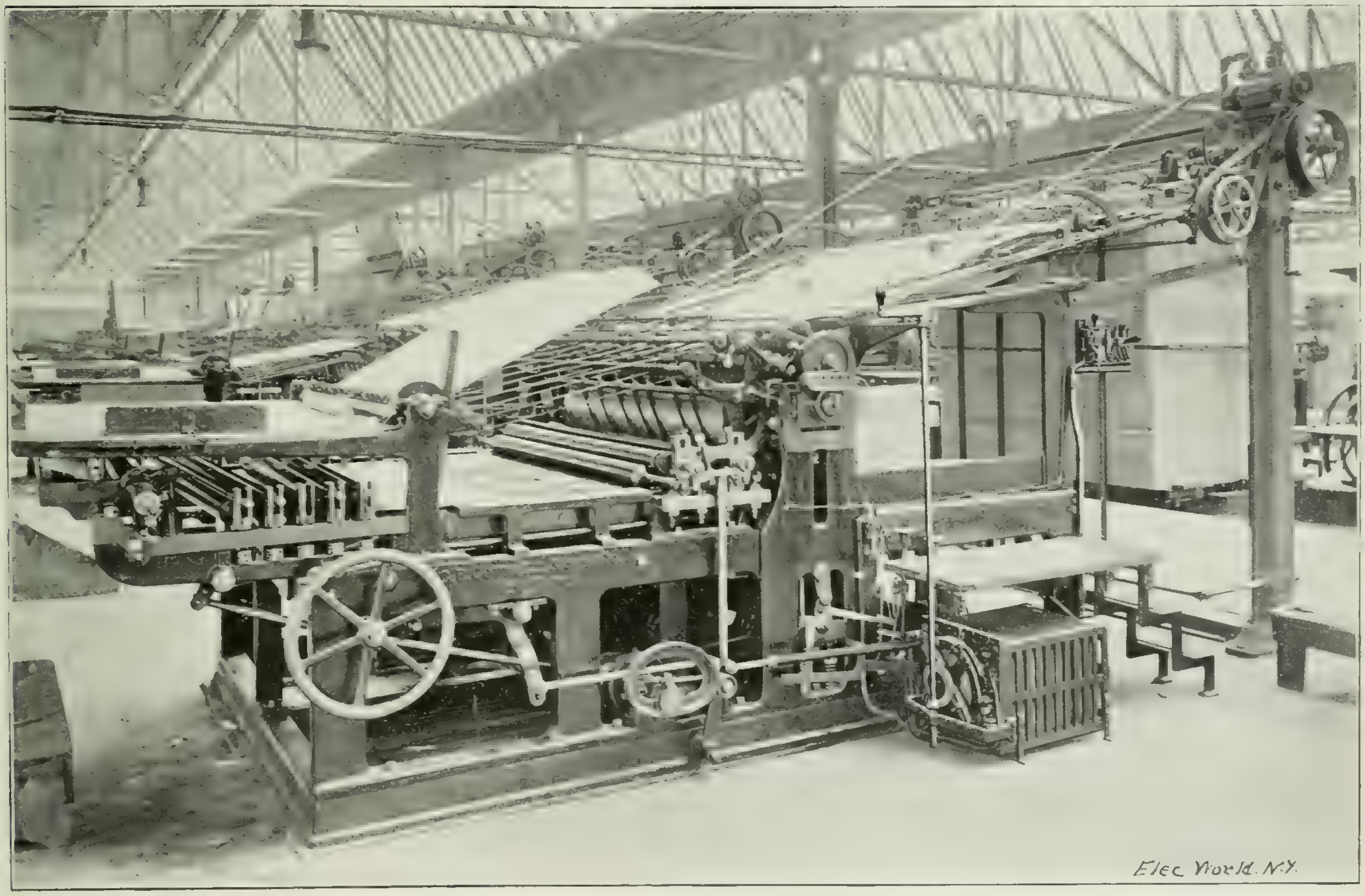
One of the Motor Controllers.

lamp supply light to a floor space 29 x 32 feet. Where better illumination is required for any special work, incandescent drop lights are placed, and, sometimes, as upon the presses, portable incandescent lamps with an allowance of cord are provided for work requiring occasionally a temporary light.

The arc lamps are controlled by double-pole, 220-volt snap switches carried on slate bases, securely attached to the side of the iron columns. The wiring to and from the switches and to the arc lamps is run in iron-armored conduit fastened to the columns and to the under side of the roof trusses. At every lamp opening the conduit contains a tee branching down, and to this tee is screwed a short nipple carrying a hook upon which the lamp is hung. By this method of installation the wires are entirely concealed. Each set of four lamps is protected by a cut-out placed in a manner similar to the ones protecting the motor leads.

There are installed in the plant at the present time a total of 95 motors, with a total of 321 horse-power.

The motors throughout are of the Lundell type, those directly attached to the presses being multipolar, with a relatively large diameter. The commutator, like the armature, is short and of large diameter, with a large number of bars.



View of Press-room, Showing Skylight Unobstructed by Belting or Shafting. Motor-Driven Press in Foreground.

There are various considerations which usually determine in each case whether a motor should be belted, geared or directly coupled to a machine, or perhaps indicate that the machine should be grouped with others of its class and driven from a common shaft. For instance, there are certain classes of machinery, such as folders, stitchers, type-setting and type-distributing machines, etc., which take but a very small amount of power, which are each in operation almost continuously and which can be arranged in rows convenient to a line-shaft. There are few, if any, advantages to be gained by driving such machines with individual motors, and especially is this the case when the driving shaft can be placed below the floor, as is done in the plant under consideration. The machine belts pass directly down through the floor to pulleys carried upon a shaft supported by floor stands bolted to planks in the bottom of the shaft pit. This pit is built with a concrete bottom and brick side walls, and is covered with the floor built in sections, so that it can be removed for purposes of inspection and oiling. The shaft is driven by a belted motor set upon a stand at the wall end. This motor rack is made of three by three timber, securely bolted together, and fastened to the floor. Underneath the motor and between the legs of the rack is placed the starting box, mounted on a slate base, which also contains the main-line switch and the fuses for the protection of the motor. Each box is also provided with an overload attachment which will break the circuit in case of an excessive current. As a rule the motors belted to a line-shaft in this way are shunt wound and run at a speed of 1000 r. p. m.

It may seem strange, in view of the admitted losses in line shafting, that any shafting whatever was allowed in the plant, but when the inefficiency of very small motors and their comparatively large cost of installation are considered, reasons will not be found lacking for putting a limit on the tendency toward individual machine driving. In some cases, such as paper cutters, smashers or embossing machines, which depend largely upon the inertia of their moving parts to furnish the power for their operation, a great advantage is gained by having a number belted to a line-shaft, and thus operated by a common source of power, for, under such conditions, each machine gets the benefit of the stored momentum of the fly-wheels of the entire line. A case in point is that of six cutters and a book-binding machine operated by one 5-hp motor. Individual driving would have required at least seven 1-hp motors, and the result would have been far from satisfactory or economical. On the other hand, there are machines which may take a small amount of power, but which are in operation only intermittently, or perhaps cannot be conveniently located in positions to be belted to a line-shaft. Such instances are found in the electrotype foundry, where there are numerous small machines, each with its individual motor either belted or attached by gearing.

The driving of the large presses, however, presents the most problems. Here the conditions of operation leave but little doubt that individual motors should be provided. But whether to belt, gear or direct couple the motor to the press is the problem. The belted equipment is the cheapest, the easiest to buy and install, and the more convenient to repair, as an injured motor can be quickly replaced. The higher speed at which they run furnishes a certain amount of inertia to carry the press over the "centres" of each impression. The belted motor takes up valuable room, however, and as it must be protected it usually presents an unsightly appearance. The geared motor can be installed in most cases and is an improvement over the belted type, though the increased cost of its installation makes its advantage a doubtful one. The direct-coupled motor takes the place occupied by the driving pulleys of a belt-driven press, and thus has the advantages of neatness and compactness. As presses are usually built, the main driving shaft makes five revolutions to every impression, so that a press operating at 1440 impressions per hour requires a direct-coupled motor running at 120 r. p. m. This slow speed means a large and comparatively expensive motor. Its armature must be keyed directly to the press shaft, and this often means that the shaft of the old press must be taken out to have an extension welded upon it. The slow speed of the armature prevents the accumulation of energy to help the press over the centres. In spite of these disadvantages, however, the improvement in the mechanical design of the equipment with direct-coupled motors over the belted or geared arrangements and the longer life of the slower-running motors were thought to be sufficient to justify the extra investment, and, therefore, motors directly coupled to the forty-eight presses were installed.

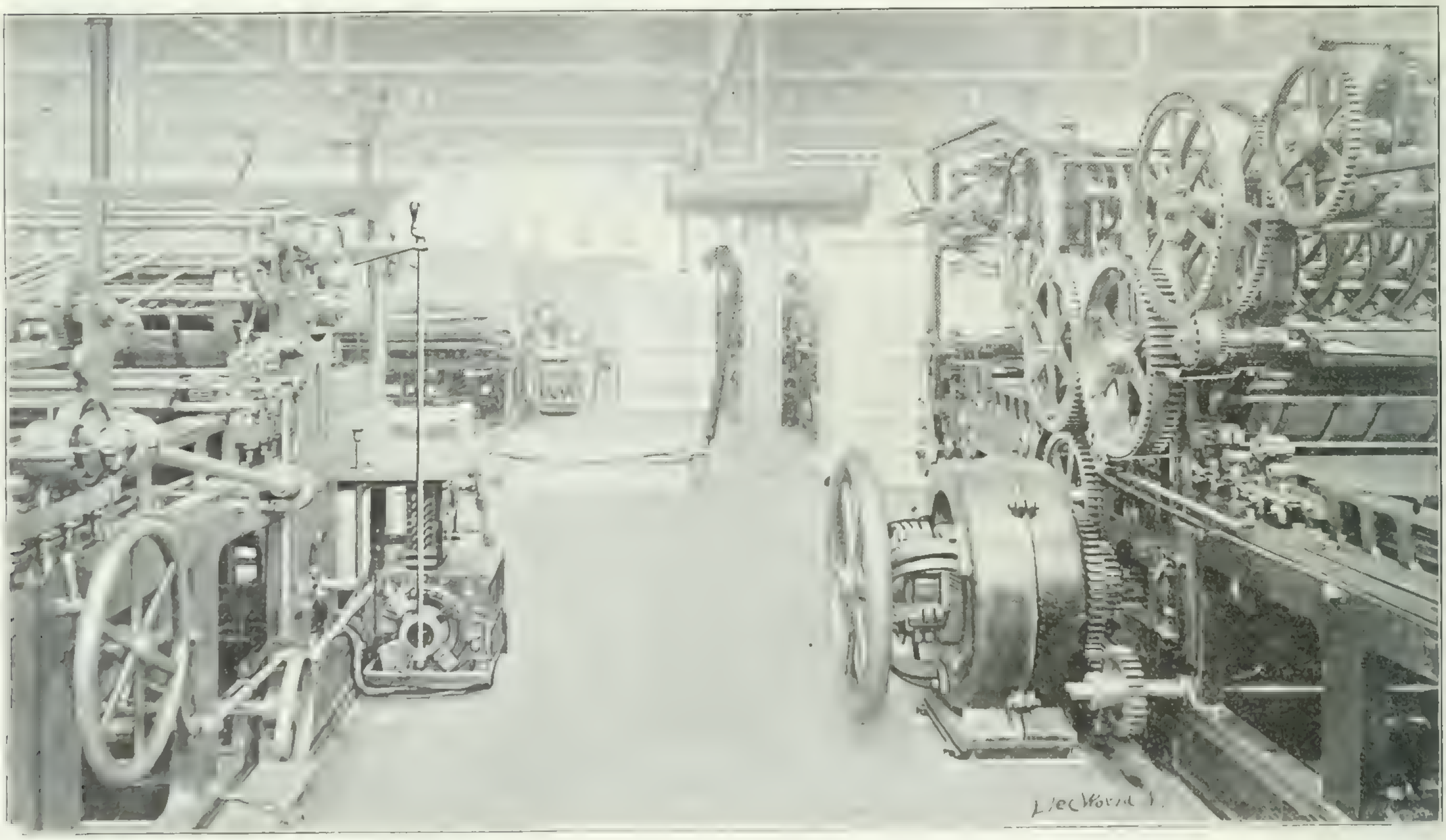
The control of the press motors presents a number of difficulties, and the solution which has been worked out in this case may prove of interest. A printing-press controller should have a handle placed within easy reach of the feeder, by means of which the press can be conveniently controlled and stopped. In case of a failure of the current from any cause, the controller should be automatically returned to the "off" position. It should [illegible] ing arrangement so that the pressman can set the press for a certain number of impressions per hour, and then leave its [illegible]

[illegible]

lowest speed should be 50 per cent. of its highest speed. Now, the speed of a short-wound motor may be varied in three different ways: (1) resistance may be inserted in series with the armature, (2) the intensity of the field magnetism may be changed, or (3) the potential difference applied to the motor may be altered. The first method is uneconomical and unsatisfactory in operation, as it results in an unsteady speed under such a variable load as is given on a printing press. The second method, while more economical than the first, is limited in its application, for the speed of a motor cannot be satisfactorily controlled in this manner below the limit of about three-quarters of its full speed. To extend this range of speed and insure sparkless operation at the higher loads when the field is weakened a large and expensive motor will be required. The third method requires complicated generating machinery and distributing circuits, and if but two voltages are used (one double the other) the system will not secure the range of speed desired.

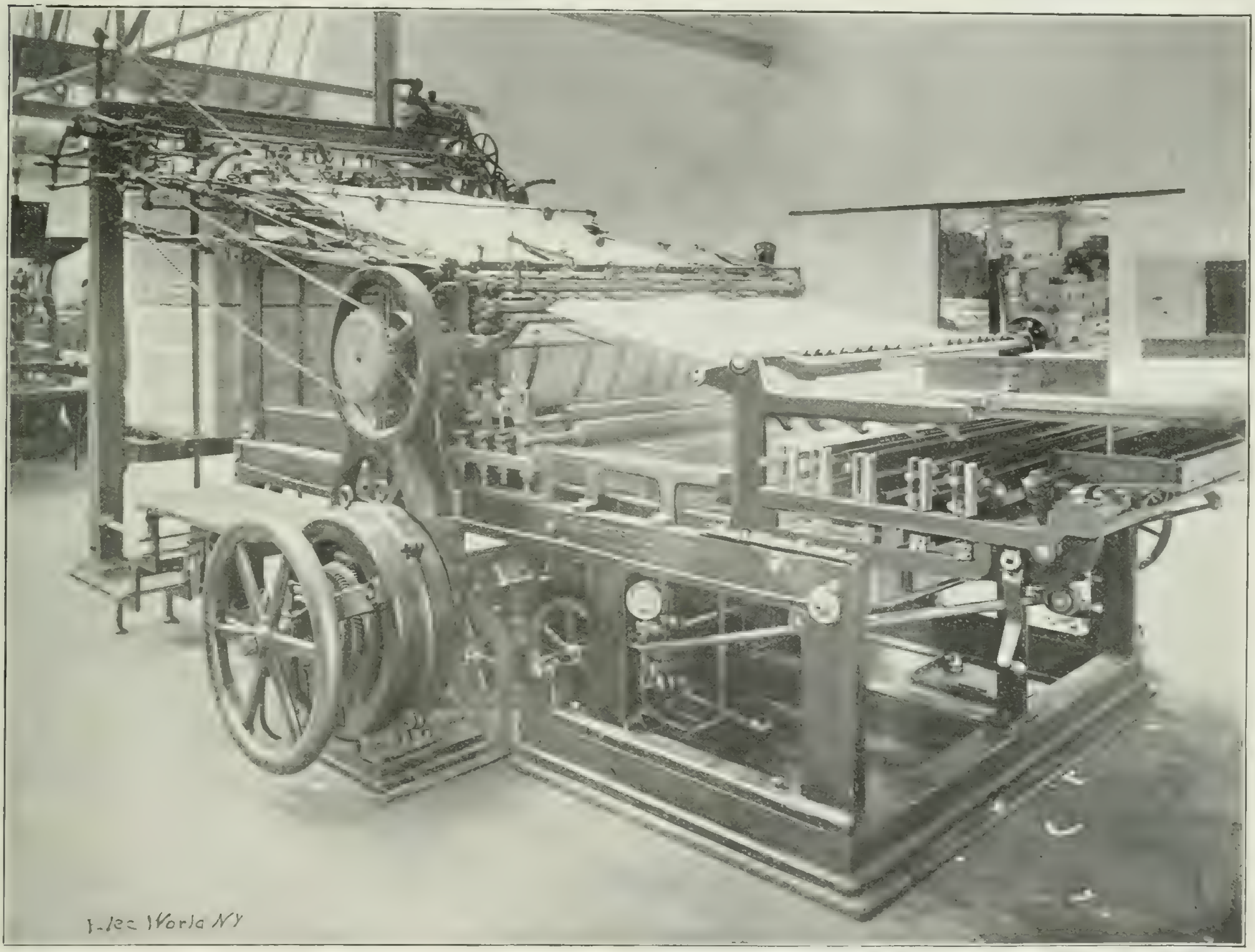
The system of control adopted for this plant combines the first two methods. Between full speed and 75 per cent. of full speed the speed variations are secured by changing the field magnetism. This is accomplished by cutting in or out sections of the series field winding. Between three-quarters speed and one-half speed the variations are secured by inserting resistance in the armature circuit. Three-quarters speed is taken as the average or normal speed of the press, and at this point all series field coils are cut out, and the motor is operated as a straight shunt machine with no resistance in series with its armature. In this way the main controller provides for ten positions of speed, five of which are secured by armature resistance and five by field commutation. An auxiliary [illegible] handle is placed on the [illegible] side of the press, by means of which ten additional speeds can be obtained between any two of the main controller's speeds, so that the method of control [illegible] different speeds, and it is therefore possible to operate the press [illegible] at the highest rate which the character of the work will permit.

[illegible] shown on page 500 [illegible] of the main controller. The steel rod passing down from the handle at the left of the press feeder, Fig. [illegible] armature resistance and series field windings. The contact arms [illegible] which contains a



View of Press-room Showing Motor and Controller of Motor-Driven Presses.

series of small holes corresponding to the number of speeds secured by the controller. Pivoted at the centre is a movable arm fitted with a handle and pin which can be made to enter any one of the ten holes. When the current is turned on and the controller revolved, this arm moves around until it engages a pawl operated by an electromagnet. As long as the current is passing through the motor this magnet holds the controller in position, but it will release the arm as soon as the current is interrupted, and a strong spiral spring on the controller rod immediately brings the arm back to the "off" point. The "automatic" low-voltage release is thus secured, while the locking feature is obtained by means of the movable arm, which can be set at any hole corresponding to any desired speed. The hole corresponding to the normal speed is marked, and the press is usually operated on this point.



Motor-Driven Cottrell Press with Automatic Feeder.

On the right of the feeder is placed a small panel board containing the main-line switch, a circuit breaker and fuses for protecting the motor. The switch is of the "tumbler" type, and is connected so that when thrown up it connects the motor ready for operation. When this switch is opened an extension of each blade makes a contact with the lower clips so as to connect the shunt fields of the motor across a non-inductive resistance, providing a path for the field discharge and thus avoiding the danger of a puncture. The circuit breaker is adjustable through a wide range, and is of the "time limit" type. In this type the acting magnet is shunted by an exposed coil of high-resistance wire. If an excessive current exists for a length of time, the shunted current flowing through this exposed coil heats the wire and thus sends a larger proportion of the current through the magnet windings and the circuit breaker acts. Momentary currents, such as occur upon starting the motor, or when it is loaded heavily for an instant, are not supposed to open the circuit breaker. Unfortunately, the feeder soon discovers that the circuit breaker can be adjusted to such a point that it will bother him only at long intervals, and at this point he leaves it. Practically, then, the motor must be protected by fuses which cannot be adjusted. These fuses are of the enclosed cartridge type and are placed in both sides of the circuit, one being located on either side of the main-line switch upon the panel board. The appearance of the controller and panel board can be seen on the press in the foreground of the picture presented on page 501.

By means of a lever and arm which pass through the bottom part of the press the controller can be operated from the opposite side and the press can be run slowly in either direction in "making ready," without tugging at a belt or without the assistance of the feeder. Push-buttons are located at convenient places about the press frames, with circuits connected so as to shunt the "automatic" magnetic release attachment, and thus the press can be quickly stopped from any one of a number of points in case of accident.

It is needless to point out that such a model printing establishment as has been described would have been impossible with the old method of transmitting power by means of belts and shafting. The successful operation of this plant is such an emphatic argument in favor of the electrical method of operation that it may be well worth while to review briefly the advantages which have been secured.

The light throughout the plant is entirely unobstructed by belts, so that during the day full benefit is secured of the ideal skylight method of lighting, while at night the operators are not annoyed by shadows, and the amount of artificial illumination required is a minimum.

The predominating idea in the arrangement of the entire plant has been to secure convenience in operation, and the designers of the plant have not been hampered with the necessity of concentrating the machinery near the source of power or of arranging it, in all cases, convenient to long lines of shafting.

The elimination of overhead power-transmitting devices not only takes away the danger of moving belts and revolving pulleys, but improves the appearance of the plant, and this is certainly appreciated by the employees, who take pride in the neat appearance of their workrooms.

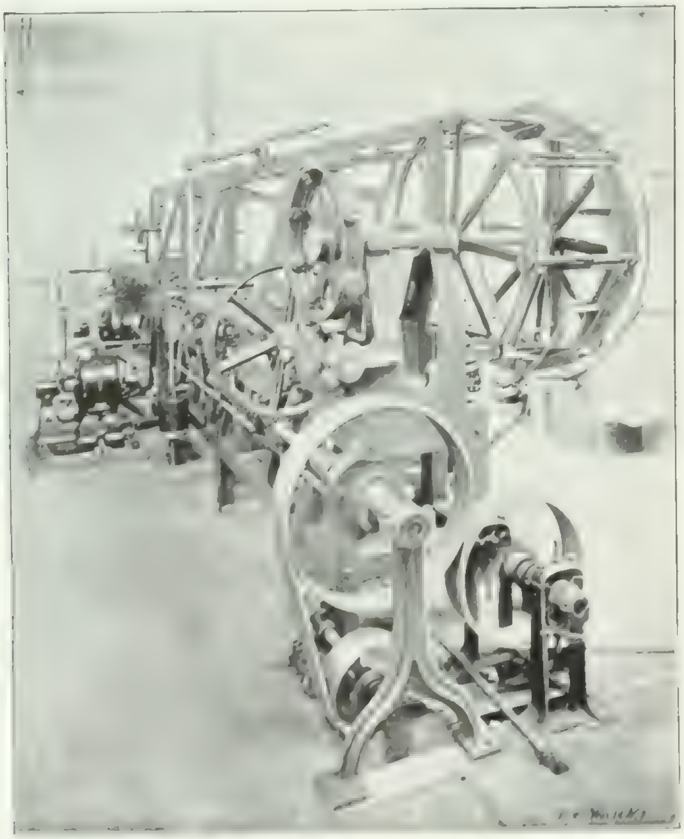
Without overhead belts and pulleys keeping the dust-laden atmosphere in constant agitation, there is much less waste of stock spoiled by dripping oil or falling dirt—an advantage which it takes a printer to appreciate thoroughly.

The arrangement of the plant over a large area instead of in floors one above another, with belts passing from floor to floor, secures lower insurance rates. The wires running from the engine room to the departments when once installed require no further attention. One department may be operated overtime, while the remainder of the plant is at rest. The lighter the load the more efficient become the transmitting circuits, while the opposite is true with belts and pulleys. The number of units in operation in the engine room can be varied to suit the changing demand for power, and thus secure an economy which is impossible with one large engine belted to a main driving shaft.

The absolute control of the presses, with their easy and convenient manipulation, when "making ready," and their wide range of speed, allowing them to be run at their fullest capacity, has a great influence in increasing the output of the plant. When a machine is not in operation it is immediately shut down and there are, therefore, no "stand-by" losses outside of the engine room.

The most important advantage, however, is the saving in fuel. The result of the operation of the new plant is that only about one-third of the amount of coal is burned that was required before the move was made. A part of this saving must be attributed to the design of the power plant, with its modern equipment, so that just how much economy has been gained by the operation of the purely electrical part of the plant cannot be definitely determined.

The Corliss engine was furnished by the Atlas Engine Company; the motors by the Sprague Electric Company; the motor controllers and starting boxes by the Cutler-Hammer Manufacturing Company, and the switchboard and wiring by the Western Electric Company. George C. Nimmons was the architect of the building,

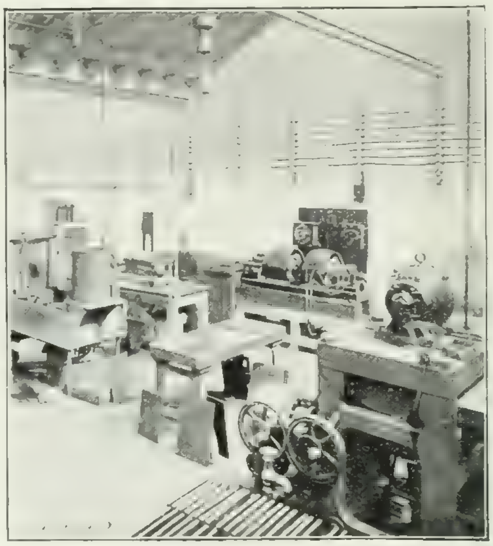


Motor-Driven [illegible] Machine.

[illegible] of the company, W. B. Conkey.

The Belfast Municipal Electric Plant.

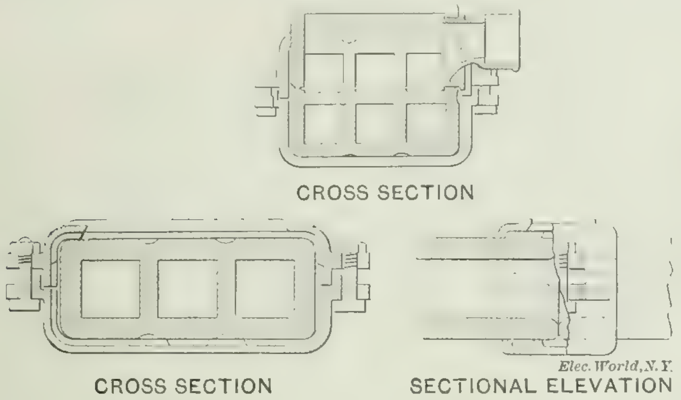
The new Belfast municipal station, although on the boundary of the present area of supply, is very centrally situated as regards Belfast as a whole, and will ultimately become a true central station. It is very conveniently situated on the River Lagan, enabling the condensing plant to be used without difficulty, and facilitating supply of fuel and materials. The ultimate capacity of the buildings that can be erected on the land acquired for this station is 20,000 horse-power, but the present buildings are capable of housing only 10,000 horse-power. The following description and illustrations are taken from the London "Electrician."



Electrotyping Room, Conkey Printing Plant. Electrotyping Motor-Generator in Background.

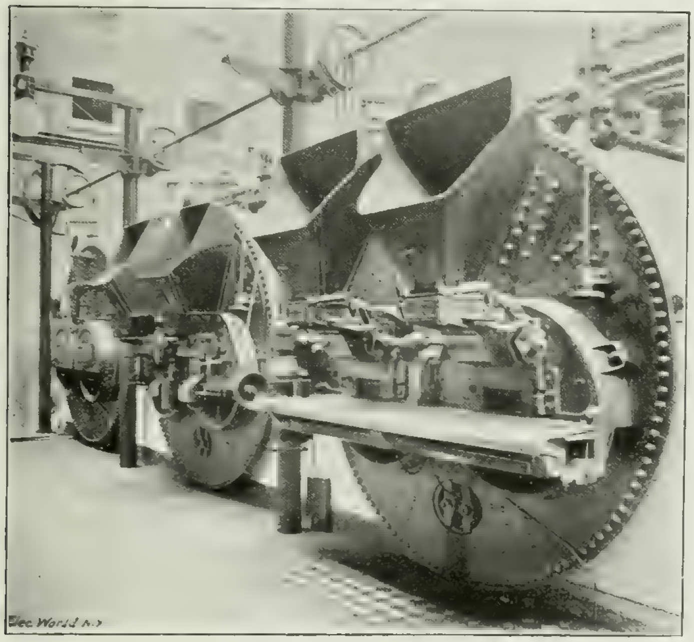
Owing to the soft and marshy nature of the subsoil at Belfast, the buildings have been erected on piles, no less than 1200 having been driven for the building and 154 for the chimney stack, which is 175 feet in height and has a diameter at the base of 25 feet, the internal diameter of the flue being 13 feet. The buildings throughout are of fireproof construction, the floors being of concrete and steel. The paving of the battery-room floor is of vitrified tiles embedded in cement, the joints being afterward run with pitch, this having been found to serve best for the purposes of a battery room. The ground floor is occupied by the engine house, the boiler house and accessories, the battery room and various offices. The boiler house and engine house are each 200 feet in length, the latter being 64 feet wide and the former 40 feet wide. Both are very spacious, lofty and well lit, the roof in each being carried by light steel trusses. When completely equipped, the present boiler house will contain ten Lancashire boilers, each 30 feet in length by 8 feet diameter, but three only are at present erected and a fourth is being put in. Two of these boilers are fitted with mechanical stokers of the Bennis and Proctor types, and the third is at present arranged for hand-firing. By this arrangement the relative merits of hand-firing and the various systems of mechanical stoking can be carefully watched by the chief engineer, and the decision ultimately arrived at as to which is the best adapted to local conditions. Welsh small coal is usually burned.

At the end of the boiler room there is a large economizer, consisting of 216 tubes, the scrapers of which are worked by a small electric motor. The coal bunkers extend the length of the boiler house and are arranged so that they can be worked with helical conveyors and elevators for feeding the mechanical stoker hoppers. At present these hoppers are filled by hand. The pump room adjoins the boiler house, and is extremely well arranged. It is equipped with steam and direct-geared, motor-driven pumps, arranged on a duplicate feed-water system, the pipes being so designed that the feed can take place either through the economizer or direct to the boilers. Each boiler, which works at 180 pounds pressure and has been tested to 270 pounds, feeds steam into a duplicate system of steam mains carried by tie rods from brackets fixed to the walls or suspended from the roof. The connection to each engine consists of a Y piece provided with stop valves, and the boilers have two junction valves with a [illegible]-inch branch to each main. The piping is of lap-welded mild steel, the flanges of wrought steel being welded on. Copper expansion bends are provided to allow for changes in length. Each boiler has three safety valves, and the valve equipment throughout is on the Hopkinson-patent parallel-slide principle.



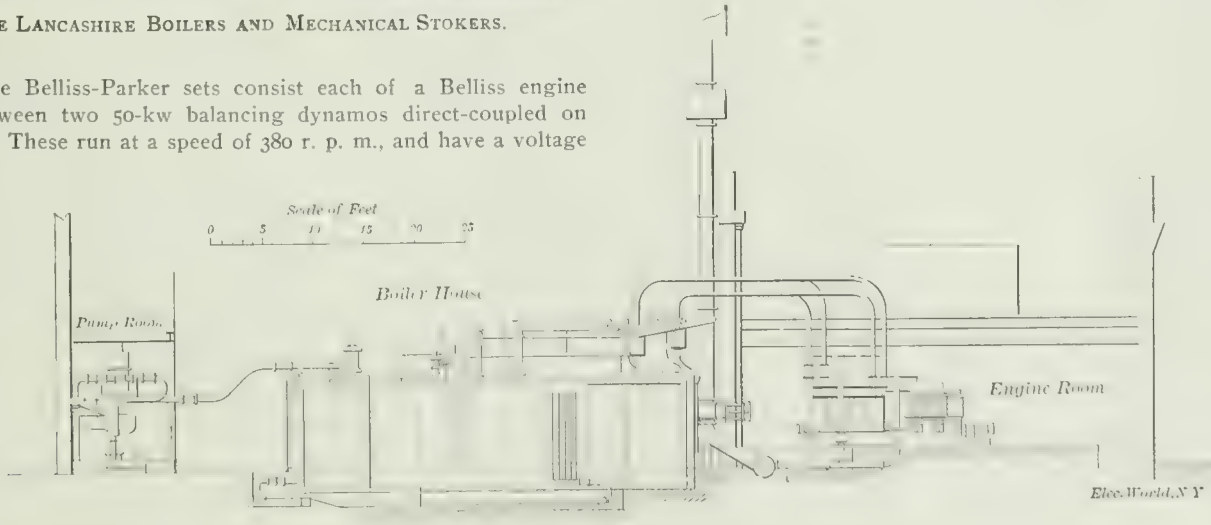
Section of Doulton Conduits.

The present equipment of the engine house consists of three sets of continuous-current steam dynamos, the steam engines being built by Messrs. Belliss & Co. and the dynamos by Messrs. Thomas Parker (Limited). A fourth set is in course of erection.

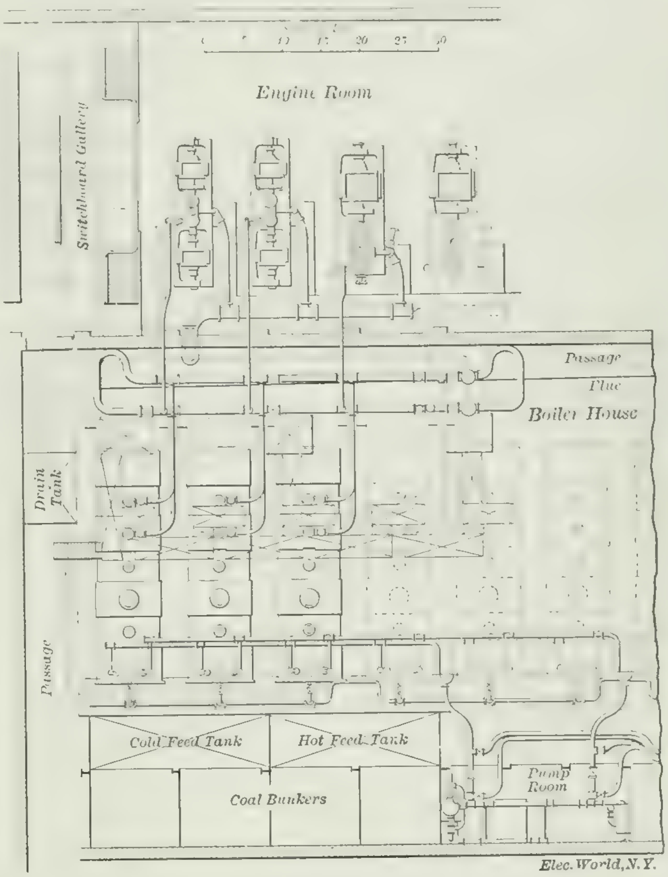


The Lancashire Boilers and Mechanical Stokers.

Two of the Belliss-Parker sets consist each of a Belliss engine placed between two 50-kw balancing dynamos direct-coupled on one shaft. These run at a speed of 380 r. p. m., and have a voltage variable from 220 to 350 volts. The larger set consists of a single three-crank engine, coupled direct to a 200 kw continuous current dynamo, capable of delivering from 440 to 500 volts. When worked at the higher pressure of 500 volts these generators might conveniently be used for driving electric tramways on the trolley system, but at present there is no definite scheme of electric traction in Belfast.

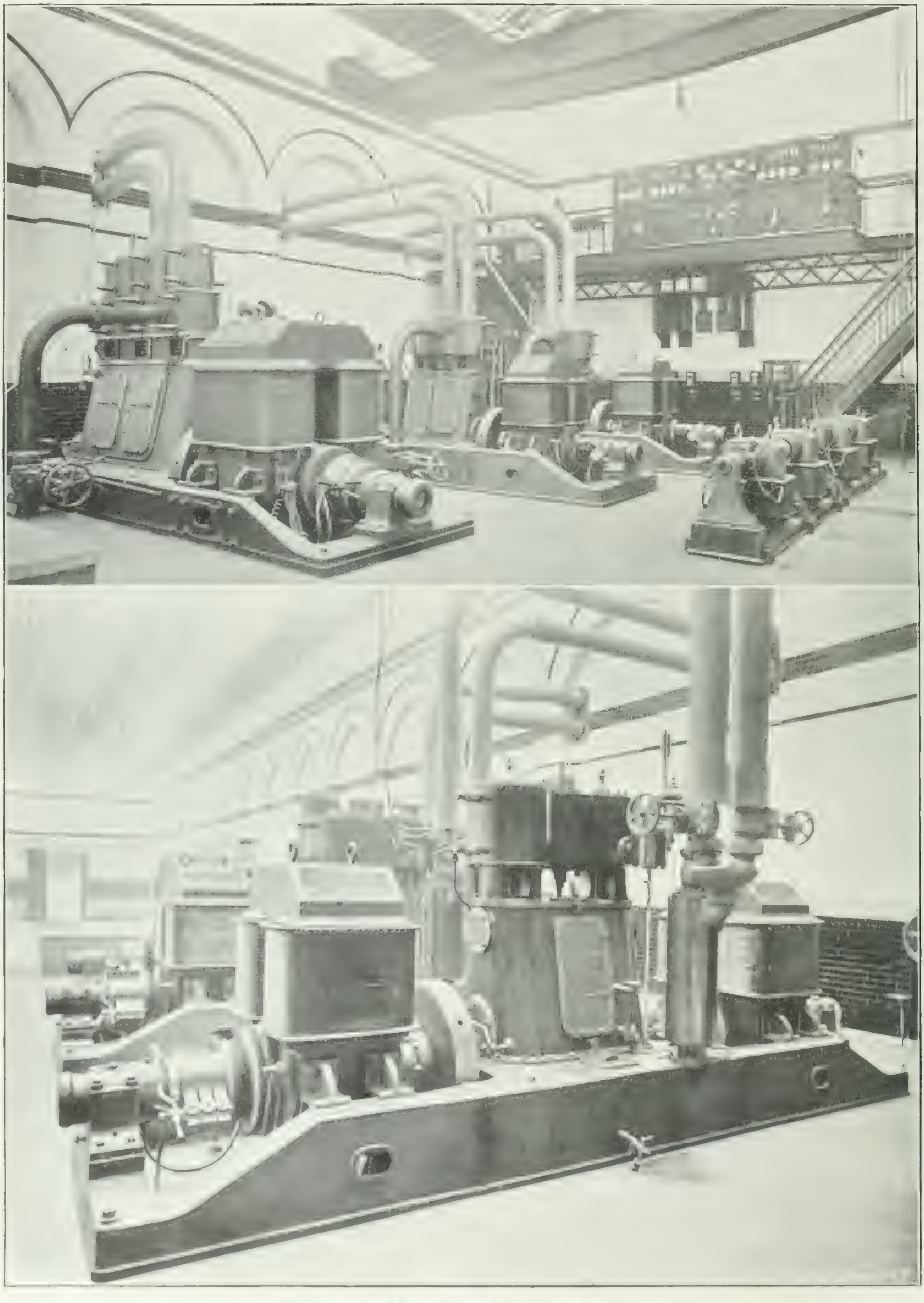


Sectional Elevation of Belfast Plant.

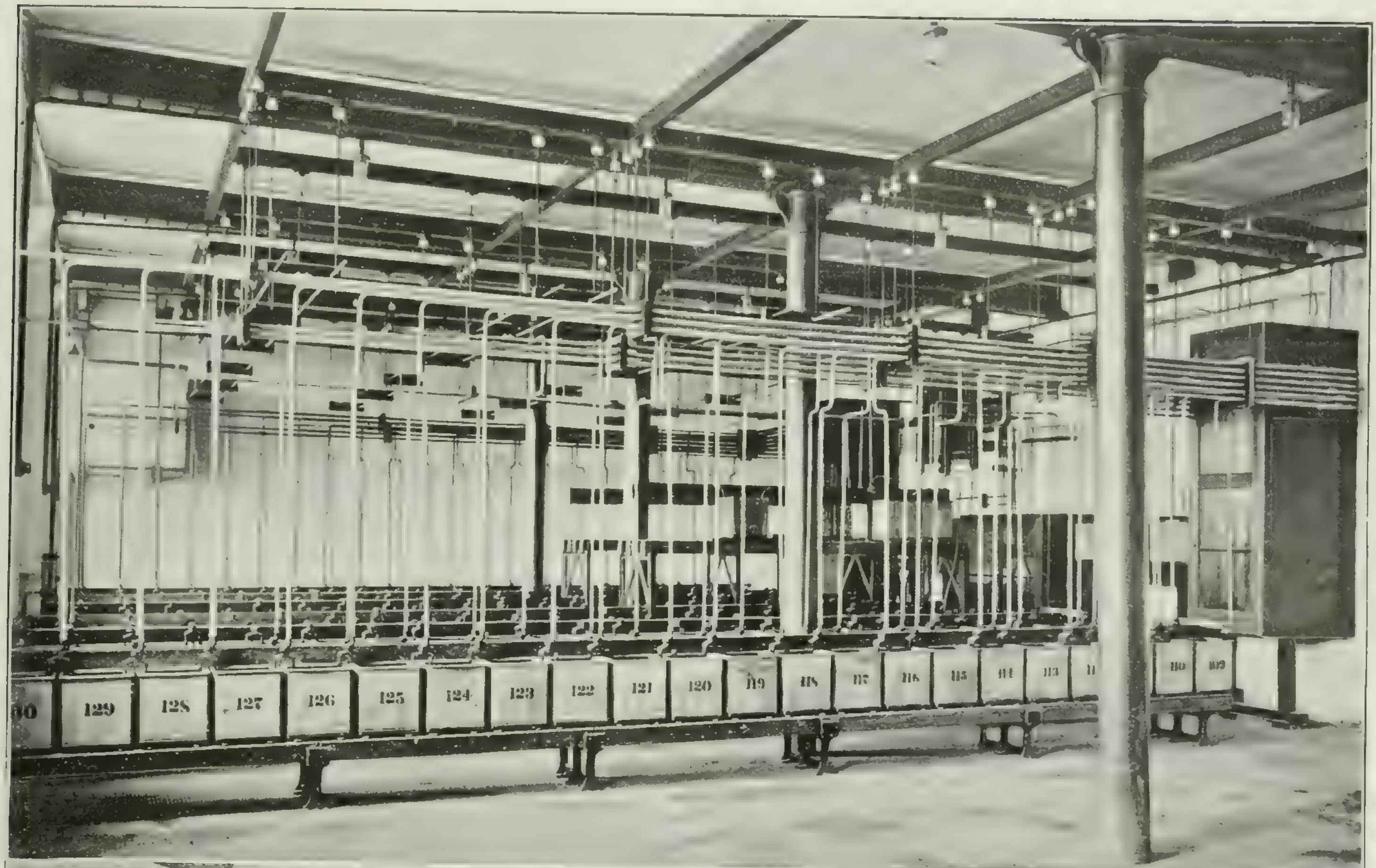


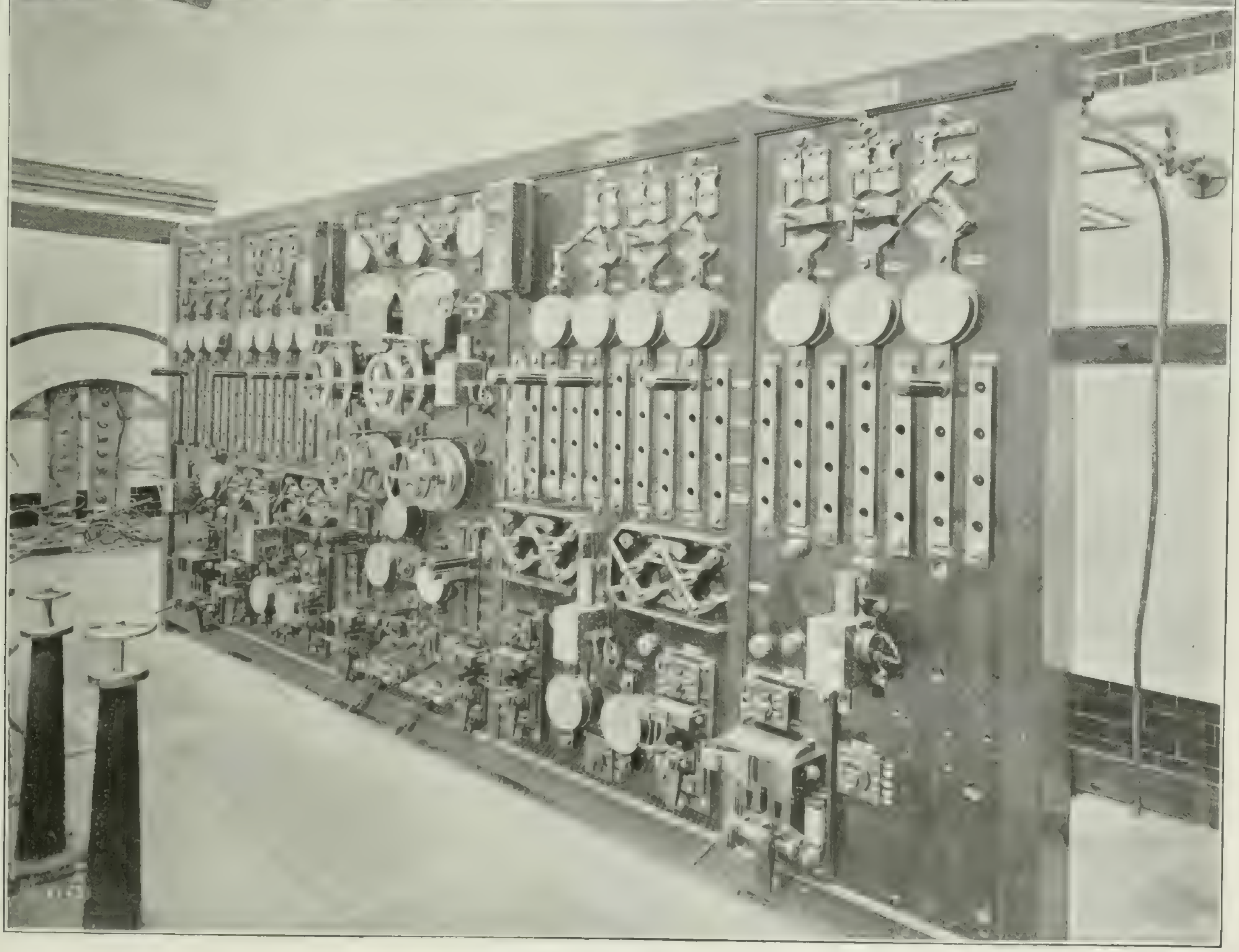
Partial Plan of Belfast Power Plant.

In addition to the generating sets the engine house is at present equipped with motor generators and boosters on the Crompton principle, these being used either for balancing on the three-wire mains by boosting the feeders, or for charging the cells. At one end of the machine room there is a spacious and well-equipped switchboard gallery, from which a splendid view of the machinery room can be obtained. The board is at present equipped for six feeders, eight generators, and the boosters, motors, generators and three-wire batteries. The panels are of enameled slate, 7 feet 6 inches high, the width varying from 2 feet 8 inches to 3 feet 3 inches. The framework of the switchboard is of steel, with teak mouldings between the panels. A novel feature of the switching arrangements is the introduction of mechanical gear in place of electrically connecting the wires for the regulating resistances. A similar method of control is in use for the regula-



[illegible] Generating Plant—Motor Generators and Boosters.
Main Generators, with Three-Wire Set in Foreground.



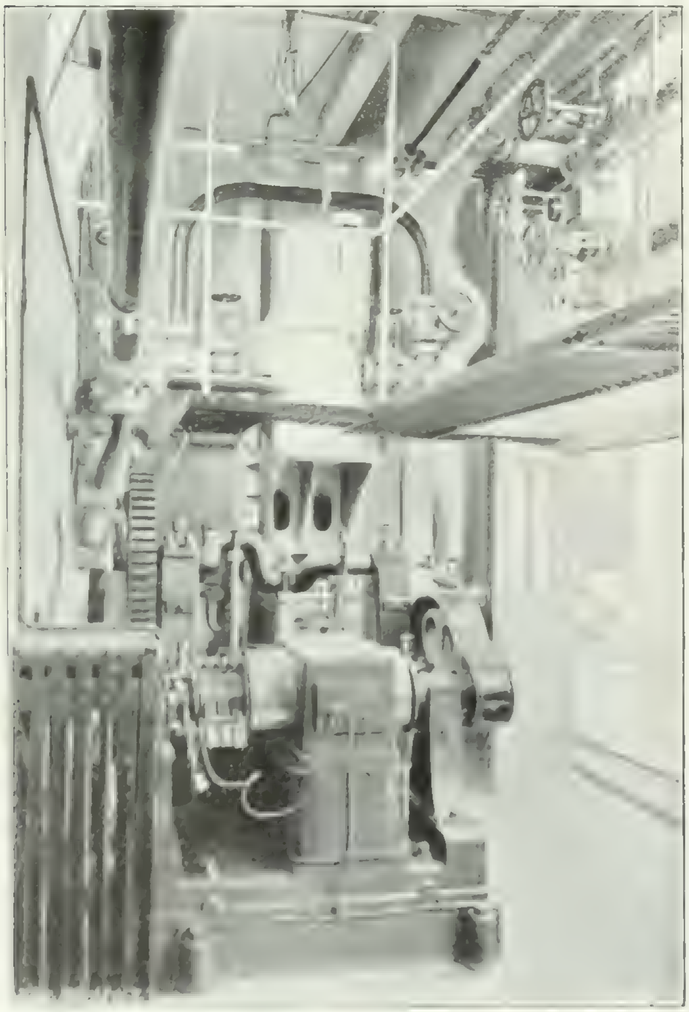


The Storage Battery Room.
The Front of the Switchboard.

tor end-cells of the battery, for the purpose of regulating the battery pressure in charging and discharging.

The battery room is on the lower level immediately behind the switchboard, and controlling shafts, operated from the switchboard, pass down through the floor to the regulating switch on the battery room wall. The battery room is at present only equipped with one-half of its possible storage capacity—viz., with two batteries each of 130 E. P. S. cells of the Faure-King type. The normal capacity of these cells is 500 ampere hours for five hours, but they are capable of developing 300 amperes for one hour's discharge. Overhead, throughout the battery room, are a number of movable contact connectors, by means of which any cell may be milked from the hospital cells. The electrical connections for this operation are clearly shown in the illustrations. The ingenious but apparently impracticable system of telescoping the electrical connections of the batteries for the purposes of regulation has been abandoned. This method was introduced by Professor Kennedy into the old station, but it has been found that the irregularity of charging and discharging the overlapping cells is more marked in such an arrangement than with the ordinary end connector contacts. At present there are forty-five end-cells on each battery, these being, in each case, at the middle wire or inner end of the battery. Thus, ninety cells in series are regulator cells, and these may be charged up independently of the other cells in the battery by means of a local circuit, the current coming from one of the motor-generators running at a low pressure. While the two main batteries, therefore, are working on the feeders or general supply, the out-of-use regulator cells may be charged up to their proper limit. This arrangement is found to work much more smoothly and satisfactorily than the telescope system.

Distribution from the new station is on the three-wire contin-



[illegible]

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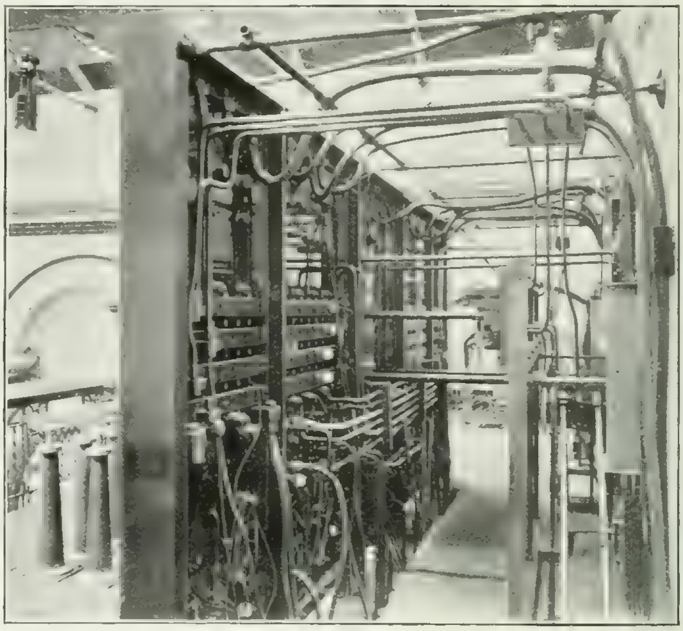
the Belfast soil this has not proved successful, and no more strip has been put in. There are short lengths of lead-covered, armored three-core cable, but the cables, as a rule, are of single core, the feeders varying from 0.2 to 0.525 square inch section, the mains being 0.2 square inch on the outers and 0.1 square inch on the middle conductor, excepting on very long lines, where 0.2 square inch section middle conductor is put in. Of main cables, no less than 30,000 feet of roadway frontage have been put in, and there are in all some 250,000 feet of single duct. Practically the whole of the drawn-in cable is carried in Doulton conduits of the standard type, with either two, three or six rectangular ducts, each 2¼ inches square. On account of the softness of the soil in which these are laid the joints have had to be specially strengthened by means of a locked cover and chair specially designed for the purpose, this being of cast iron pieces clamped together and bolted in position. The interior of the joining pieces is recessed, and the upper piece is provided with an aperture through which is poured a rapid-setting bituminous compound, which entirely surrounds the ends, but is prevented from entering the ducts by mandrils, one of which is inserted into each duct while the joint is being made. Thus perfect continuity is secured throughout the duct, while the bolted covers and chair give ample rigidity to the conduit to enable it to withstand a subsidence of the soil. Branch coupling connections are provided for in the following manner: At suitable intervals in the line of conduits special lengths are laid which are grooved during manufacture in such a way that, while strength is preserved, a longitudinal division can be made by means of a chisel when desired. When a T-connection is required the upper portion of the split length is detached, giving access to the cables. The cable joints having been completed, a junction cover, made for the purpose, is substituted for the piece which has been detached. This cover is fitted with a cast iron socket-piece to take the service pipe. Details of the service box, as applied to [illegible] conduit are shown in an accompanying illustration. It may be interesting to state that the most distant point at present supplied with current is [illegible] miles from the new generating station.



Rear View of the Switchboard.

Dating from July 1 last the charges for lighting were the equivalent of [illegible] cents per hour for the first one and one-half hours' average total used on the consumers' maximum demand, and 4 cents per kw hour afterward. A special price of 10 cents per kw hour is made for churches and other places of worship. For power and heating purposes the charges are 8 cents per kw hour for the first one and one-half hours, and [illegible] cents per kw hour afterward. Mr. McCowen has devised a very serviceable and effective system of hiring out motors, the motors being actually supplied by the electricity department. The [illegible] range from an annual rental of [illegible] hp motor to $60 for a 10 hp motor. Meter rentals range from [illegible] per quarter for 10 amperes up to $3.60 per quarter for [illegible] amperes.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE
AMERICAN AND FOREIGN
By Carl Hering

Dynamos, Motors and Transformers.

COMMUTATOR DESIGN. Matthews. Lond. "Elec. Rev.," Oct. 21.—An article on commutator design, in which he enumerates and discusses six causes of sparking, with special reference to the last three, which are: Faulty construction of the commutator, bad connections and too small a commutator. He enumerates the conditions of a sound commutator, referring chiefly to the mechanical construction; he claims that in all commutators the method of holding the various segments together is far from being a sound mechanical construction; fibre washers at the ends of the commutator are the worst materials possible; he claims that the only proper material is pressed mica and micanite.

POLYPHASE MOTORS. Hanappe. "L'Eclairage Elec.," Oct. 15.—A continuation of his long article, in which he studies the action of such motors in detail. The article does not admit of being abstracted.

Lights and Lighting.

NERNST INCANDESCENT LAMP.—"Zeit. f. Elektrochemie," Oct. 20.—A brief description of a device of Deri for producing the heat which is necessary in the Nernst non-conducting filament, in order to make it a conductor. The Nernst filament consists of a body which, when cold, is a non-conductor, but which after being heated becomes a conductor. He accomplishes this by means of a filament inside of the other, whose resistance is so high that a current passing through it will generate sufficient heat to warm up the body surrounding it to the necessary temperature. This inner filament is made of a mixture of a refractory, non-conducting material or of a conductor of the second class, with metal or graphite, the materials being finely pulverized and intimately mixed; the material is made plastic and then pressed into rods and filaments. Nothing is said of practical tests.

NON-INTERCHANGEABLE LAMP SOCKETS.—"L'Energie Elec.," Oct. 1.—A brief, illustrated description of a lamp socket made in France, the object of which is to prevent a consumer, who pays according to the number of lamps installed, from taking out a lamp and replacing it by one of a higher candle power. The socket is made on the principle of a bayonet joint, but there are three pins and corresponding slots, the relative distances between them being different in lamps of different candle power, thus preventing a lamp from being inserted in a socket made for another one; the sockets are made for 5, 10, 16 and 32 cp lamps.

FIRE-FLY LIGHT. Broomall. "Sc. Am.," Nov. 5.—A short article giving a summary of what is known on this subject. This light contains photographic rays, which will pass through aluminum, cardboard or copper plate; the rays are capable of reflection and probably refraction and polarization; this indicates the presence of rays belonging to the ultra-violet class, and if this is so they are probably the same as the rays emitted by uranium, known as Becquerel rays; besides these invisible photographic rays it contains ordinary light rays. The organ producing them consists of a pale, transparent, superficial layer which gives off the light, and a deep opaque layer whose function is not obvious; the ultimate branches of the tracheæ or air tubes are distributed through this apparatus, as are also nerve fibres. Carbonic acid extinguishes the light and oxygen intensifies it, which points strongly to the theory that the light is the result of some form of slow combustion, and the probabilities indicate that fats and some form of free phosphorus are the active agents. The luminous organs retain their power after death and even after desiccation and subsequent moistening; there seems to be no reason, therefore, to adopt the theory that we have to deal with any direct transformation of vital into radiant energy; the most probable explanation is that it is the result of slow combustion; but there still remains to be explained why this combustion produces extreme ultra-violet rays, while other forms of combustion do not.

Power.

SHOREDITCH DUST DESTRUCTOR. Baker. Lond. "Elec." and "Elec. Eng.," Oct. 21.—A communication making some deductions from the authorized and audited accounts of the vestry and claiming that the statements of the vestry clerk in his report are not borne out by the figures in the authorized accounts, and are consequently misleading. According to the clerk's report there is a net profit of over $6000 at the end of nine minths; the present writer finds instead a total loss of about $7000, the greater part of which is chargeable to the destructor system and represents the excess of the cost of the disposal of the refuse above the cost of the old system. He does not mean to infer from this that all destructors will be financial failures, as, on the contrary he thinks this plant shows glaringly the faults which may be remedied, and that 36 cents per ton for the disposal of the refuse without clinkers may be achieved, this figure having been recently reached in St. Pancras.

ELECTRIC PLOWING.—"Elek. Zeit.," Oct. 20.—An editorial in which, after briefly referring to the difficulties in making a proper comparison with steam plows, a brief description is given of the Dahlwitz plant at Hoppegarten. The central station has a capacity of 60 horse-power, an alternating current of 1000 volts being used for lighting and a continuous current of 500 volts for power purposes; this general application of electricity is one reason why the whole plant is commercially satisfactory. During the year 625 hectares are plowed at a cost of 12.5 marks (about $3.12) per hectare, which is considerably cheaper than with steam plows. The plow is worked by means of a cable, which passes across the field and back, the plow being attached to it; the cable is wound up on one drum and unwound from another. The depth of the furrows was from 20 to 25 cm (8 to 10 inches), and the width is 130 cm at a speed of 1 metre per second; the consumption of current at the central station was between 30 and 50 amperes at 500 volts.

KERKA WATER POWER PLANT. Giovaninelli. "L'Eclairage Elec.," Oct. 15.—The conclusion of the description of this proposed plant (see "Digest" last week). He discusses the economical features.

ELEVATOR EQUIPMENT FOR UNDERGROUND RAILWAY.—"Eng. News," Nov. 3.—A long article, accompanied by a double-page plate and various other illustrations, describing the electric elevator equipment for the Central London Underground Railway. This equipment is to be installed by an American company (the Sprague Electric Company), and is said to be much the largest elevator equipment ever contracted for; it is now being installed.

ELECTRIC POWER IN MINING. McGhie. "Cassiers' Mag.," Nov.—A short article calling attention to the very rapid progress made recently and to the advantages of using electrically driven machinery of various kinds. The article is accompanied by a large number of illustrations and brief descriptions.

TWO AND THREE PHASE SYSTEMS COMPARED. Stewart. "El'ty," Nov. 2; reprinted from Lond. "El'ty."—A short article discussing the question under what circumstances it is desirable to choose a two or three phase system for the transmission of power.

Traction.

USE OF HIGH VOLTAGES ON ELECTRIC RAILWAYS.—"L'Eclairage Elec.," Oct. 15.—The Swiss Government having raised an objection toward high voltages on electric railways, on the ground of danger, a Swiss manufacturing company obtained the views on this subject from three experts; these views are given in abstract in the present short article. The voltage which was to be used was 750. Kapp thought the Government was not justified in insisting on a limit of 500 volts, as that voltage was as dangerous as 750; from a practical standpoint 500 volts might be even more dangerous, as there is a false idea of security which does not exist; he recommends the use of circuit breakers or fuses to guard against connections with the earth. S. P. Thompson, like Kapp, thought that the dangerous voltage should not be limited to 500 and cites a fatal case in which the voltage was only 300; it is a mere matter of construction to protect a trolley line of 500 to 1500 volts. Weber gave the results of a set of experiments on the limit of security of the voltage of alternating currents; his results have already been published; his conclusions are that the use of high alternating-current voltages on railroads is very dangerous, but accidents have been rare; the dangers of high voltages are not great in comparison with the other dangers on railways, such as collisions, etc.; high voltages are necessary on economical grounds and a limitation of the voltage is therefore not justified.

THE DOOM OF THE TROLLEY.—Lond. "Elec. Rev.," Oct. 21.—An editorial calling attention to some recent statements by Dr. S. P. Thompson in a recently published article in some daily paper. He claims that if in Monaco electric cars can be run without either overhead wires or a slotted conduit, it is certain that they can be run in England also; he maintains that the slotted conduit is neither the alternative nor the best alternative for the trolley wire. His article is followed by a description of the surface contact system which he and Walker devised and which was described in THE ELECTRICAL WORLD, Oct. 22, p. 418.

GLASGOW ELECTRIC TRAMWAYS.—Lond. "Elec. Rev.," Oct. 21.—The beginning of an illustrated description of this new trolley line.

RAILWAY SHOP METHODS. Cravath. "Elec. Eng.," Oct. 27.—A short description of some of the methods used on a Chicago line. In order to keep the armatures dry through the winter months, when many of them are not in use, they are taken out of the cars and stored in a dry room. The method of checking out tools is described. Instead of the conventional form of hose for car wiring, this road uses a specially made cable, containing the necessary number of conductors. The vestibule cars are being equipped with an illuminated route sign.

MOUNT LOWE RAILWAY. Ellison. "Sc. Am.," Oct. 29.—A short, popular description, accompanied by a number of picturesque illustrations, of the electric railway up this mountain in California.

Installations, Systems and Appliances.

SYSTEM OF CHARGING IN NEW YORK.—Lond. "Elec.," Oct. 21.—An editorial note commenting on a new system introduced by the Edison Company, in New York city. It is claimed that that company attempted to follow Wright's system, but did so only partially, so that the advantages of the system are lacking, leaving the new system little superior to the one used before. Instead of basing the differential rate on the maximum demand, it is based on the number of lamps installed; although this may encourage some extravagance by existing consumers, it will induce new consumers to put in as few lights as possible. It is thought that if the new system proves a success in New York, the Wright system would have given still better results.

BEST DIVISION OF UNITS IN A PLANT.—Lond. "Elec. Eng.," Oct. 21.—Answers to the question of what the most economical arrangement is in a direct-current three-wire system, the choice being between one steam dynamo of 200 kw and a balancing transformer, or two steam dynamos, each of 100 kw, or one steam engine and two dynamos coupled to it. Both writers give preference to the first system, although it is admitted that it is difficult to lay down any hard and fast rule owing to local conditions.

EVOLUTION IN CENTRAL STATION PRACTICE. Scott. "Eng. Mag.," Nov.—After a brief, general description of the alternate current systems and their characteristics, he points out the great flexibility of the polyphase system, citing the installations at Niagara Falls and Hartford as examples; he shows that the polyphase system affords a means for combining the whole service of a large station into a single unit, or for combining the power plants of many scattered stations into one single power plant. A table shows the principal items of cost, which are increased or decreased when a main power station and sub-stations replace several power stations. Some curves show the general relation between the first cost of different systems for conducting power; they show that the direct-current transmission is cheaper to install than a 2000-volt alternating with transformers if the distance is less than about a quarter of a mile, for 220 volts, or two-thirds of a mile for 500; the cost of copper for 2000 volts becomes excessive when the distance exceeds a few miles; the high first cost of rotary sub-stations can be justified only by economy in operation; the curves also show the advantages of the alternating current distribution over the direct through sub-stations. He believes that the electrical developments during the past ten years are due more to the engineer than to the inventor.

WASHINGTON.—"Elec. Rev.," Nov. 2.—A brief, illustrated description of the new station of the United States Electric Light Company, which has just been completed, and is said to be the most compact and complete station of its kind. There are connected with the station 73,000 incandescent lamps, 1500 arc lamps, besides 1700 horse-power for motors and power for a railway company having a 260-hp battery; both the direct and the alternating current are used, and almost all the power is distributed through underground wires, giving general satisfaction.

Wires, Wiring and Conduits.

CALCULATING WIRING.—Lond. "Elec. Eng.," Oct. 21.—Answers to a request to show how to calculate the size of mains for a given drop. One of the answers gives the following rule: Multiply the current by the length of wire in feet and divide the results by the loss of volts allowable; look up this result in a table, which he gives, and opposite to it will be found the proper size of wire.

RULES AND REGULATIONS.—"Elek. Zeit.," Oct. 20.—A German translation of some of the official rules in France concerning the construction of electric circuits.

Electro-Physics and Magnetism.

THEORY OF COHERERS. Van Gulik. "Wied. Ann.," 9; abstracted in the Lond. "Elec.," Oct. 21.—Two theories have been offered to explain the change of resistance in coherers due to electric waves; Branly thought that it was due to a modification of the dielectric separating the metallic particles; he supposes this dielectric [illegible] conductivity. Lodge, on the other hand, [illegible] contact was established; the [illegible] of this. The present author [illegible] between the [illegible] theories and the [illegible] Lodge's view. The actual process [illegible] may be imagined as follows: A mi[illegible] having a sort of tube through it; very small particles are torn off the metallic surfaces and lodged in this tube, thereby forming a metallic conducting bridge, which [illegible].

[illegible] OF COHERERS. Dorn. "Wied. Ann.," [illegible] in the Lond. "Elec.," Oct. 21. He examined the [illegible] for use in wireless telegraphy. The [illegible] by Marconi were found to be [illegible] was found necessary to [illegible] the tube. The results point [illegible] of the surface condition of the metal.

the gas in the tube is also important. Neither exhaustion nor heating has any effect on a tube with aluminum filings. It is certain that the behavior of metallic filings is dependent upon many conditions, which it will be difficult to unravel completely.

NOMENCLATURE. Feldmann. "Elek. Zeit.," Oct. 20.—An article in which he suggests German names for the characteristic quantities in the designation of alternating currents. Besides suggesting the names, all of which are characteristically German, differing entirely from those used in most, if not all, the other languages, he describes what is meant by each of the expressions and how the numerical values of the quantities and their relations are calculated. Among the quantities considered are reactance, impedance, admittance, their relations, etc.

DIFFUSION OF ROENTGEN RAYS. Malagoli and Bonacini. "R. Acad. Lincei," 7, p. 96; noticed briefly in "Science Abstracts," Aug.—They describe experiments tending to show that the influence of the intervening air as a diffuse reflector is extremely small, and that the apparent bending of the Röntgen rays is due mainly to the action of surrounding bodies.

OBSCURE CATHODE REGION. Wehnelt. "Wied. Ann.," June; abstracted at considerable length, with numerous illustrations, in "L'Eclairage Elec.," Oct. 15.—Descriptions of the apparatus, experiments and results.

MAGNETIZATION AND CONDUCTIVITY. Milani. "Nuovo Cimento," 6, p. 191; noticed briefly in "Science Abstracts," Aug.—He showed by a series of carefully made experiments with strong fields that the alleged influence of magnetization on the electric conductivity of a solution of ferric chloride parallel to the lines of force does not exist, or is too slight for detection.

MAGNETIC DEFORMATION OF NICKEL. Jones. "Roy. Soc. Proc.," 63, p. 44; abstracted briefly in "Science Abstracts," Aug.—He measured the magnetic contraction of nickel wire and compared the results with the values deduced from Kirchhoff's theory; the observed contraction was much greater than the calculated.

SUN SPOTS AND VARIATION OF MAGNETIC ELEMENTS. Ellis. "Roy. Soc. Proc.," 63, p. 64; noticed briefly in "Science Abstracts," Aug.—The data given cover the period 1841-'96; the three curves representing the number of spots, the diurnal ranges of declination and of horizontal force, are of the same general form, the maxima and minima occurring at the same time for all. He concludes that these three phenomena must therefore be due to some common cause.

NICKEL-STEEL. Guillaume. "Sc. Am. Sup.," Oct. 29; translated from "La Nature."—A short, illustrated article on the magnetic and other properties; it contains some data.

PHOSPHORESCENCE. Jackson. "Sc. Am. Sup.," Oct. 29.—A reprint of his Brit. Assn. paper.

Electro-Chemistry and Batteries.

ELECTRO-DEPOSITION OF CADMIUM AND ITS ALLOYS. Cowper-Coles. Lond. "Elec. Rev.," Oct. 21.—A short article enumerating the properties of cadmium and describing briefly the ways in which it may be deposited; cadmium can now be bought of a good quality at a low rate; it is suitable for coating the terminals of primary and secondary batteries and for preventing the corrosion of steel. Lately cadmium had been extensively deposited as an alloy with silver; with a small percentage of silver it has been used during the last three years for coating bright steel parts of machines, such as bicycles, and an alloy containing 75 per cent. of cadmium has been extensively used for plating domestic articles; this alloy withstands the tarnishing effect of the atmosphere much better than fine, pure silver. A silver cadmium alloy is electropositive to nickel, therefore when it is used for coating steel the corroding action of the air and water is much more violent in the presence of nickel than of the alloy, owing to the more intense electrical action with the former (unfortunately he does not state whether it is also electropositive to iron, like zinc, the electrochemical action of which with respect to iron is the reverse of that between nickel and iron); samples of nickel-plated iron and iron coated with this alloy were subjected to different corroding influences and showed that while the former rusted badly in a short time those coated with the alloy were but little corroded; the coating of the alloy is less porous than the nickel. The process of depositing the alloy from the cyanide of the two metals is described, but the determinations of the best conditions require careful experiment and much time and trouble; some remarks roughly indicating the laws governing the deposit are given.

ELECTRO-DEPOSITION OF COPPER. Lond. "Engineering," Oct. 21.—A short article calling attention to the electrolytic refining of copper and referring briefly to the improved Elmore and the Dumoulin processes of making tubes and sheets of copper. There are about thirty-one electrolytic copper refineries at work in Europe and America. Over one-third of the total output of the world is now electrolytically refined. The method, which is practically the same in all, is described briefly; the value of the so-called impurities, which contain gold and silver, amounted in one year to over three and a half million dollars in the plant of the Anaconda Company; the value in all the refineries in Europe and America is estimated to be about $8,000,000 per year; the gold and silver obtained are more than sufficient to cover the cost of the operation of the refining. In connection with a description of the Elmore process, the defects of which are now said to have been overcome, it is stated that a satisfactory tube free from all the objections observed in the older process is now obtained. In connection with the Dumoulin process, a description of which was noticed in the "Digest" last week, it is stated that the smooth deposits are obtained by the application of an insulating coating to the inequalities which form on the surface; the impregnators, which move over the surface of the metal, coat all projecting parts with a thin film of animal matter, which hinders further deposition until the surrounding depressions have been raised to the common level (this was not clearly stated in the previously cited description). It is claimed that there is now no doubt that these two processes can turn out satisfactory products.

COMMERCIAL ELECTROLYSIS OF WATER. Garutti. "Elettricita," 17, p. 152; abstracted in "Science Abstracts," Aug.—The chief difficulty in the electrolytic preparation of hydrogen and oxygen lies in the complete separation of the gases. In his process he uses a metallic diaphragm inserted in the cell, but not reaching the bottom, so as to allow sufficient space for the passage of the liquor from one electrode to the other. A plant of thirty-two cells, yielding daily 30 cu. m. of oxygen and 60 of hydrogen, has been working for six months, and the gases are sufficiently pure for commercial purposes, the oxygen containing about 1.5 per cent. of hydrogen and the hydrogen only a trace of oxygen.

The "Sc. Am. Sup.," Oct. 29, translates a short, illustrated article from "La Vie Scientifique," describing this process briefly; it is operating very satisfactorily and economically in Italy, Switzerland and Belgium, yielding very pure oxygen at a cost of less than half a cent per cubic foot, leaving a large margin of profit. The electrolyzer consists of steel-plate cells, the bottoms of the diaphragms being provided with small apertures, allowing the electrolyte to pass through, but not the gas bubbles, thus preventing the gases from mixing.

PRODUCTION OF ALUMINUM AT FOYERS.—"Soc. Chem. Ind. Jour.," 17, p. 308; abstracted in "Science Abstracts," Aug.—A description of this water-power plant. The practical yield of the metal is 1 pound per 12 electrical hp hours.

TREATMENT OF SULPHIDE ORES. Steinhart. "Industries and Iron," 24, p. 262; noticed in "Science Abstracts," Aug.—He discusses the treatment of ores containing lead, zinc and silver, by quite a number of different processes.

ELECTROLYTIC HYPOCHLORITE. Volta. "Elettricita," 17, p. 312; noticed briefly in "Science Abstracts," Aug.—A description of the Tailfer process. The chlorine and soda produced by the electrolysis of the salt are conducted to a special absorbing vessel, where the hypochlorite is formed by their mixture, which thus takes place outside of the cell; this is the special feature of the process. The product thus obtained contains 20 to 30 times its volume of available chlorine; the electrolyte contains 250 grams of sodium carbonate per liter; 400 kg of hydrochlorite are produced with 100 amperes at 100 volts in twenty hours; the cost of production is one-third of the present market price of the hypochlorite.

CHEMICAL EQUILIBRIUM AND E. M. F. Knuepffer. "Zeit. Phys. Chem.," 26, p. 254; abstracted in the "Zeit. f. Elektrochemie," Oct. 20.—He used a certain reaction to study the relation between these two quantities and the conversion of chemical into electrical energy. The reaction which he uses represents a cell which, according to the temperature and concentration relations, acts sometimes with the evolution of heat and sometimes with the absorption of it.

INTERNAL FRICTION OF SALT SOLUTIONS. Euler. "Zeit. Phys. Chem.," 35, p. 536; abstracted briefly from the "Zeit. f. Elektrochemie," Oct. 13.—The object of the researches described was to determine the law connecting the friction of salt solutions with the friction of the ions, to determine the friction coefficient of different solutions and to compare them with the migration velocity.

OSMOTIC PRESSURE. Larmor. "Cambridge Phil. Soc. Proc.," 9, p. 240; abstracted briefly in "Science Abstracts," Aug.—He considers that the thermo-dynamic basis of the law of osmotic pressure is valid, while the hypothesis of ionic dissociation must be judged separately by its agreement with facts.

ELECTROLYTIC STAND.—Lond. "Elec. Rev.," Oct. 21.—A brief, illustrated description of an improved stand devised by Marshall for electrolytic research. The upright post consists of a concentric tube and rod, insulated from each other and connected at the base with the wires, thus doing away with all wires around the apparatus itself.

COMPARISON OF ACCUMULATORS. Shoop and Benndorf. "Elektrochem. Zeit.," Oct. 21.—The first part of a very long article in which they describe and give the results of experiments undertaken to compare accumulators of different systems with each other, so that the best system could be selected for any given purpose; they compared three quite different systems of accumulators. The first portion is a long dissertation describing the meanings of the terms and the characteristic properties of accumulators; this appears to be a good summary, but does not seem to contain anything new. The question often asked, Which accumulator is the best? cannot be answered in a general way; in each particular case certain conditions will determine the choice; the only question which can arise is which system is the best for any particular case, the answer to which is, that which at the desired output and satisfactory efficiency is the most reliable and involves the least cost of maintenance in which is included the interest on the original cost. They lay particular stress on tests made with an auxiliary electrode of cadmium; this consisted of a rod of cadmium, like a pencil, immersed so as to offer a surface of about 10 cm; the voltage between this electrode and each of the others, both while the current is flowing and after it has been stopped, were measured and all these figures are given in the voluminous tables; the sum of the voltages measured between this electrode and the two plates should be, and was found to be, equal to that between two plates; such a test shows the condition of each of the plates separately. According to Exner, the difference of potential between cadmium and sulphuric acid of 1.15 sp. gr. is about + 1 volt, and if, therefore, 1 volt is deducted from the reading between the cadmium and the positive plate, the remainder will give the e. m. f. of that plate; subtracting that between the cadmium and the negative plate from + 1 volt will give the e. m. f. of the spongy lead plate. The three cells had almost equal capacities and were always connected in series. They were discharged at various rates and charged at 7 amperes until gas was evolved at both electrodes; moreover, they were always charged with one-fifth more than the previous discharge. The accumulators tested were the Baumgarten, the Guelcher and the Oblasser; the results of the first two are given in voluminous tables in the present installment; these tables give the time, the current (which was kept constant in each discharge) and the various voltages with the auxiliary electrode described above, besides the differences between the calculated and the observed results, both on open and closed circuits. A brief description of each of the systems is given, together with the various weights of the different parts.

RESTORING SULPHATED ACCUMULATOR PLATES.—"Elektrochem. Zeit.," Oct. 1.—A short article describing a method (which is not new) of restoring badly sulphated plates so as to make them useful again. It consists in connecting such a plate to one of zinc, in sulphuric acid; the action of the zinc will reduce the sulphate to spongy lead. (When this is applied to the positive plates it should be understood, although not so stated, that it will reduce not only the sulphate, but also the remaining peroxide, to spongy lead, and the plate will then have to be formed over again to convert it into a peroxide plate).

THEORY OF THE LEAD ACCUMULATOR. Dolezalek. "Wied. Ann.," 65, p. 894; noticed in the "Zeit. f. Elektrochemie," Oct. 20.—A complete publication of his article, of which a condensed form was noticed in the "Digest" Mar. 12. Incidentally it may be mentioned that in order to show that the low capacity of accumulators is due to the lack of acid he describes experiments in which an accumulator plate is so mounted that during the discharge sulphuric acid is forced through it, when the capacity will be almost three times as great as under ordinary conditions.

JACQUES CARBON CONSUMING CELL. Skinner. Lond. "Engineering," Oct. 21.—A brief notice of his Brit. Assn. paper. He found that the air, which is blown into the fused soda, acts by keeping the iron surface clean; hydrogen peroxide added to the soda has the same effect. He hopes to determine the electrochemical equivalent of carbon from the current of the cell and the loss in wight of the carbon electrode.

THEORY AND CONSTRUCTION OF GALVANIC CELLS. Platner. "Elektrochem. Zeit.," Oct. 1.—A short article on the chemical process in the zinc cell and on the depolarization by chlorate; no general conclusions seem to be drawn.

Units, Measurements and Instruments.

INSULATION INDICATOR FOR DISTRIBUTION WIRES. Kallmann. "Elek. Zeit.," Oct. 1.—The conclusion of his long paper (see "Digest" last week). He shows how his indicator may be applied to a two-wire system; this can readily be inferred from the description previously given. He mentions briefly that there would be no deflection of the instrument for the case in which the leakage current from the two wires is equal; he claims that this "apparent" lack of deflection would very rarely occur, but when it does an additional test is easily made, and this consists in connecting momentarily a relatively small resistance, say of a few hundred ohms, between either pole and the earth; the highest deflection is then to be taken as the proper indication. (He does not appear to point out that, in general, his indicator always shows merely the difference between the two leakage currents and that only in the exceptional case in which one of the lines is perfectly insulated will his indicator give the correct leakage current; the absolute equality of the two leakage currents may be exceptional, but some leakage from both is certainly the rule; this intrinsic fault of the instrument does not seem to be brought out clearly.) He then shows how it is applied to a three-wire system, but neither the diagram nor the explanation is quite clear; it seems as though he applied the galvanometer to each of the two-wire halves successively, as he states that only one instrument is necessary; in this application he states that the instrument shows the difference between two differences of currents. He then shows the application to two-wire systems in series—that is, to the beginning and end of a long-distance transmission, for instance, or to the distribution branches at the ends (this, of course, involves the use of two or more testing wires from the distant end back to the near end, an important element in his system which is not emphasized); one is therefore enabled to measure the leakage current of distant distribution wires from one point. In conclusion he gives an illustrated description of the model which he used in his experiments (as he does not state that the instrument is in practical application, it is to be presumed that it has not yet been so used). He emphasizes the fact that this instrument shows the condition of insulation, not by means of the resistance to earth, but by the leakage current, and claims this to be the preferable method; rules and regulations should allow for a definite proportion of leakage current instead of requiring a certain insulation resistance.

INDICATORS.—"L'Eclairage Elec.," Oct. 15.—Brief descriptions, illustrated with diagrams, of several Siemens & Halske indicators. One of these is to give a signal when the voltage varies more than a certain amount; it consists simply of an electromagnet which operates one of two relay circuits when the voltage is too high or too low. The others are a ground indicator, a current indicator and one showing the direction of the current; they do not seem to be of especial interest.

PLATINUM VOLTMETER Callendar and Griffiths. Lond. "Engineering," Oct. 21.—A brief abstract of their Brit. Assn. paper. The current strength and voltage of continuous or alternating currents were determined from the rise of temperature of a platinum wire, which is not subjected to any strain and can therefore be much finer than any voltmeters of the Cardew type; the instruments have no magnifying gear, are very sensitive, absorbing little current and having very wide ranges; they are especially adapted for determining fluctuations in the neighborhood of 110 volts. In the recording device a pen is attached to the sliding contact of the galvanometer in a straight bridge wire, and is kept automatically at the balance point by means of a delicate relay controlling a pair of collector motors. No further description is given in the abstract.

HOUR METER.—"L'Elec.," Oct. 22.—An illustrated description of the Richard hour meter, consisting essentially of a pendulum which is started when the current is started and stops when the circuit is open, indicating the total time of the flow of the current in hours; it rewinds itself automatically every twenty seconds.

ELASTIC MOMENT OF SPIRALS. Guillaume. "L'Ind. Elec.," Oct. 10.—A short discussion on the proper way of stating and measuring the elastic moment of spirals. The logical unit is the unit couple divided by the unit angle. In practice the measurement of the couple can be replaced by the measurement of the oscillation of a known moment of inertia.

NATIONAL PHYSICAL LABORATORY.—Lond. "Elec. Rev.," Oct. 14.—An editorial on the report noticed in the "Digest" Oct. 29. It is claimed that the proposed arrangement probably satisfies the wishes of no one concerned, but it has the merit that the Government may accept it.

The Lond. "Elec.," Oct. 21, contains a communication by C. E. He claims that the conclusions of the committee are vague and indefinite on the most important points—namely, the scope and purpose of the proposed laboratory.

Telegraphy, Telephony and Signals.

INDUCTIVE DISTURBANCES IN TELEPHONES. Laarmann. "Elek. Rundschau," 15, p. 132; noticed briefly in "Science Abstracts," Aug.—The disturbances due to the neighboring currents may to some extent be compensated by the Brockett method. The primary of a coil is placed in series with the telephone line circuit and the secondary is connected as a shunt between the two points of that circuit; so that the secondary currents oppose and neutralize the primary. The telephones are connected in the shunted portions of the line; or another induction coil may be inserted in the shunt portion, the primary being to line and the secondary to receivers. The telephone current is only slightly weakened; it is claimed to be very effective.

MODERN TELEPHONY. Wehrenalp. "Zeit. fuer Elek.," Oct. 16.—The continuation of his long serial (see "Digest" July 9). In the present portion he discusses telephone central stations and their construction and arrangement.

NEW SYSTEMS OF TELEGRAPHY.—"El'ty," Nov. 2.—Brief description of two new systems. One is that of Professor Rowland, which is shortly to be tried between New York and Philadelphia; it will transmit four messages in each direction at the same time; it is a printing telegraph, the keyboard being like that of a typewriter and the messages being received in type either on a sheet or a tape. The advantages are that no skilled operator is required at either end, and that a large amount of time is saved; an ordinary typewriter operator could send messages at the rate of forty words per minute, making the capacity of the wire eight times this. This is practically all that is said about it. The other [illegible] of Mercadier, which it may be [illegible] over the line [illegible] can be sent simultaneously [illegible] the principle [illegible] and the signals are heard [illegible]

[illegible] DISTANCE OF TELEPHONE SPEECH [illegible] He discusses the American practice of

clearing the line of static charge by increasing the self-inductance and leakage, and of balancing the static capacity with a mutual self-inductance. A form of telephone lightning arrester is illustrated.

TELEGRAPHY WITHOUT WIRES.—"Sc. Am. Sup.," Nov. 5.—A brief, illustrated description from "La Nature" of the Dosne apparatus for performing experiments in wireless telegraphy.

Miscellaneous.

INFLUENCE OF ELECTRICITY ON PLANTS. Lemstroem. Lond. "Engineering," Oct. 21.—A brief abstract of his Brit. Assn. paper. He gives a summary of his researches since 1885 concerning the relations between atmospheric electricity, the aurora, sun spots and plant growth. An increase in plant growth amounting to 40 and even 75 per cent., but varying with the different plants, was observed; it was found, however, that when water is wanting electricity, which gives rise to an energetic absorption of moisture, may prove injurious; tobacco prospered remarkably when kept well watered at the same time; he stretched wires connected with a static machine and provided with points across the fields; he ascribes the beneficial effects either to the formation of ozone and nitric acid, or more probably to the electro-capillary phenomenon of Gernez—that is, that water rises in a capillary tube higher than it does normally when a point electrode, positive or negative, is inserted in the tube at the top.

BRITISH ASSOCIATION.—Lond. "Engineering," Oct. 21.—The continuation of the brief abstracts and notices of a large number of the papers, some of which have been noticed under their respective headings in the "Digest." The report of the committee on electric standards describes the progress made in the determination of the ampere. Solomon described the determination of the temperature coefficients of the two 10-ohm standard coils used by Ayrton and Jones in their determination of the ohm. Ayrton and Jones described their ampere balance in detail. Fawcett described a standard high resistance prepared by depositing upon glass in vacua, cathode films of alloys, and heating them afterward in a partial vacuum. A platinum gold alloy of a temperature coefficient of 0.01 per degree C. seems the more suitable, but this coefficient varies with the thickness of the film; the resistances of one megohm and upwards have not changed by more than 0.001 per cent. during a period of four months. Barrett, Brown and Hadfield presented a report on the electric conductivity and magnetic permeability of new alloys of iron, principally nickel steels; the paper is said to be of considerable practical importance, but is not abstracted. Rosa and Smith measured the heating effect of an alternating voltage on the dielectric of a condenser; they found that paraffin paper wastes very little energy, while with beeswax and resin the loss was much greater. Lodge described an attempt to construct a magnifying or bellowing telephone, but succeeded only with the former; the opinions were fairly unanimous that an attempt to increase the human voice to a bellow must fail because it is mechanically impossible to set a sufficient quantity of air in motion; he succeeded in magnifying the sound to the intensity of the human voice, but no more. Chattock measured the velocity of electricity in electric wind and concludes that the electricity in wind travels faster than the gaseous particles themselves; also that negative electricity travels quicker than positive; (the question arises, What is it that travels?) Cook, in a paper on the brush discharge, described a number of experiments, illustrated with many photographs. There were two papers on the Zeeman effect, one by Preston and one by S. P. Thompson. There were three papers by Lord Kelvin, the first on the dynamical theory of refraction and anomalous dispersion; another on the continuity of the undulating theory of sounds, elastic solid light and electric waves, in which he comes to the conclusion that no continuity could be shown; the third was on the graphic representations of the two simplest cases of a single wave. A paper by Callendar and Griffith on the measurements of small differences of resistance is noticed; the apparatus was described some years ago, but has been perfected and now measures the resistance to within one part in three million. The report on electrolysis, which is said to be an important one, is briefly abstracted. It includes a paper by Griffith on dilute solutions and one by Whetham on conductivity of dilute solutions.

ELECTRIC CURRENT AND THE LAW. Meili. "L'Eclairage Elec.," Oct 15.—A translation in abstract of his article noticed in the "Digest" June 25 and April 30.

LIGHTNING ON KITE WIRES.—"Sc. Am. Sup.," Nov. 5; reprinted from the "Monthly Weather Review."—An article describing some of the recent experiences of the observers of the Weather Bureau in connection with kites in which the kite wires were destroyed by heavy electric discharges. In one case the wire was completely destroyed, the amount being 12,500 feet; particles of melted wire adhered to the reel, the kite at the time was in a comparatively clear sky. In another case there appeared to be a rope of smoke along the wire, which latter was quickly consumed by a powerful bolt of lightning; fire seemed to rise to the kite, and the wire seemed to be on fire along the whole length; in one case the concussion of the bolt was very great. Four cases are described. The whole subject is briefly discussed; according to Elster and Geitel the whole earth can be considered either as a sphere with a negative charge acting on the regions above it by induction, or the atmosphere can be considered as the dielectric of a condenser of which the earth is the negative side and the upper layers of the atmosphere the positive. There appear to be at least three different conditions leading to the electrification of the kite line; in some cases the discharges are strictly momentary; Professor Marvin says that in such cases the wire is the receiving instrument in an immense wireless telegraphy system, the signals over the wire being indications that lightning is passing at some far distant point; the currents may be called inductive discharges and may in some cases be strong enough to fuse the wire; in other cases it may be actually struck by lightning. The kite wire used by the Weather Bureau is 0.028 inch in diameter, having a tensile strength of 210 pounds; a current of 15 amperes is required to heat and maintain the wire at a red heat when its resistance is about 0.7 ohm per foot, or about five times that when cold; from this it is calculated that the discharge which fused 12,000 feet of wire in one case was at least 130,000 volts.

An Improved Telephone Switchboard.

The illustration at the bottom of this page gives a view of a new switchboard equipment recently installed in the exchange of the Home Telephone Company at Trenton, N. J. This board was manufactured by the American Electric Telephone Company, of Chicago, and, it is claimed, represents a distinct advance in the art of switchboard construction. It embodies all of the latest improvements, and is fitted with 1200 drops, with a capacity in its transfer system for 2000 drops. It is built for full metallic circuits, and is provided with the company's self-restoring express drops. The transfer system is fitted with the latest improvements, using incandescent electric lamps for signaling

It will be interesting to independent telephone managers to know that this company is able to successfully carry through in an up-to-date manner any telephone construction work, however extensive or expensive it may be.

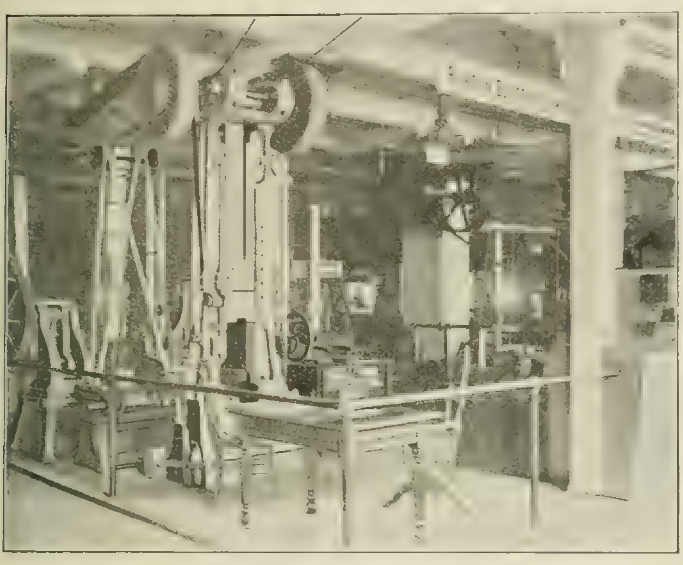


Exhibit of the Burton Electric Smelting Company.

Some of the Exhibits at the Mechanic's Fair, Boston.

THE BURTON ELECTRIC SMELTING COMPANY, of Boston, makes an elaborate exhibit of its smelting apparatus and some of the other electrical inventions of Mr. George D. Burton. Several liquid forges are in service besides the one in the Edison exhibit, and attract a great deal of attention from the uninitiated, who are astounded to see metal melted and cooled in the same water. A power-driven punching machine is also in the exhibit, driven by a Belknap motor to show the practical use of the forges. Electric current for welding and forging by dry processes is generated by an Eddy 15-volt, 1200-ampere machine, belted to a 20-hp motor and connected to an anvil by 2-inch solid copper rods. Souvenirs are distributed made by electric forging processes.

THE LQMBARD WATER WHEEL GOVERNOR COMPANY, Boston, Mass., exhibits one of its type "B" governors set up and in operation as it would appear in connection with a water wheel. This Type "B" is the form of Lombard governor which is most often used in electrical plants. Of the 80,000 horse-power of water wheels which is now being governed by Lombard governors about 40,000 horse-power is being regulated by the type of governor shown in the exhibit. Types "A" and "F" are also shown, the former being for small turbine plants and the latter for Pelton and other impulse wheels.

THE STANDARD THERMOMETER & ELECTRIC COMPANY, Peabody, Mass., shows a full line of samples of eighteen different styles of enclosed arc lamps, giving several varieties of cases and many combinations of different types of inner and outer globes and reflectors. One 220-volt lamp takes from two to three amperes maintaining, it is claimed, from 140 to 150 volts across the arc. Multiple-series lamps for 220-volt circuits and taking from four to six amperes are also shown, as well as a straight series lamp, the latter being fitted with a short-circuiting cut-out mounted immediately over the lamp in an inverted cup-shaped shield, taking the place of the ordinary hanger-board

The Lombard Water Wheel Governor Company's Exhibit.

Switchboard in the Exchange of the Home Telephone Company, Trenton, N. J.

cut-out. The company's alternating-current enclosed arc is of interest in that the same lamp is made for any commercial frequency and without change of adjustment will burn on circuits with a pressure anywhere from 100 to 120 volts. The lamp maintains a potential of eighty volts across the arc, there being no resistance in the controlling circuit but that of the series solenoid. The lamp is also remarkably noiseless, due to the use of felt between the gear and the case, removing the resonant effect of the latter. The alternating-current lamp is trimmed with a five-eighth-inch cored lower and one-half-inch solid upper carbon, the increased size of the lower carbon giving a life of from 120 to 135 hours. Mr. Roger Upton is the designer of this line of lamps.

Exhibit of the Standard Thermometer and Electric Co.

The Cahill & Hall Direct Electric Elevator.

Several radical departures in elevator construction have been developed by the Cahill & Hall Elevator Company, San Francisco, and embodied in an electric elevator, the correct scientific principles and ship-shape design of which are most pleasing to those versed in this line of work. The greatest novelty in this machine is the system of roping, which is outlined in the accompanying drawing. The two hoisting ropes are virtually endless and are not fastened into any hoisting drum or multiplying sheaves. They are driven, as are ciple which is ingeniously turned to account, as described below. The two winding ropes are not fastened to the cage, but run from the upper end of the counterweight over a sheave down to and around the double driving sheaves of the winding machine; from them under an idler sheave mounted at the back end of the machine, as shown in the photographic illustration, and up again to the under side of the counterweight. The machine itself is hinged near its forward end, and the greater part of its weight is supported in the bight of the winding ropes passing under the above-mentioned idler, this weight always giving a certain predetermined tension to these winding ropes. The car or cage is simply supported by ropes direct from the top of the counterweight. The combination may, of course, be over-counterweighted to balance the average load of passengers and thus to give the greatest economy of power. In winding it is obvious that should either the car or the counterweight strike an obstruction, such as the bumpers, or become bound by the setting of the safety stop or for any other reason, the increased upward pull of the winding ropes—no matter which way the machine were running—would tend, as soon as it more than overcame the weight on the idler sheave, to make that end of the machine climb up the ropes. This would remove all tension from the outgoing end, which would immediately allow the cables to slip on the winding sheaves. This is a feature which exists in no other electric-elevator equipment, and is undoubtedly of great value, owing to the fact that with rigid connection between the rope and the winding machine, in case of any obstruction, the enormous strains attainable before the fuse blows, especially with worm gears or screws, aided by the momentum of the motor, strain all parts of the equipment and tend to break the ropes, sheaves or fastenings and allow the cage to drop.

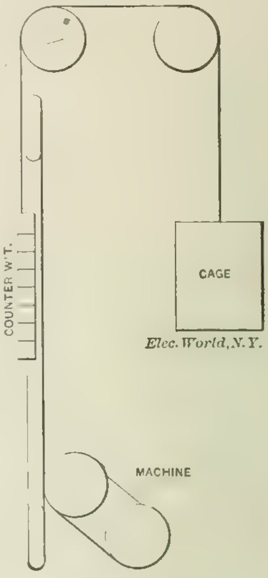


Fig 1

The motor is of rectangular yoke, double-pole iron-clad design without magnetic joints in the field frame, cumulatively compound wound, and is rated at 15 horse-power at its normal speed of 800 r. p. m. Its weight is 2400 pounds. Tests made by Mr. E. S. Cobb showed a starting torque of 2448 pounds at the surface of the 10-inch armature, with all the controlled resistance thrown in and with no material heating in either rheostat or motor.

The armature shaft is connected through insulating couplings to a shaft carrying right and left hand worms, which respectively mesh with gears coupled to the two driving sheaves. This arrangement balances the end thrust on the worm shaft, and that without the fine adjustment necessary with the ordinary right and left hand worms driving one drum, since with the arrangement here shown the load is automatically equalized between the two driving sheaves at all times. Two independent magnetically operated brakes operate pulleys on the worm and armature shaft. Both are set by gravity and released by solenoids, one being that used in the regular operation and controlled within the cage, the other being connected up with contact strips on the car which [illegible] operating current and set both brakes.

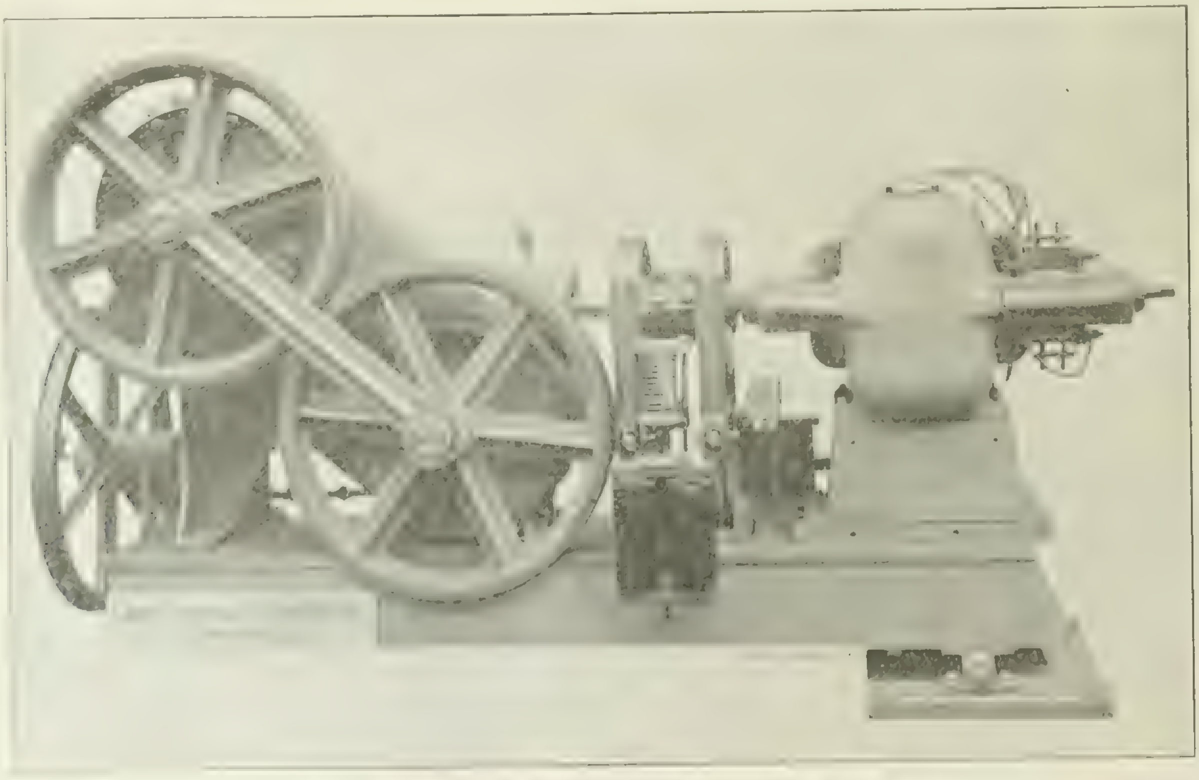


Fig. 2.—Machinery of the Direct Electric Elevator.

Financial Intelligence.

DIVIDEND.—The directors of the Erie Telephone & Telegraph Company have declared the regular quarterly dividend of 1 per cent. payable on November 21.

THE NEW YORK & NEW JERSEY TELEPHONE COMPANY has filed a certificate at Albany, N. Y., of an increase in capital from $5,000,000 to $8,000,000.

THE BROOKLYN RAPID TRANSIT COMPANY in its October statement reports gross earnings of $525,135, which is an increase of $65,613, as compared with the gross earnings for the same month last year.

Special Correspondence.

NEW YORK NOTES.

MR. HENRY FLOY, who last August resigned his position as manager of the Minneapolis office of the Westinghouse Electric & Manufacturing Company, has, with Prof. R. C. Carpenter, of Cornell University, opened a consulting engineer's office in the St. Paul Building, 220 Broadway, New York. The firm, under the name of Floy & Carpenter, is securing its share of consulting business, and is at present doing work for the Utica Belt Line Railway, Ithaca Street Railway, the Standard Oil Company, the Youngstown Gas Company and other concerns.

ATMOSPHERIC POTENTIAL.—Mr. William A. Eddy, the kite expert, has recently made some rough experimental determinations of the difference of potential between the atmosphere and the earth in the neighborhood of the Statue of Liberty on Bedloe's Island, in New York harbor. It was the prevalent idea that this large mass of metal would to a certain extent equalize the potential between the ground and the atmosphere in the neighborhood, but metallic kites sent up to a height of about 350 feet gave greater sparks to ground when within 30 feet of the head of the statue than when 500 feet away, apparently showing that the statue tends, if anything, to increase the potential in the neighboring strata rather than the reverse.

DARKNESS ON A LIGHT SUBJECT.—Mystery still surrounds the New York Gas & Electric Light, Heat & Power Company as to its real identity and purposes. Much speculation has been indulged in over the plans of this company, and many opinions have been expressed on the subject, but as yet the officers have kept their own counsel and not admitted the interested public to their confidence. During the past week another theory has been evolved, which may or may not have some elements of truth in it. It hails from Philadelphia, the home of gas and electric combinations, and it is to the effect that Messrs. Widener, Elkins and Dolan, of that city, are interested in the New York enterprise, and propose to bring about the consolidation of all the electric light interests in Greater New York. Another and later rumor is to the effect that the company has purchased the Consolidated Telegraph & Electrical Subway Company, of this city, paying therefor $6,000,000. This step is, according to the story, necessary in order to carry out the alleged purpose of consolidating the electric light business in Greater New York, and using the surplus power of the street railroads in the general scheme for furnishing light and power.

THE EDISON ELECTRIC ILLUMINATING COMPANY, of Brooklyn, recently executed a mortgage for $10,000,000 to secure a like amount of bonds, $2,000,000 of which were to be issued immediately. The question arose as to the amount of internal revenue tax to be paid on the document, and the company referred to the Internal Revenue Collector of Brooklyn for an opinion. That official submitted the matter to the Commissioner of Internal Revenue at Washington, who, in rendering an opinion, states that the company is mistaken in believing that it will only have to pay tax on the $2,000,000 worth of bonds now issued. He states that the instrument is a fully executed and completed contract, which provides for a specific and liquidated amount of money, upon which this company lodges its credit. There will be required no other instrument when each issue of bonds is made, although these issues are in future. The commissioner's office considers the instrument to be unquestionably a mortgage for $10,000,000 fully executed, passed and settled, with nothing remaining to be done, and it is therefore held to be subject to taxation as a mortgage for $10,000,000. The Kings County Electric Light & Power Company also separately executed a mortgage to secure the same bonds, and it was also asked whether this mortgage must also be stamped or whether the two mortgages be treated as one, both being given to secure the same loan. The commissioner decided that the mortgage executed by the Kings County Company is subject to the same taxation as the one executed by the Edison Company. Under this ruling it is stated that the Edison Electrical Illuminating Company will have to pay a stamp tax of $5000.

ELECTRIC POWER FOR THE THIRD AVENUE SYSTEM.—On Monday last the Third Avenue Railroad Company began work preparatory to installing the underground conduit system on its lines. Ducts for the feeders are now being laid on Third Avenue, south from 124th Street, in trenches dug alongside both the up and down town tracks. The number of ducts will vary from twelve to thirty-four or more at different parts of the line. McRoy conduits and cement-lined pipes manufactured by the National Conduit & Cable Company are being used in the work. The entire system of the Third Avenue company will be equipped with electric power. The roads to be changed over are the Third Avenue, the 125th Street and Amsterdam Avenue, the Forty-second, Manhattanville & St. Nicholas Avenue, and the Dry Dock, Battery and East Broadway lines. The two last named are now operated by horses. The present cable conduits on the Third Avenue road will be used for the electric system, but new rails will be laid. These will be 60-foot 7-inch girders, made by the Johnson Company. On the other lines entirely new construction will be carried out, 9-inch 60-foot girder rails being used. The reason that only 7-inch rails will be laid on Third Avenue is because of the height of the yokes in present use, which will not permit of a higher rail being used. The electrical system to be adopted will be similar to that used by the Metropolitan Street Railway Company on its various electric lines. That is the most definite information that can be given at the present time regarding the electrical equipment, as the contracts have not yet been made. The large power house on the Kingsbridge Road will be equipped with modern apparatus, which will generate alternating currents. These will be transmitted to sub-stations at various points on the system and transformed to direct current for the operation of the cars. Just what apparatus, the number and size of units, etc., will be installed at the main and sub stations has not yet been determined upon, as the contracts have not yet been submitted. The situation may seem to many to be a peculiar one. The Third Avenue Railroad Company has determined to adopt electric power, and has actually begun the preliminary work with this end in view, but has not yet even asked for bids on the equipment. The plans are in the hands of the engineers, however, and will soon be ready to be bid on. The work of changing over to the electric system will be carried on as rapidly as possible; the laying of the rails on the Third Avenue line will immediately follow the duct work. The installation of the conduit system on the Dry Dock and other lines will commence at once and be carried to completion as quickly as possible.

BUFFALO AND NIAGARA FALLS NOTES.

IT IS HOPED that the Urban flour mill will be ready to start up with electric power before the end of the month. Since every other mill besides some other concerns are waiting to see how this venture comes out it is very essential that a good job shall be made of the work.

THE MANAGERS of the Automatic Telephone Company are not yet prepared to push the invention in this city, though they are doing well elsewhere. They are at present content with enjoying a little "family" sort of an exchange, with the wires connecting the offices of the leading members of the company, who are mainly lawyers.

USELESS LIGHTING.—The Buffalo city authorities are at loggerheads over the disposition of the arc lights that are located on the outlying parts of the city. Several years ago the land speculators secured a lot of lights in the uninhabited sections of the city, and they are still illuminating the bare fields. An agitation has been started in favor of moving them farther in toward the heart of the city, where they will do more good.

THE BELL TELEPHONE COMPANY is spending a large amount of money in burying the wires even at points in the city far removed from the business centre. A gentleman, in speaking of the policy of the company in this regard, expressed admiration for the enterprise shown, but was of the opinion that it did not help pile up dividends. He regards the popular clamor against overhead wires as very unwise, as it necessitates high charges.

THE CANADIAN NIAGARA POWER FRANCHISE.—Speculation over the probable course of the Niagara power authorities in regard to the Canadian franchise has not been put at rest by the payment last week of the $12,500 rent that had been allowed to lapse so long. It is claimed that the franchise has now run out on account of the failure of the Canadian branch of the company to go ahead with the work. Secretary Rankine came here from New York this week, and was in consultation with local members of the Canadian company, but they refused to talk on the question beyond saying that there would be developments soon. The franchise stipulated that the Canadian company should have 10,000 developed horse-power now and water connection for 25,000 horse-power. Some time ago the company applied for an extension of eighteen months, and may have obtained it.

ST. LOUIS NOTES.

ANOTHER STREET RAILWAY FRANCHISE measure was introduced into the House of Delegates at last Tuesday's meeting. The road is called the Clifton Heights & Oakland Railway, and is to cover the southwestern district of the city and connect with a county road, to be secured by franchise later.

PROPERTY OWNERS along the route of the proposed new extension of the Lindell Railway are preparing to take into court the question of the validity of the franchise recently granted by the Municipal Assembly and signed by the mayor. The points of controversy will be made upon laws which, it is held, are in direct conflict with the new line. At the head of the contesting party is some of the best legal talent in the city.

A SUIT has been filed against the St. Louis Underground Service Company, the Citizens' Electric Light & Power Company, the National Subway Company of Missouri and the Kinloch Telephone Company by two prominent citizens. They ask for the production of certain books and the appointment of a receiver for the St. Louis Underground Service Company. The suit grows out of a controversy over some stocks.

THE CASS Avenue and Fair Grounds Railway Company applied to the Circuit Court last Tuesday for an injunction restraining the St. Louis & Suburban Company from operating over its tracks. The route was granted the Suburban by the Municipal Assembly April 5, 1898. The Cass Avenue road objects to it. It is also charged that in granting permission for the loop the Municipal Assembly violated the Julian law, which provides that when municipal street franchises are granted they shall be bid for and given to the highest bidder. It is claimed that this was not done in the case of the Suburban road.

WASHINGTON NOTES.

FOUR SUITS for injunction have been brought against the Chesapeake & Potomac Telephone Company within the past week. A bill in equity has been filed by Mr. George C. Altemus, who seeks to prevent the removal of a telephone from his establishment in the city, which the company has threatened, although he has offered to pay the price fixed by Congress as the yearly rental of a telephone in the District. Three other suits were filed on November 4 in the Supreme Court of the District of Columbia. The petitioners are James and Lewis Holmes, doing business at First and E Streets; Fenton A. Denison, trading as Denison & Co., at No. 206 Tenth Street, and Collins & Gaddes, at No. 511 Eleventh Street.

GAS EXPLOSION AT THE CAPITOL.—On Sunday afternoon last an explosion of gas occurred in that part of the Capitol occupied by the United States Supreme Court, causing much damage. This accident is a strong argument against the use of gas and favorable to the adoption of electric light in such buildings, where there is much valuable property in jeopardy. Apart from the danger of gas explosions the products of combustion from the gas jets are injurious to books and fabrics, and in time produce a dingy appearance to the surroundings. These objections are entirely removed by the use of electric light. There are now two electric light plants in the Capitol, but the use of gas in halls and similar places is yet continued.

AMERICAN LAMPS IN JAPAN.—The American consul at Hiogo writes to the State Department that he has received a letter from K. Ikeda, president of the Kobe Electric Light Company, in answer to the consul's inquiries relative to electric light supplies. The company, the letter states, formerly used only the Edison lamp, but in 1894 changed to English and German lamps, in consequence of the latter being cheaper; but it recognizes the superiority of the American or Edison lamp, and says that it is desirable to use lamps requiring the least amount of power. Apparatus for testing lamps is now being installed, which may disclose that the company should discard the cheaper English and German lamps, and again use the Edison.

CHICAGO NOTES.

ALL OF THE BRIDGES across the Chicago River in the business sections of the city are now operated by electric motors. The Adams Street bridge was recently equipped with electrical apparatus, and this was the last of these structures to be so outfitted.

A JAPANESE ELECTRICAL FRANCHISE.—It is reported that the Siemens & Halske Company of America has received a proposition from the Japanese Government to form a syndicate to develop electrical enterprises in Japan, such as electric railways and lighting plants, and that the matter is now under consideration by the Chicago company. The franchise, it is stated, will be exclusive, and one of the most valuable ever granted to one syndicate or corporation. The Elkins-Widener syndicate, of Philadelphia, it is stated, will be interested in the Japanese syndicate if it is formed. The syndicate, it is reported, will have a capitalization of about $10,000,000.

MEXICAN NOTES.

PRESIDENT PORFIRIO DIAZ has promised to visit Monterey the latter part of this month, and extensive preparations are now being made for his [illegible] The electric light company is wiring all of the public plazas and buildings, and the electrical illumination upon the occasion [illegible] will be exceedingly beautiful.

THE WORK of introducing electric traction on the street-car system of the city of Mexico is making good progress. The first portion of the system to be [illegible] the line to Guadalupe and the line to San Angel, by way of Chapultepec, Tacubaya and Mixcoac, embracing in all about [illegible] and [illegible] will be used [illegible] double bracket [illegible] in which the trolley wires is suspended from wires strung across the street from pole to pole, [illegible] of the Babcock & Wilcox type, and three McIntosh & Seymour engines. The nom- [illegible]

PACIFIC COAST NOTES.

[illegible]

[illegible]

[illegible]

was made into Bakor Bay to avoid the shipping, and then another splice to a cable was made. It is claimed to be the only line of the kind in use.

CANADIAN NOTES.

THE STATEMENT of the Montreal Electric Street Railway Company for the last year shows the net profits to have been $601,704.18, against $507,885.60 for the year previous. After paying a 10 per cent. dividend, $138,000 was carried over to the rest account.

A BY-LAW providing that the Toronto Electric Street Railway shall have vestibules on the rear of the cars has gone into effect, but the vestibules are not in evidence, nor does there appear to have been any effort on the part of the company to provide them. The Toronto civic authorities are determined to test their power in the matter, and City Solicitor Caswell promptly laid information against the company for breach of the by-law. The case will come up for trial.

THE OFFICIAL ANNOUNCEMENT has been made by the Quebec, Montmorency & Charlevoix Electric Railway Company that it is proposed to equip the road running from Cape Tourmente, Quebec, with electric power, and to construct an independent branch to Montmorency Falls. The estimated cost of improvements is given as $330,000, and when completed the system will comprise over 60 miles of electric railway. The president of the company is H. J. Beemer. The shareholders of the Quebec, Montmorency & Charlevoix Railway and of the Quebec Electric Railway on Wednesday week had their first general meeting since the amalgamation of the two companies, to authorize the board of directors to issue debentures to the amount of $1,500,000, bearing 5 per cent. interest, redeemable in twenty-five years and secured by a first mortgage on all the properties of the company. Since the companies were amalgamated the gross receipts have been $79,006, and the expenses $33,647, leaving a net balance of $45,559.

NEW CALCIUM CARBIDE FURNACES.—For the past two weeks there has been an experiment going on in this city which has now developed into an industry. It is the manufacture of calcium carbide for the production of acetylene gas by means of a new, yet simple and effective, method. The inventors of this new scheme are Messrs. H. Lamoth and J. W. McRae, of Ottawa. The new idea is in the furnaces which are to be used in the manufacture of the carbide. The furnace consists of two electrodes, one suspended from above and the other placed on the ground. The two are connected by means of carbon pencils, which form an arc producing sufficient heat to melt the coke and limestone which are piled around these electrodes, and form it into calcium carbide. It is the intention of the promoters of this new industry to erect a plant containing about forty of these furnaces, which will be kept running sixteen hours per day. The carbide is produced for $60 per ton wholesale, and the factories now making this product throughout Canada are unable to keep up with the orders for this product. By operating their present plant the inventors expect to be able to turn out about 10 tons of carbide per day.

SOUTH AFRICAN NOTES.

THE RUNNING OF A 10,000-VOLT PLANT.—The generators of the power transmission system of Moodie's Gold Mining & Exploration Company, Limited, recently ran for over eighty-eight days continuously without any interruption whatever. During this time there were partial losses of load (due to line fuses going) amounting in all to only twenty-five minutes.

LIGHTING AND TRAMWAY CONTRACTS.—There has recently been a little more activity than usual in the electrical business. The town of East London has concluded contracts for a lighting system and also for a tram line, the total to be outlaid being about $200,000. Bloemfontein has also decided at last to put down an electrical plant, and the work in connection with the Grahamstown Exhibition is in progress. All of these undertakings are in the hands of Johannesburg firms.

PROPOSED ENLARGEMENT OF JOHANNESBURG LIGHTING WORKS.—The Town Council of Johannesburg proposes to raise £150,000 ($750,000) on debentures for the purpose of increasing its lighting plant. The town possesses two lighting systems, one electrical, the other gas. It is proposed to extend both of these and to give further facilities for the use of gas for cooking purposes. Since the town took over these undertakings in April, [illegible], the dynamo capacity has been raised from [illegible] to [illegible] kilowatts, while that of the gas plant has been more than doubled in the same time. In addition to the town plant there is, of course, a very large amount of lighting done by private concerns.

FRENCH NOTES.

ELECTRIC TRACTION AT VINCENNES, SEINE.—The question of [illegible] electric traction by the overhead system for the compressed air [illegible] the lines through the Vincennes wood is now up for consideration.

ELECTRIC TRACTION IN FRANCE.—France is next to Germany in the number of electric railway lines now in operation. During [illegible] her mileage [illegible] miles, making a total construction for one year in France almost equal to the total existing mileage of England. Seventy-two companies use the overhead trolley, eight use underground conductors, and thirteen operate with storage batteries.

AN IMPROVEMENT IN TROLLEY WHEELS.—The invention is intended to guard against the jumping of the trolley wheel from the wire, which occurs with such annoying frequency at switches and sharp turns where the wire is necessarily out of line with the centre of the track. Instead of mounting the wheel rigidly at the end of the pole a spiral spring connects the two, allowing the wheel to follow the many irregularities of the wire, no matter in what direction they occur, without causing too much pressure between the wire and the flanges of the wheel.

THE MACHINE SHOPS OF THE DECAUVILLE COMPANY.—The new Decauville Company has recently built some new shops for electro-mechanical work, and is now able to fill orders for generators and motors of all sizes, or to contract for complete electrical installation, transmission of power, traction work, etc. Among the installations made by this company is that at Sondière de la Madeleine, near Saint-Nicholas du Port (M. et M.), which has been found very satisfactory. Also a number of motors were put into the foundries and smelting works at Pont-à-Mousson, and both generators and motors for Darblay & Sons, Essonnes. A recent order received by the Decauville Company was from the Norman Electric Light Company, of Rouen, for a three-wire system electric light generator of 800 horse-power.

AN ELECTRIC PROTECTIVE DEVICE FOR LINEMEN.—A new arrangement has been invented for the protection of linemen at work. The object of this instrument is to provide a path for the current which will conduct it off the line before it reaches the lineman in case the current is thrown on to a dead line by mistake while it is undergoing repairs. For overhead work it is composed of six hooks connected together in two groups and carried on an insulated handle, with which they may be fastened to the wires without the aid of a ladder; each group of hooks is grounded through a flexible conductor ending in a metal spike, to be stuck into the ground. For underground work the hooks are replaced by clamps which have insulated handles kept apart by a strong spring, and which are grounded as before through a spike and flexible connection.

ELECTRIC TRANSMISSION OF POWER.—An application has been made by a corporation for a franchise to permit the erection of a power station on the banks of the Loire. The enterprise contemplates developing near the Villerest paper mill 10,000 gross horse-power, to be transmitted for light and power purpose to Roanne and its environs. There is at present a considerable use made of steam power in this district at a cost of operation varying from 200 to 500 francs and over per year on a basis of ten hours per day and 300 days per year. Leaving out of consideration the possible use of current for electro-chemical purposes, and leaving out also the possibility of transmitting power to Charlière, Regny, Amplepuis, Thizy, Cours, etc., it is practically certain that with cheap power in the district considered new manufactures and industries would be attracted and the old ones greatly developed. This could be done successfully by selling power at from 300 to 150 francs per horse-power per year (10 hours per day and 300 days); this would be equivalent to 15 centimes (3 cents) per kilowatt, and would effect a saving to the consumer of 25 to 50 per cent. in the cost of his power. In addition, there are not far from a hundred villages which would all use electric light, the advent of which is earnestly desired by the inhabitants. Many municipalities and manufacturers are already in line, and need nothing but proposals to become customers.

A TELEPHONE LINE ALONG THE MEDITERRANEAN COAST.—It has been decided to establish telephonic communication between Marseilles and the towns along the coast. The great importance and practical value of this line to both public and private business in these cities is very evident; it brings them into communication not only with Marseilles, but with all the other cities with which Marseilles is connected and with Paris in particular. There was a meeting on April 25 between the representatives of the various cities concerned and a telegraph superintendent, M. Frouin, ministerial chief of the office of telegraphic communication, who was especially appointed to consider the matter by the Minister of Posts and Telegraphs. At this meeting it was agreed to issue bonds for 350,000 francs on the credit of the cities and towns concerned in the enterprise, these bonds to bear interest not to exceed 3½ per cent., together with provision for a sinking fund, which will wipe out the debt in five years. At the rate of interest specified the yearly interest account is 12,650 francs, which will be divided as follows: Marseilles, 2000 francs; Toulon, 3000; Hyères, 300; Fréjus, 300; Menton, 250; Draguignan, 250; Grasse, 200; Antibes, 200; Saint-Raphael, 200; Vallauris, 150; Beaulieu, 150; Villefranche, 150. It is readily understood that these interest charges will decrease from year to year in proportion to the receipts with the operation of the sinking fund provision. Every city is at liberty to advance the necessary capital directly from its treasury.

General News.

THE TELEGRAPH AND TELEPHONE.

OWENSBORO, KY. The Cumberland Telephone Company contemplates the erection of a modern exchange building here.

BOSTON, MASS.—The People's Telephone & Telegraph Company, Worcester, has been incorporated. J. L. Currier is president; F. W. White, treasurer; capital, $150,000.

HARRISBURG, PA.—The Pennsylvania Telephone Company has let the contract to extend its line from New Tripoli to Slatington by way of Garmansville, Sagersville, Dibertsville and Slatedale. The new line will be in operation by December 1.

RICHMOND, KY.—A scheme is on foot to buy up and consolidate all the local telephone lines of Central and Eastern Kentucky, numbering about twenty-five, extending as far north as Maysville and south to Somerset, into one system. Capitalists of this city are at the head of the scheme.

NEW YORK, N. Y.—The Fowler Switchboard & Telephone Company, of New York City, has been incorporated to manufacture telephone and other electrical fixtures. The capital is $5000. Directors, John T. McRay, of New York City; Samuel B. Fowler, of Brooklyn, and L. Victor Heckles, of Brooklyn.

SANTIAGO DE CUBA.—An overland telegraph line from Guantanamo to Manzanillo by way of Santiago has been ordered constructed by the United States Signal Corps. The line will be used for the transmission of official government dispatches, but it is stated that commercial business will also be accepted.

BOSTON, MASS.—The Mexican Telephone Company has expended $33,000 in establishing metallic service, which amount has been paid out of the earnings. The company is increasing its rental per subscriber from $75 to $125, although the metallic service is optional. It, however, reports a gratifying demand for the service at the higher price.

NEW PHILADELPHIA, OHIO.—The Tuscarawas Home Telephone Company, with headquarters at this place, and a capital stock of $75,000, has been incorporated by J. S. Bailey, F. W. Bainbridge, J. W. Yeagley, O. S. Wefty and J. H. Mitchell, to operate a telephone system between New Philadelphia, Canal Dover, Uhrichsville, Dennison, Canton, Carrollton, Cadiz, Cambridge, Coshocton, Millersburg, Wooster and neighboring villages.

BOSTON, MASS.—The instrument report of the Bell Telephone Company for the month ended October 20 shows the following: Gross output 33,639, an increase of 10,508 over October last year; net output 21,816, an increase of 5830. Since December 20, last year, the gross output was 278,363, an increase of 92,487, and the net output 158,281, an increase of 48,658. The total number of instruments outstanding October 20 was 1,077,420, an increase as compared with the number at the same period last year of 193,930.

SAN FRANCISCO, CAL.—In a recent interview with Mr. Heinrich Hofmeister, director of the German telegraph system and superintendent of the cable system at Emden, that gentleman gave some interesting facts concerning the telegraph service in his country. He stated that the greatest difference between the service there and the telegraph service in this country is that the Germans do more for the small towns and villages. In Germany the mails, the telegraph and the telephone are combined in one department, which is in charge of Dr. Von Stephan, whose principal aim is to secure the most perfect system at a minimum cost. The telegraph tolls in Germany compared with those in this country are very much lower, the charge for a 10-word telegram to any part of the Empire being about 5 cents of our money. In the telephone service 25 cents for five minutes' conversation is charged, irrespective of the distance, which is not taken into account as in this country. Individual telephone subscribers pay 150 marks or about $36 a year for the use of the telephone. Overhead wires were abolished in Germany long ago, not only in cities, but through the Empire. Cables containing seven copper conductors constructed like submarine cables and encased in iron pipes, are used on the underground work. Germany, Mr. Hofmeister said, is one gigantic spider web of underground cables. Main lines radiate from Berlin to the uttermost edge of the country, and these radiating lines are joined together at regular intervals. Occasionally wires are strung on poles in the country, but two poles are used, instead of one, to support the cross arm. Porcelain insulators are used in overhead work in place of glass.

ELECTRIC LIGHT AND POWER.

CLARENCE, MO.—At a special election held here it was voted to issue $5000 of electric light bonds.

WICHITA, KANS.—The city authorities are considering the question of establishing an electric light plant.

CHARLEROI, MICH.—A vote will be taken here on the proposition to bond the city for $10,000 to purchase the electric light plant now operated by private capital.

PEORIA, ILL.—The Diamond Motor Company has been organized in this city, with a capital stock of $30,000. The incorporators are E. Couck, W Reyle, A. Fink and G. Scheefer.

IRONTON, OHIO.—The electric plant was burned to the ground recently. The damage amounts to about $8000, which is partly covered by insurance. The plant will be rebuilt at once.

EDWARDSVILLE, ILL.—The plant of the Edwardsville Electric Light & Power Company was recently completely destroyed by fire, entailing a loss of $40,000. Immediate steps have been taken to rebuild.

GREENPORT, L. I., N. Y.—The Greenport Electric Light Company is considering the advisability of having a new electric light plant established in this village in place of the old one, which is sadly in need of repairs. A new boiler will be put in at once.

BENTON HARBOR, MICH.—The City Council of Benton Harbor has closed a contract with the Benton Harbor & St. Joseph Electric Light Company for a term of five years. The contract calls for 1200-cp arc lights, and the price paid for forty lights for the five years is $14,000, making a rate of $70 per electric light per year.

MACON, MO.—The Trans-Mississippi Electric Light & Power Company has been incorporated with a capital stock of $30,000. Col. F. W. Blees, J. F. Schaefer, of Kansas City, and Charles E. Roel, of St. Joseph, are the directors. The company was organized for the purpose of establishing and managing electric light and power stations.

ALLEGAN, MICH.—The Kalamazoo Valley Electric Company, recently organized, has begun the construction of a dam in the Kalamazoo River 4 miles from here, to cost $125,000, and which, it is expected, will develop 13,500 horse-power. Four large water wheels will be put in, and the electric power generated will be distributed to Allegan, Kalamazoo, Plainwell, Otsego and other towns for lighting and power purposes. The works will be in operation next spring.

CHARLESTON, W. VA.—The Edison Junior Electric Light & Power Company, of New York City, has been incorporated here for the purpose of manufacturing, selling, licensing or otherwise dealing in electric storage batteries and electrical appliances, etc. Capital subscribed, $100, with the privilege of increasing the same to $500,000 in all. The shares are held by Thomas A. Edison, Jr., Valentine Robinson, H. C. Hepburn, E. A. Drake, C. S. Henry, R. M. Jordan, J. G. Batterson, Jr., and F. J. Stone, all of New York City.

UNADILLA, N. Y.—The Standard Light, Heat & Power Company has been incorporated with a capital of $600,000. The company will furnish electricity for the villages of Unadilla, Gilbertsville and Otego, Otsego County; Sidney and Franklin, Delaware County, and Bainbridge and Afton, Chenango County. The directors are Henry G. Canfield, Samuel E. North, J. Fred

Sands and Daniel R. Buckley, all of Unadilla. The company has secured the paper mill plant near Sidney, and the Crookerville mills above Unadilla is also incorporated in the same concern. The company already holds the lighting franchise for Bainbridge, and is getting estimates on water wheels and machinery for its central station.

THE ELECTRIC RAILWAY.

NORFOLK, VA.—The Port Norfolk Electric Railroad, valued at about $500,000, has been sold, it is stated, to New York parties.

DAYTON, OHIO.—The Dayton & Xenia Traction Company has filed papers of incorporation at Columbus. The capital stock is $300,000. The road will be built over private right of way at once. J. M. Wilson is to superintend the work.

CEDAR FALLS, IA.—J. F. Cass, of Sumner; L. S. Cass and C. J. Fossilman, of Waterloo, have bought the Cedar Falls street car line and will change it to an electrical system, running in connection with the Waterloo & Interurban Railway. Work will commence at once.

FRANKFORT, KY.—The officers of the Frankfort Street Railway Company have served notice on the City Council that if compelled to lay new rails on the streets of the city where brick streets are being put in they will be compelled to go out of business. The Council lately passed an ordinance ordering the new rails put in.

COLUMBIA, N. Y.—The Columbia Traction Company has been incorporated under the laws of New Jersey, with a capital of $100,000. The proposed road is to connect Hudson and Philmont. The officers are: President, Franklin G. Simmons; treasurer, William C. Allen; secretary, E. F. Foote. Mellenville and Claverack will also be connected.

HAMPTON, VA.—The transfer of the property of the Newport News, Hampton & Old Point Company to the Newport News & Old Point Railway & Electric Company has been accomplished. The exact sum involved in the deal has not been made public, but it is known that with the extensive improvements contemplated it will exceed $1,000,000.

STREATOR, ILL.—The Streator Electric Railway was sold recently by a master in chancery from the United States Court at Chicago. It was bid in at $14,000 by C. C. Barr. Mr. Barr was the principal stockholder in the road. The road runs to the four corners of Streator, and it now is apt to go to the owners of the cross country line between Streator and Ottawa.

LINCOLN, ILL.—The City Council has granted the Lincoln Electric Street Railway Company an extension to forty years, with the provision that unless the company shall construct a certain loop, covering nearly two miles of territory in the neighborhood of Lincoln University, within twenty-four months, the rights of the franchise shall become void and will be forfeited.

JOHNSTOWN, PA.—A new trolley line from this city to Geistown, Scalp Level and Windber is assured. A charter has been granted to the Johnstown & Somerset Traction Company, which will build and operate the road. The incorporators are Charles S. Price, David Barry, M. L. Woolf, H. H. Weaver and Frederick Krebs. The road will open up a large section of territory.

BOSTON, MASS.—The Railroad Commissioners have authorized the Mystic Street Railway Company to issue $80,000 twenty-year 5 per cent. bonds for funding the floating debt of the company incurred in construction and in the purchase of the Arlington & Winchester Street Railway Company. The bonds will also refund the floating indebtedness of the Arlington & Winchester [illegible]

CLEVELAND, OHIO.—The City Council recently passed ordinances imposing a 4-cent fare on the big and little consolidated railway systems. Both companies have begun proceedings in the United States Circuit Court, asking for an injunction preventing the city from carrying the ordinances into effect. A temporary restraining order was issued, good until December 1, when the [illegible]

KENOSHA, WIS.—The Milwaukee, Racine & Kenosha Street Railway Company has succeeded in getting the Common Council to grant it a franchise. The company will at once begin the construction of the road through the city, but will meet with great opposition by many of the property owners along the proposed route, who severely criticise the Council for its [illegible]

[illegible] city, and the Monongahela Traction Company, which is now building a road along the south bank of the Monongahela River to McKeesport, intends try- [illegible] son station, on the Pittsburg, Virginia & Charleston Railroad, and proposes [illegible]

[illegible]

[illegible] ton, of Cleveland, will conduct the sale. A reorganization committee will purchase the plant and extend it over many streets not now covered.

[illegible]

PHILADELPHIA, PA.—An ordinance has been introduced in Camden City Council to grant a franchise for a terminus in that city of an electric railroad between Philadelphia and Atlantic City. The tracks are to be elevated within the city limits at a height of 14 feet in the clear and 20 feet above steam railroads. The ordinance contains the names of Walter N. Boyer, Frederick S. Dickinson, Lewis W. Moore and Daniel Caldwell as applicants for the franchise. These are said to be Philadelphia capitalists, and it is reported that there is a capital of $3,000,000 back of the scheme.

NEW BRUNSWICK, N. J.—The Brunswick Traction Company, which controls all the trolley lines in Middlesex County, and also lines in Somerset and Union counties, has been merged with the New York & Philadelphia Traction Company. Judge Gottfried Krueger, of Newark; Andrew Radel, of Bridgeport, and E. H. Radel, of New Brunswick, have purchased a controlling interest in the New York & Philadelphia Company. J. Blair MacAfee, vice-president of the New York & Philadelphia Company, will retain his office, and his company will be operated under the direction of the Brunswick Company.

NEW YORK, N. Y.—In a recent issue of a financial exchange it was stated that at the annual meeting of the Central London Railway an explanation was given to those present in reference to the letting of contracts for apparatus and material to American concerns. The company states that the contracts for carriages, locomotives and machinery were given to American firms because the more extensive use of electric traction in the United States has brought the manufacture of apparatus to a higher state of perfection and at much lower cost. "Their tools and manufactured machinery," the report states, "are much in advance of ours, as might be expected when the small amount of electric traction construction in England is considered. The difference in the cost of production here and in America is considerable, and as it is desired to build and fit the line on the very latest and best principles, no resource was left us but to approve of the electric traction company's action."

NEW YORK, N. Y.—A peculiar accident occurred on the line of the Staten Island Electric Railroad Company, near St. George, on the night of November 2. A car going down a hill blew out a fuse, and in order to replace the burned-out fuse with a new one the trolley pole was pulled down from the wire, thus leaving the car in darkness. The motorman of the car following, not being able to see the disabled car, descended the grade at a rapid rate, and a collision resulted before the brakes could be effectively used. There were thirty-seven passengers on the second car, and they were hurled in a heap in one corner, while the windows of both cars were broken and the platforms wrecked. A third car came along, and the motorman, not being aware of anything unusual ahead of him, came down the hill and ran into the wreck of the two cars, and the fourth car met disaster in a like manner. There was much excitement for a time, but fortunately no one was seriously injured, although the passengers received a good lively shaking up. The four disabled cars were towed to the repair shop at New Brighton, after a delay to traffic of over an hour.

PERSONAL NOTES.

MR. FRANK NICHOLS PHILLIPS, second son of Mr. Eugene F. Phillips, and president of the American Electrical Works, of Providence, R. I., is to be married on November 15 to Miss Edith Remington Peck. The young couple have the best wishes of the electrical fraternity for a future full of happiness and prosperity.

MR. WILLIAM J. CLARK, general manager of the railway department of the General Electric Company, has, according to information from Washington, been requested by Secretary of War Alger to examine and put the finishing touches on the report of the late Colonel Waring in reference to the sanitation of Havana and other Cuban cities. Mr. Clark is an authority on Cuban affairs, having spent considerable time in that part of the world, and this invitation on the part of the United States Government is a well-merited recognition of his ability to pass upon matters of such vast importance. Mr. Clark went to Cuba in connection with transportation matters, and while there he and Colonel Waring were together much of the time. Colonel Waring gave Mr. Clark much information about his work, and explained his plans, and it was in this way that the latter gentleman became familiar with the matter. It was on account of his knowledge of the subject that Mr. Clark was chosen to complete the work left unfinished by the untimely death of Colonel Waring.

OBITUARY NOTE.

MR. CHARLES H. SUMMERS, chief electrician of the Western division of the Western Union Telegraph Company, with headquarters in Chicago, died suddenly of heart failure in San Francisco on November 2. Deceased was a native of Kentucky, and began his telegraphic career in 1854. He was very widely known in the telegraph field.

Trade and Industrial Notes.

MR. WILLIAM LINDSAY, formerly with the F. M. Pierce Engineering Company, of New York City, has recently joined the local selling staff of the C. & C. Electric Company, succeeding Mr. C. H. Kirkland, who has [illegible]

THE LOMBARD WATER WHEEL GOVERNOR COMPANY, Boston, Mass., [illegible] of work on hand and is behind its orders at the present time. It reports that it is now building for unfilled orders governors to control water wheels aggregating about 18,000 horse-power.

[illegible] MOTORS.—The Crocker-Wheeler Electric Company, 39 Cortlandt Street, New York, in Bulletin No. 5 describes small sizes of very slow motors [illegible] small machines [illegible] are also given.

MR. CHARLES [illegible], Newark, N. J., [illegible] on the [illegible] the mountains of Russia, where he intends to make his platinum contracts for the coming year.

THE WESTERN ELECTRIC COMPANY has distributed a bulletin giving a full description and price list of the Western Electric non-sparking brushes. These brushes are said to be very satisfactory in eliminating the sparking at the commutator. Upon request a copy of the bulletin will be sent to any one who has not received one.

THE WALKER COMPANY, according to a Cleveland dispatch, has just finished the first of the eleven carriages for the Buffington-Crozier disappearing guns, for which it was awaraded the contract last April. A test was made on November 1. The carriage weighs 107,000 pounds, and the gun, which is an 8-inch rifle, 32,000 pounds.

THE BERLIN IRON BRIDGE COMPANY, East Berlin, Conn., is erecting the steelwork for a generator room and an engine room for the United Gas Improvement Company, Waterbury, Conn. The roofs are to have steel trusses supporting the roof covering of corrugated iron lined with the Berlin Iron Bridge Company's patent anti-condensation fireproof lining.

THE COLUMBIA INCANDESCENT LAMP COMPANY, St. Louis, Mo., reports an excellent business this season. Notwithstanding the fact that the facilities for turning out Columbia lamps have been increased 25 per cent., the company is compelled to operate its factory three nights each week in order to handle the volume of business which has been coming in this fall.

THE WESTERN ELECTRICAL SUPPLY COMPANY, 10 and 12 North Ninth Street, St. Louis, Mo., is distributing in the trade, with its compliments, a blank duplicate order book. Any order sent to this company will receive prompt and careful attention. This method of facilitating the work of making out orders should bring to the company an extra amount of business.

THE ROBB ENGINEERING COMPANY, Limited, of Amherst, N. S., has issued a little pamphlet entitled "Steam." The contents of the pamphlet are devoted in the main to a description of the Robb-Armstrong engine, which is built by this company, and the Mumford improved, the Monarch and other types of boilers. The engines of this company are excellently adapted for the driving of electric generating machinery.

THE AMERICAN ENGINE COMPANY, Bound Brook, N. J., has just shipped a complete 25-kw direct-connected plant to the Porvenir sugar estate, Santo Domingo. This, it is said, will be the first direct-connected plant installed on the island. The same company is also about to install a 35-kw complete plant of its own manufacture in the Grenoble apartment building, Fifty-seventh Street and Seventh Avenue, New York City.

MR. WILLIAM D. PACKARD, of the New York & Ohio Company, Warren, Ohio, has designed a new form of fuse wire holder of the style commonly used for the protection of outdoor transformer primaries, the patent on which, No. 613,594, was issued November 1. The holder embodies a transparent or translucent bulb by which the condition of the fuse may be seen and means for replacing the fuse without any tools whatever.

MESSRS. EDWARDS & CO., 144th Street and Fourth Avenue, New York, have brought out a new bellstriking device for church bells, village fire alarms, etc. It is said to be less expensive than other apparatus of this kind and satisfactory in operation. Two towns are now being equipped with the device. The Edwards Company is in a position to furnish the full equipment for the system and install the same.

MR. J. P. WILLIAMS, 39 Cortlandt Street, New York, has received the sole agency for New York State and New England for the sale of the Morris constant-potential, direct-current enclosed arc lamp. It is stated that this lamp has given the utmost satisfaction wherever it is used. It is made for use on all standard constant-potential circuits, of 110, 220 and 550 volts. These lamps consume five amperes and have a life of 100 hours, the length of the lamp over all being 30 inches.

THE MUELLER ELECTRIC COMPANY is the name of a company just organized by Messrs. William Mueller and H. J. Schuette, with headquarters at 713-715 Burling Street, Chicago, Ill. Mr. Mueller, who is already well known in the electrical trades, assures his customers that their orders will receive prompt attention, as the new company has an excellent corps of employees. The Mueller Electric Company has issued a new catalogue, a copy of which can be had on application.

PAPER FRICTION WHEELS AND PAPER PULLEYS.—The Rockwood Manufacturing Company, 330-338 South Pennsylvania Street, Indianapolis, Ind., has just issued an illustrated price list of its paper friction wheels and paper pulleys. Paper and iron friction wheels in pairs are adapted to any class of work performed by the common spur, bevel or mitre gears, and are especially desirable where machinery is thrown in and out of gear, and for reverse motions. Friction gearing is noiseless in operation.

MOULDED INSULATION.—In the last issue of THE ELECTRICAL WORLD appeared a paragraph concerning some of the products of the Mica Insulator Company, of New York, Chicago and London, under the head of "Moulded Porcelain." This error in the title, while an obvious one, might mislead some of our readers into the belief that the Mica Insulator Company is also in the porcelain business, but it is not. The production of its micanite materials requires its undivided attention, and gets it.

THE PARIS EXPOSITION.—Manufacturers and others who are considering the advisability of making an exhibit at the Universal Exposition, to be held in Paris in 1900, may learn something to their advantage in this connection by communicating with the Franco-American Company, 163 Washington Street, Chicago. The object of this company is to arrange for space and look after the exhibits of its patrons. It claims to have had twenty years' experience in this line, and is, therefore, well qualified to conduct this important business.

PROTECTION AGAINST LIGHTNING.—One of the greatest problems which presents itself to every electric light station manager is the proper protection of electrical machinery from damage by lightning. Anything leading to a proper solution of the problem is always welcome. The Electric Appliance Company, Chicago, has just issued a special circular on Wurts lightning arresters, which embody all of the improvements to date in this class of apparatus. The circular gives some valuable hints with reference to protection from lightning.

THE AMERICAN ELECTRIC TELEPHONE COMPANY, of Chicago, has just closed a contract for a switchboard of 2000 metallic lines for Lancaster, Pa., to be built on the same designs and plan as the board which is going in the exchange of the Home Telephone Company at Trenton, N. J., and which is briefly described and illustrated on another page in this issue. The company reports a noticeable increase in its orders for apparatus for the extension of exchanges, which is taken to indicate a generally healthy state of the telephone business throughout the country.

HAIR SPRINGS FOR ELECTRICAL INSTRUMENTS.—In the construction of electrical indicating instruments, the accuracy of the instrument depends very largely upon the integrity of the hair springs used. As a result of thorough and practical tests and examinations it has been shown that the hair springs made by Mr. F. N. Manross, Forestville, Conn., are among the best produced. For electrical instruments and for recording gauges, Mr. Manross makes phosphor-bronze springs, and those interested in these matters would do well to communicate with him.

VITOGEN.—In steam plants, particularly in electric light stations and power plants, the danger of scalding and burning is always present. It is always wise, therefore, to be prepared for emergencies, and some remedy should be kept at hand and immediately available to relieve suffering in case of accident. Vitogen is highly recommended for its healing properties in case of burns and scalds. It is a powder, and is sprinkled upon the parts affected, giving immediate relief and promoting healthy conditions. It is non-irritating and is antiseptic. The G. F. Harvey Company, Saratoga Springs, N. Y., manufacturer of Vitogen, has many convincing testimonials as to the healing qualities of this substance.

THE IMPROVEMENTS OF THE McEWEN ENGINE AND THOMPSON-RYAN DYNAMO.—In a description in these columns in the issue of October 29 of the exhibit of the Ridgway Dynamo & Engine Company, at the Mechanics Fair, Boston, Mass., it was stated that the inertia governor used was a modification of the Rites design. On the other hand, it is a form of the Begtrup inertia governor, the patents on which are owned exclusively by the Ridgway Dynamo & Engine Company, and which this company states to be the original and first successful inertia governor used in this country. In regard to the dynamo, it was stated that the brush holders were a modification of the reaction type, and it should be stated that this is only so in point of appearance, the modification, as there noted, differentiating it from that type and allowing of its construction independent of the Baylis patents.

FRINK'S REFLECTORS.—I. P. Frink, 551 Pearl Street, New York, in catalogue No. 32, describes Frink's patent reflectors for electric and combination fixtures for use in lighting churches, halls, banks, stores, offices, public buildings, factories, etc. The catalogue contains sixty-four pages, and is profusely illustrated with reflectors of every imaginable design. The reflectors are made of the best crystal corrugated glass, of double silver plate, coated on the back with heat and moisture proof cement, and are therefore calculated to last. Every one desiring the best distribution of light should investigate the merits of these goods. I. P. Frink produces a line of electric signs. Plain block letters of standard type of construction, ready to mount on framework or sign board, are kept in stock, and the concern will be glad at any time to submit designs and quote prices upon any style of sign desired, either in plain, block, script or fancy lettering.

THE AMERICAN ASIATIC ASSOCIATION is the title of an organization having for its object the dissemination among its members of information touching matters pertaining to trade with Asiatic countries, including China and the Philippines. Among its members are the General Electric Company, the C & C Electric Company, the Goulds Manufacturing Company, the Niles Tool Works Company, the Okonite Company, Ltd., the Pantasote Leather Company, Messrs. Charles A. Schieren & Co., the Western Electric Company, of New York; the Westinghouse Electric & Manufacturing Company, of Pittsburg, and Henry R. Worthington, of Brooklyn. The association publishes a paper called the "Journal of the American Asiatic Association," of which Mr. John Foord is editor. His address is P. O. Box 1500, New York. The possibilities of the extension of trade in the Philippines and China and other Asiatic countries, and the promising fields for enterprise which are about to be opened up in these far away lands, render the work of this association of great value and importance to its members, who are among the leading concerns in their respective lines of industry in the United States.

HYDRAULIC TOOLS.—The Watson-Stillman Company, 204-210 East Forty-third Street, New York, has been engaged for thirty years in the business of manufacturing hydraulic jacks, and any statement made by it regarding these indispensable tools may safely be accepted unquestioned. The company has just issued a seventy-page illustrated catalogue of its extensive and varied lines of hydraulic tools for railroad work. This company makes hydraulic jacks and tools for every purpose, and among the devices illustrated in the catalogue of special interest to electric railway engineers and mechanics are, besides the ordinary plain jack, the Vreeland patent transfer pit jacks, hydraulic screw punches, hydraulic "T"-rail bender, hand and belt power hydraulic wheel presses. hand-power car-axle straightening press, etc. The hydraulic rail bender has been recently added to the company's line of railroad tools, and is said to have fulfilled every expectation in actual practice. Where tools of one style are made in different sizes a table accompanies the descriptive matter, setting forth the various sizes, principal dimensions, lifting power, weight, etc., and the price. Every shop manager should have a copy of this catalogue and keep informed on the subject.

Business Notices.

THE ILLUSTRATIONS in this issue were made by the Photo-Engraving Company, 9-15 Murray Street, New York City

HAWAII AND THE PHILIPPINES.—Send 4 cents (in stamps) for an illustrated booklet issued by the Chicago, Milwaukee & St. Paul Railway, the direct route across the American continent to the new trans-Pacific possessions of the United States. Full of latest reliable information and valuable for reference. Can be used as a text book in school. Address William Kelly, Jr., G. E. P. A., 381 Broadway, New York.

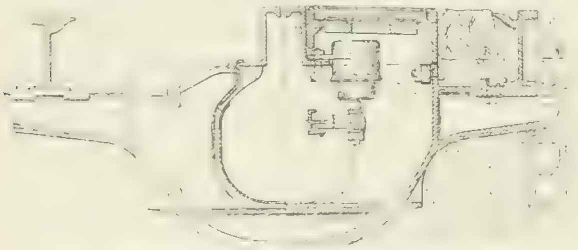
ILLUSTRATED RECORD OF ELECTRICAL PATENTS

UNITED STATES PATENTS ISSUED NOVEMBER 1, 1898

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

[illegible] EMERGENCY FUSIBLE CUTOUT FOR ELECTRIC CIRCUITS; C. H. Long, of Louisville, Ky. App filed July 10, 1897. In an electric switch, the combination, with the opposed wire plates, spanned by the fusible wire and opposite ones of said plates having sockets or contacts, of the laterally-movable switch adapted to engage one of said sockets or contacts, and having the fusible wire connection with one of the opposite end plates.

613,293. MECHANISM FOR SUPPORTING ELECTRIC ARC LAMPS; W. A. McCallum, of Avondale, Ohio. App. filed Nov. 18, 1895. The mast-arm head carrying the contact holder, and the contact carriage, and the lamp suspended from the carriage, the mast arm being hollow, and the carriage moving therein, and the rod connected to the carriage for reciprocating the latter, and located within the arm, and an opening through the mast through which the rod plays, substantially as described.

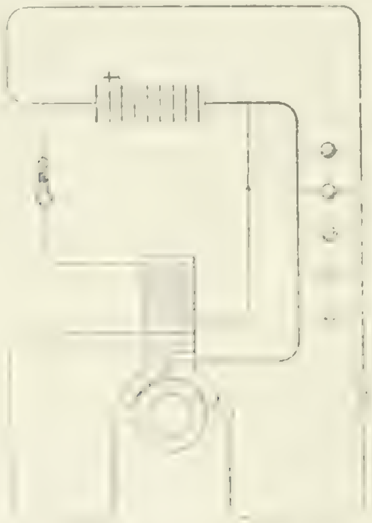


No. 613,301.—Yoke for Railway Conduits.

[illegible] YOKE FOR RAILWAY CONDUITS; F. S. Pearson, of Boston, Mass. App. filed Nov. 4, 1897. A yoke for railway conduits, having a hollow central portion and detachable manhole-curbs flush with the surface of the roadway, substantially as described.

613,348. PRINTING TELEGRAPH; A. Wirsching, of New York, N. Y. App. filed May 10, 1897. In a printing-telegraph instrument, the combination of a hollow shaft, a type-wheel, a carrier adapted to travel through the interior of said shaft and connected with and controlling the movement of said type-wheel lengthwise the shaft, means for moving the carrier through the shaft step by step.

613,406. ELECTRIC CAR LIGHTING; W. Biddle, of New York, N. Y. App. filed May 14, 1894. The combination in a system for lighting cars, of a dynamo having an armature rotated by a connection to the car-axle, an external circuit from the commutator containing incandescing lamps in multiple arc, a secondary battery in series in the external or working cir- [illegible]



No. [illegible]—[illegible] Car Lighting.

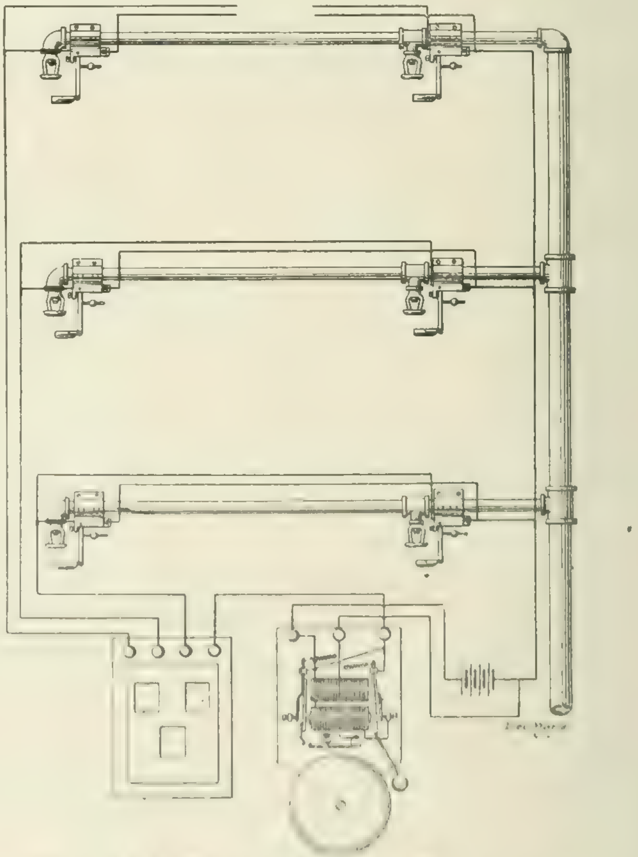
[illegible]

613,533. TELEPHONE BOX OR CABINET; I. Sparks, of Santa Fé, Territory of New Mexico. App. filed March 22, 1898. In a telephone cabinet, the combination with a box formed thereon of a partition for dividing the said box into an upper and lower closure, a movable front for closing the upper closure, adapted to carry a portion of the call mechanism, means for locking the said front board in its closed position, a removable top board provided with means to engage detents mounted on the inner surface of the front board, and a door for the lower closure, substantially as described.

613,549. GRADE-CROSSING SIGNAL FOR RAILWAYS; H. McLean Abernethy, of Elmira, N. Y. App. filed September 9, 1897. The combination with a railway grade-crossing signal of a track instrument electrically connected with the signal and comprising a rotary shaft, a sleeve mounted on said shaft and insulated on a portion of its periphery, a fly-wheel and a ratchet wheel on said shaft, contact fingers bearing on said sleeve, and means operated by a passing locomotive or train for operating said ratchet wheel.

613,567. BLOCK-SIGNALING APPARATUS; T. T. Fogel, of Allentown, Pa. App. filed Dec. 6, 1897. In a signaling apparatus, a target, a solenoid and an armature therefor pivotally connected with said target, an electric circuit, a circuit closer therefor, comprising a brush and a disc, a solenoid and an armature therefor, and means carried by said second armature for directly engaging and operating said disc.

613,594. ELECTRICAL FUSE-WIRE HOLDER; W. D. Packard, of Warren, Ohio. App. filed Sept. 29, 1897. The combination with an insulator having terminals of a translucent casing projected outwardly from said insulator, a removable fuse-wire holder located within said casing, the fuse wire being in electrical contact with said terminals, and a yielding bearing for said holder, substantially as described.



No. 613,636.—Combined Leak and Fire Alarm.

[illegible] ELECTRIC RAILWAY SYSTEM; L. E. Walkins, of Springfield, [illegible]

[illegible] COMBINED LEAK AND FIRE ALARM; H. F. [illegible], of New York, N. Y. [illegible] substantially as described.

The Electrical World.

Vol. XXXII. NEW YORK, NOVEMBER 19, 1898. No. 21.

PUBLISHED EVERY SATURDAY BY

The W. J. JOHNSTON COMPANY,

9 Murray Street, New York.

Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York.

New England Office, 620 Atlantic Ave., Boston.

Western Office, 936 Monadnock Block, Chicago.

Philadelphia Office, 929 Chestnut Street.

SUBSCRIPTION IN ADVANCE, ONE YEAR, $3.00,

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THE ELECTRICAL WORLD,

9 Murray Street, New York.

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FIRE HAZARDS FROM GAS.

Leaking gas has lately caused a serious fire in the chambers of the United States Supreme Court in Washington. The accident occurred in an "absolutely fireproof" building—the National Capitol—constructed almost entirely of non-inflammable materials, yet valuable records and other documents are reported to have been burned.

A good deal is heard about the danger of what the newspapers call "electric wires." Is not this a very fair demonstration of the harmful possibilities that lurk in the homely gas-pipe? Given a leak and a light, the conditions are ripe for a disastrous explosion, followed by the burning of everything inflammable within range. This may well occur, as it has in this case, in a building as nearly fireproof as science can make it. Is it not time to prohibit the introduction of gas into such structures?

In a building meant to resist the chance of burning, gas is an ever-present menace. Mixed with air in proportions covering a wide range, it makes a dangerous explosive. A fire once started, it adds fuel to the flames. What is called a "combination fixture," or a combined gas and electric-light fixture, is a survival of the days when electric light was not always reliable. To-day it is as much an anachronism as the buttons on the back of our coats—survivals of the day when a man going on horseback buttoned his coat-tails up out of the way. Why should such a place as the Supreme Court chamber be piped for gas? If the conservatism that has retained gas-pipes since electricity has so abundantly shown its reliability were less in evidence it is probable that we would not have to read of the destruction of valuable papers and a considerable loss at Washington. Gas in a fireproof building is simply an invitation to disaster.

MULTI-TOOTH SINGLE-PHASE ALTERNATORS.

The distribution of the armature winding of alternators into two or more slots per pole and per phase has become quite common in the case of multiphase machines, in which its advantages are greater and more obvious than in the single-phase type. The pole-wound or unitooth single-phase machine is still that more generally built, although a full comprehension of the advantages of the other would undoubtedly induce a more general demand for the multi-tooth machine. The improved working of the latter is, however, gradually forcing it into more general use, single-phase machines now being built in this country with the winding distributed in as many as eight slots per pole.

The advantages of the multi-tooth or distributed winding are several. It gives a more nearly sinusoidal form to the impressed electromotive force wave; it reduces the self induction of the windings and consequently the internal drop, and particularly the drop on reactive load; it distributes the armature distortion, which, with the unitooth construction, causes a heavy bunching of the lines of force immediately ahead of the slot, increasing the iron loss in the pole pieces even if the latter are laminated, and it eliminates the pulsating variation of the reluctance of the magnetic circuit which is inherent with the unitooth type, and which increases the iron losses. These advantages are obtained at the cost of a greater expense in construction and a far greater necessary care in the insulation and a somewhat reduced electromotive force per turn, since the distribution of the windings renders the electromotive force waves on the different slots somewhat out of phase with each other. In case of a uniform distribution over the whole pole angle, the effective electromotive force per turn is reduced by the distribution in the ratio of one to the average cosine of all angles between $\pi/2$ and $-\pi/2$, and since this average cosine is $2/\pi$, which is equal to about 0.637, the electromotive force in case of a uniform distribution is diminished about 35 per cent. The advantages, however, in case of a machine built to give satisfactory service as against one built to sell outweigh the disadvantages.

In the matter of winding this construction becomes quite simple for bar-wound single-conductor coils. The whole spiral of one pole angle may be form-wound, insulated and afterward driven into the slots, there being no necessity of bending down the ends except for the single connection between the exterior turn of one spiral and the interior of the next—that is, one bent end connection per pole. With wire-wound coils the problem is somewhat more difficult, but is simply solved with form-wound coils by making up a separate coil for every pair of slots.

THE ELECTRIC LIGHTING OF RAILROAD TRAINS.

Railway cars, especially parlor cars, are in this country almost universally lighted now by the Pintsch gas system, but the superiority in many respects of electric lighting maintains a steady attack on the various problems involved in the perfection of a suitable system for this service. While Pintsch gas gives a light far more satisfactory than that of oil lamps, and acetylene promises to excel Pintsch gas, the electric light is better yet, if a satisfactory service can be obtained, in that there is no combustion and consequently no danger of fire in case of accident. It lends itself admirably to the lavish decorative effects of modern palace cars, and it permits the use of that luxury in sleeping cars known as a berth light.

Granted that the electric is the best light, the demand for it will be a strong one, for, if there is one place where the best must be had at any price, it is in the equipment and furnishing of palace cars. The average middle-class American, no matter how simply he may live at home, demands as soon as he begins to travel the luxury of an Oriental potentate. That the electric light is considered the best is shown by the equipment of some of the most luxuriously furnished trains in this country, with a complete electric-lighting installation, in addition to the Pintsch equipment.* The latter is necessary when the train is divided or the locomotive uncoupled, as current is obtained from an isolated plant in the baggage car taking steam from the engine, but the electric equipment, with its cost of attendance, is regularly run solely to give the better light.

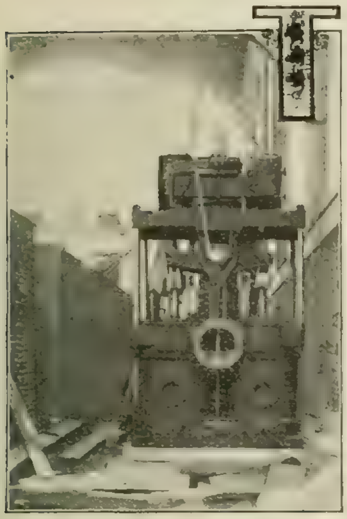
The methods of lighting trains or cars electrically are several, and a brief comparison of their relative merits may be of interest. One of the first developed was the provision under each car of a battery of accumulators capable of storing a night's charge, and arranged to be removed for recharging at the terminal stations. For cars running in regular service this system gives fair satis- [illegible] palace car, which wander from [illegible] demand, it would require a system [illegible] of the Pintsch gas method [illegible] would be difficult to establish. The isolated plant [illegible] steam from the loco- [illegible] is quite [illegible] storage cells under the cars [illegible] and to feed the [illegible] the train proper to run to branch terminals. The sine qua non of a generally applicable [illegible] system is a source of supply on each car independent of the rest of the train or of stationary charging plants. An independent engine on each car being out of the question, the most available source of power is the wheels themselves.

With axle-driven generators a storage battery is, of course, necessary to provide light when the train is standing or running below a certain critical speed. To eliminate the effect on the lamps of the difference in voltage when charging and discharging, two batteries are commonly used, one to be charging while the other is in use, but a great reduction in weight can be obtained by using one battery, alternately charging and discharging as the speed of the train varies. Such batteries to avoid, without complication, variations in the voltage and consequently in the candle power of the lights, must have a low resistance, small polarization and a high discharge rate, but their energy capacity need not be large. The problems to be solved are the provision of arrangements, first, for automatically maintaining the polarity of the current delivered with change of direction; second, for automatically cutting the dynamo into and out of circuit at speeds respectively above and below a certain minimum generating limit, and third, for automatically maintaining constant the voltage generated over a wide range of speed. The first problem is readily solved mechanically; the second can be met by a switch operated either by centrifugal weights or by an electromagnet dependent on the voltage of the dynamo; but the third is a more difficult one. One rather unscientific makeshift is the use of belts which slip when the speed or load becomes too great. This involves a considerable loss of power, and, what is worse, serious heating and wear of the slipping parts. Other systems vary the field strength inversely with the speed, thus maintaining constant voltage by means of automatic rheostats, magnets, springs, escapements, ratchets and other things which are objectionable in this sort of service.

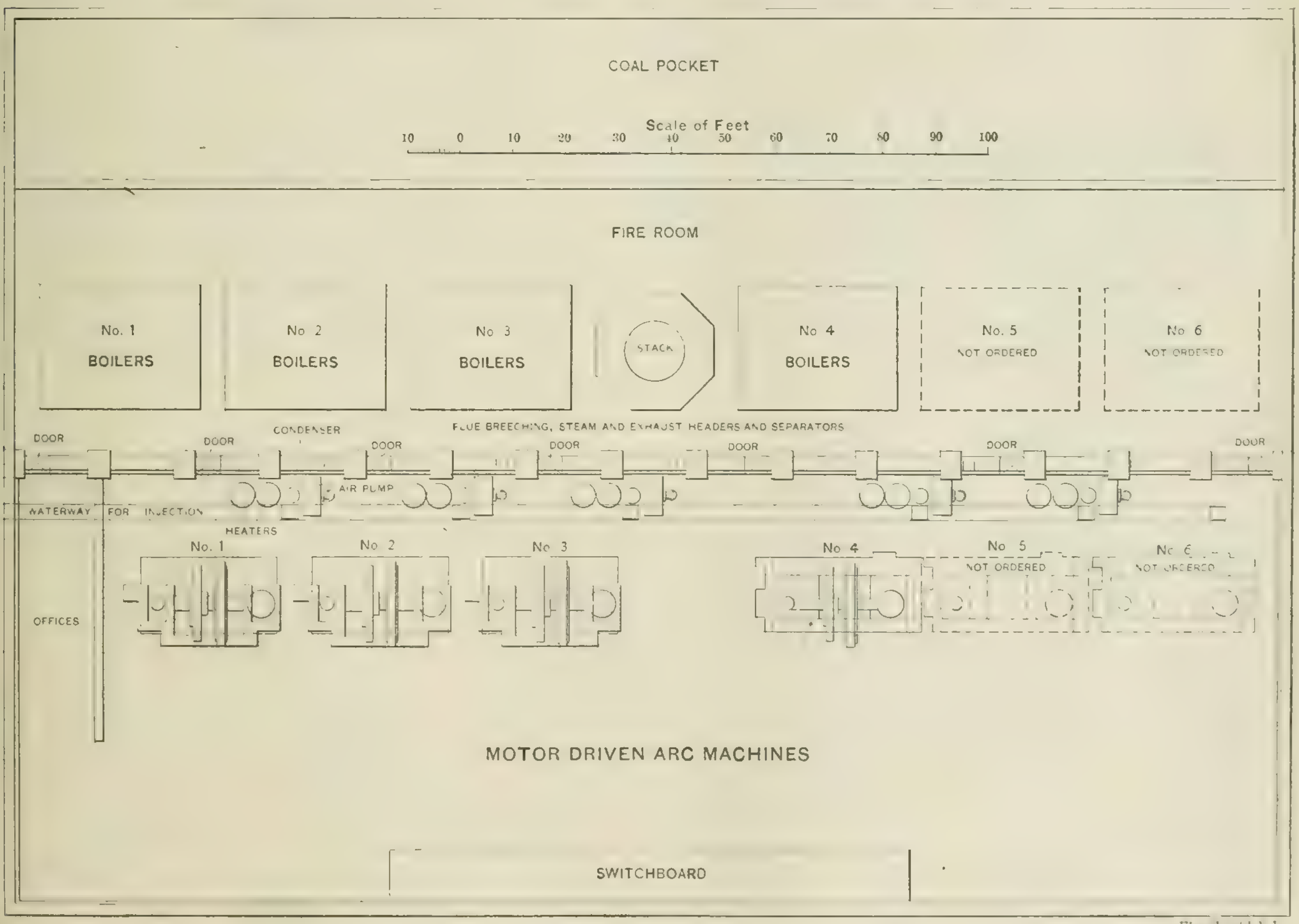
The only known method of obtaining practically constant voltage with highly variable speed and without troublesome devices, and one which seems to have been neglected in spite of the great advantages which it would possess in storage-battery charging, is as follows: The use of a dynamo with a flat-topped characteristic with shunt exciting coils of magnetomotive force sufficient at the storage-battery voltage to carry the magnetization well above the bend of the curve, and with field coils in series with the armature tending—when the machine generates current—to oppose the shunt excitation. With such an arrangement small outputs through the series coils would not materially lower the voltage, but in case the speed rises, tending to increase the output, and the excitation falls below the bend of the magnetization curve, any further increase of the load would materially diminish the field density and consequently the voltage. With proper design such a machine could be made to run over a wide range of speed with a small change of output at constant pressure if delivering to a storage battery. The latter would, of course, maintain the stability of voltage otherwise unattainable with shunt machines or under-saturated fields, and would absorb the variations in load necessary to the differential compounding. The series coil, instead of reducing the equilibrium of voltage between the machine and battery, as with ordinary compound generators, would tend, with this reverse action, to increase it.

With any system of field density inversely proportional to the speed, the armature reaction with constant load becomes a troublesome factor at the high speeds and consequent weak fields, but there are now several well known methods of obtaining a proper commutation with variable field strength, so that this difficulty is probably not a serious one.

The New Generating Station of the Boston Electric Light Company.



THE Boston Electric Light Company has one of those systems which have been in operation with alternating-current apparatus from the early days, and consequently is under conditions most perplexing to its management in the matter of bringing the installation up to date. The developments in this particular line have been so great and the apparatus in use has become obsolete so much more rapidly than it has depreciated mechanically that satisfactory operation with low running expenses requires practically the throwing of much serviceable equipment in the scrap heap and the purchase of new, with a corresponding increase of the fixed charges. If this were all the trouble it would be a simple matter, as the increased fixed charges and the reduced operating expenses can be reckoned quite closely and balanced against each other, but alternating-current machinery is still developing, and it is hard to tell what old apparatus to keep in service until systems and machines have been further standardized and improved.



General Plan View of Power Plant, Outlining Position of Engines, Boilers and Electrical Machinery.

The Boston Electric Light Company, like many another throughout the country, has just gotten rid of the last of its motors on arc light circuits, and now operates a considerable load of 500-volt direct-current motors, taking about 1000 kw at the peak of the curve, which system is rather an incongruity on alternating-current work, but cannot be replaced immediately by alternating-current motors, owing to their private ownership. The company's officers, President F. A. Gilbert and the engineers, have made a careful study of the problem, and their conclusions, as embodied in the system now in course of construction and described below, will be of no little interest to the officers of the many other companies similarly situated.

The system now consists of four generating stations, with the usual combination of varied types, sizes and speeds of engines belted to series arc machines, and small alternators running independently on their individual loads, with 500-volt direct-current generators for the motor loads. The distributing system consists of the usual multiplicity of single-conductor cables, with manhole transformers of quite large sizes, running up to 30 kw grouped on primary mains with three-wire 220-volt secondaries, each transformer feeding its own district, the secondaries not being cross-connected. The immediate cause of the remodeling of the system was the building of the new Southern Union Terminal Railway station in Boston, which necessitated the rearrangement of the streets, one of which cuts off the coaling pocket and bunkers of the Congress Street station.

The new central generating station, which is now under roof, and by the time this article is read will probably have steam on one battery of boilers and one generator, is built in South Boston on a plot of ground of 13 acres, formerly occupied by the historic Harrison Loring shipyard, wherein were built many famous craft. This 13 acres has a water frontage, and in fact a large part of it is under water, but will be made useful for and by the dumping of the ashes from the station. The station is laid out structurally on the usual plan, consisting of two main rooms separated by a fire wall, each roofed by steel trusses extensible at one end, one the boiler and the other the machine room, the external dimensions of the whole being 244 by 174 feet. The general layout of the structure is shown in the accompanying plan. The boiler-room roof spans also the mammoth coal pocket, which runs the whole length of the boiler-room on the side opposite to the machine-room, and is separated from the boiler-room by a wall, which, as it does not support the roof span, may at some future time be taken down, allowing the coal-pocket space to be occupied by another row of boilers facing the same fire-room as those now under construction. This one fire-room is ample for the two rows of batteries, as the width is determined by the space necessary for the drawing of the boiler tubes, which may be drawn from either side into the same area.

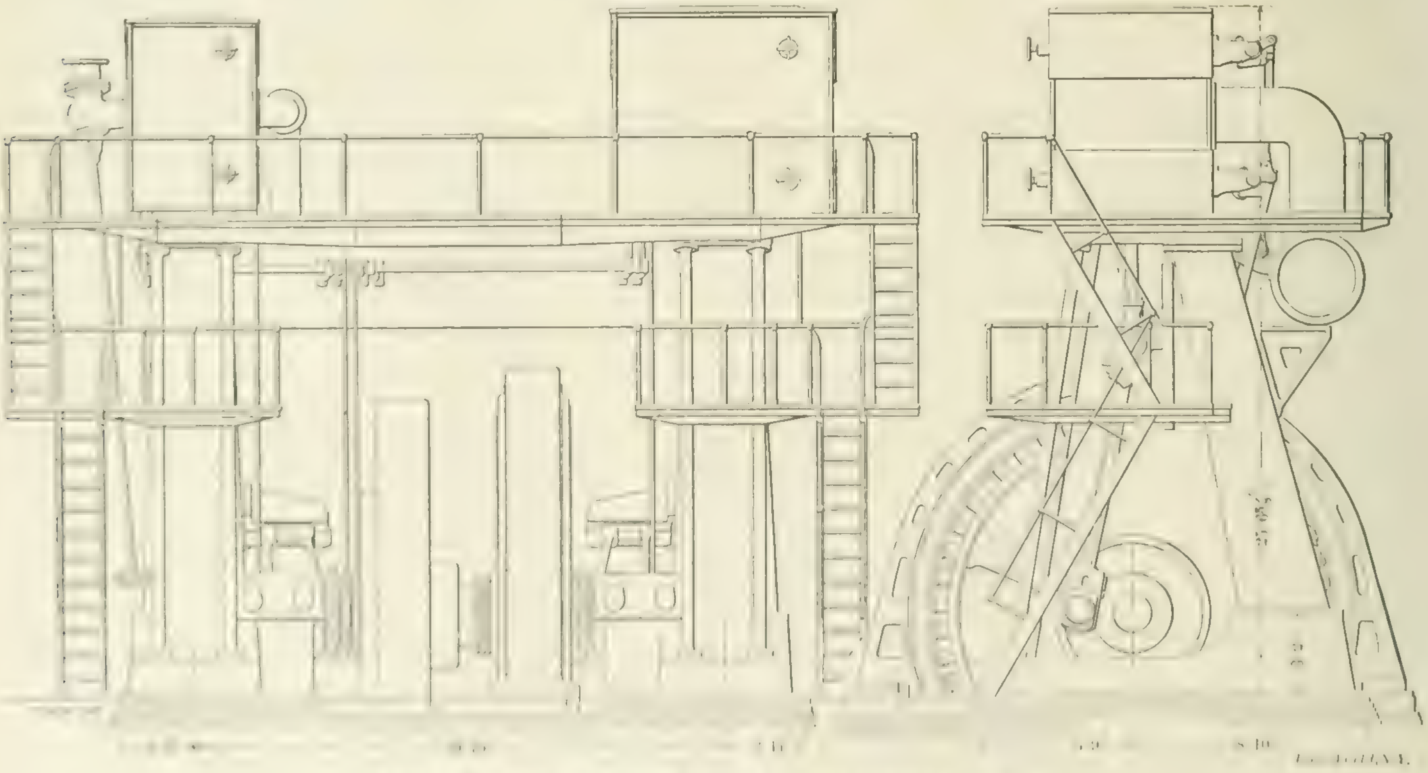
The engine-room will eventually contain one row of six generators adjacent to the boiler-room, of which four have been ordered, the other half being filled with the auxiliary transforming machinery described below, which at some future time it is expected may be displaced by the consolidation of the various services of the system, giving room for another similar row of main machines. Thus, with the endwise extension of the station to double its present length, its capacity will be increased fourfold, the present arrangement giving room for six units and six boiler batteries, with an aggregate rated output of 9000 kw, of which four sets, aggregating 6000-kw capacity, are to be installed at once.

The Exterior of the Station on August 24, Showing Incline of Coal Conveyor.

To describe the system in detail it would be well to begin with the wharf arrangements for receiving the coal. A long pier has been built, carrying a moving tower or crane, which has a travel of 150 feet, for manipulating the unloading buckets into the hatches of canal boats or other craft used in bringing in coal. From here it is taken by a conveyor, built by the C. W. Hunt Company, horizontally and up an incline (see the accompanying illustration) to the run over the mammoth coal pocket, which will have a capacity of 9000 tons, its dimensions being 240 feet in length by 30 feet in width by 50 feet in height. This pocket is built up with rolled steel ventilate the coal. The floor of the pocket is about 10 feet above the boiler-room level. Chutes discharge into the boiler-room from the lower edge of the pocket on that side and empty into coal cars, which will be run onto scales and weighed, and from there moved to the boiler fronts. The tracks also extend to hoppers under the floor of the pocket by which the coal below the normal surface of inclination to the chutes may be withdrawn without shoveling. The greater part of the coal, however, can be taken out through the chutes, the conveying apparatus overhead dumping quite close to the boiler-room side. Ashes will be handled on the boiler-room floor with cars to carry them to the district to be filled.

The water-tube boilers are of the Babcock & Wilcox manufacture, triple drum, of a nominal output of 500 horse-power each on the Centennial rating, grouped two in a battery, this giving each battery a rated evaporative capacity of 30,000 pounds per hour, sufficient for each generator, which is rated at 2350 horse-power, with a guaranteed consumption of 12½ pounds of water per hp-hour. The boilers are fitted with Hawley down-draft furnaces, and will run at 160 pounds presure. The four batteries now under erection are in a row down one side of the fire-room, which is well lighted by a glass monitor, the boilers having their backs to the engine-room wall.

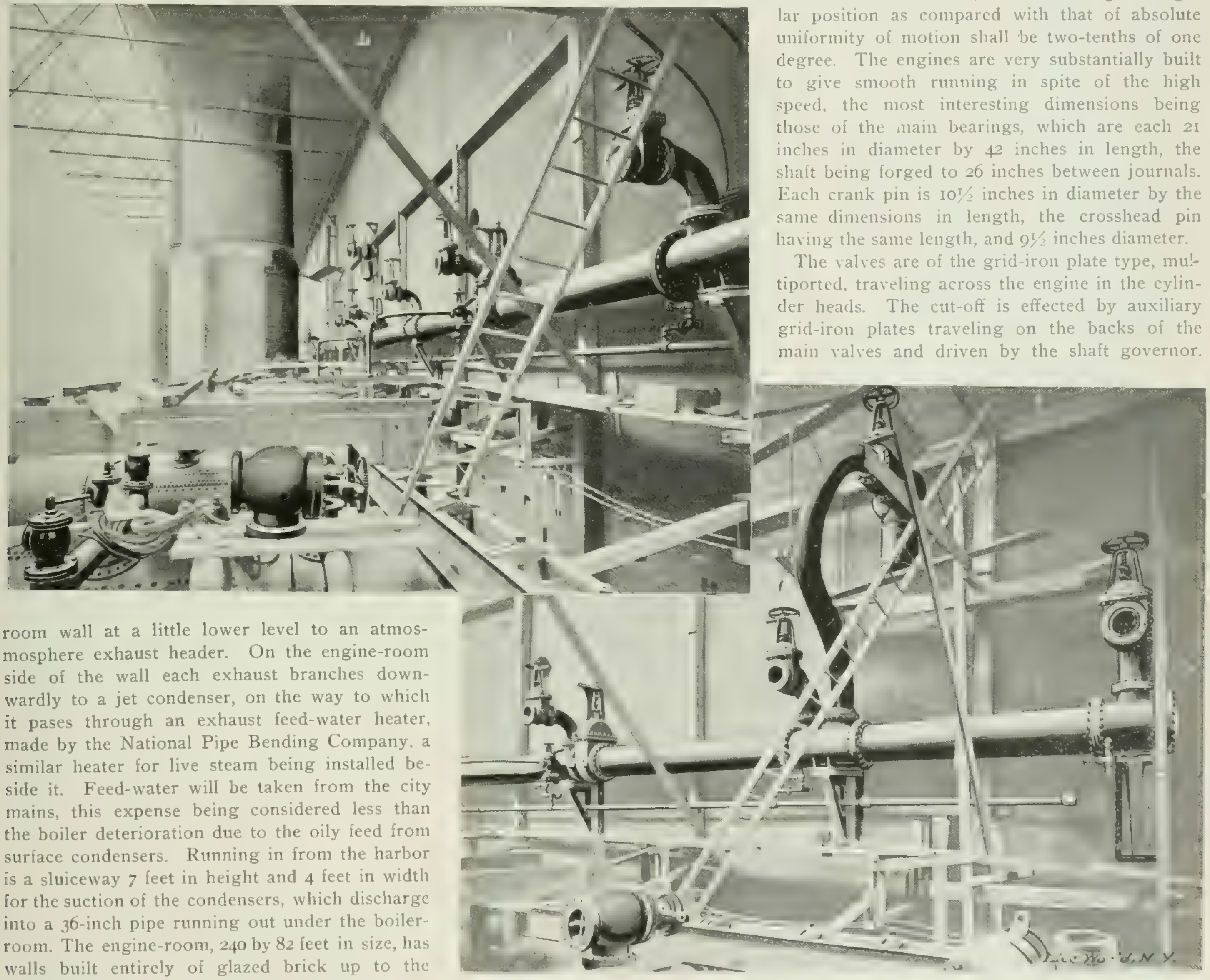
Between the two centre batteries will rise the mammoth brick stack, which, 225 feet in height, with an 11-foot bore, and with an octagonal base 22 feet between faces at the boiler-room level, is founded on a grillwork of I-beams laid in concrete—19 feet deep—on the gravel and clay substratum. The building has no piling whatever; quicksand was struck under some of the foundations for



Front and Side Elevations of One of the Generating Units.

[illegible]

[illegible] and the solid substratum was reached at a depth of about [illegible] feet. This chimney is capped with cast iron [illegible] with flanges by which they are bolted together, the iron weighing in all about 7 tons, and being capped with a lead ring. The flue gases reach the chimney through breeching behind the boilers, more properly termed a chamber, on account of its large size and the fact that it is of brick. The floor of this chamber is of steel girders, with brick arches.



Views Showing Piping Connections Between Boilers and Engines.

Steam is taken from the boilers through nozzles rising vertically to a height of 10 feet, with elbow valves at their tops geared down to handles at the floor level. These steam taps drop vertically into the 20-inch header which runs the length of the boiler-room above the flues. Springing from the header immediately beside each boiler inlet is the engine outlet, and the header may be thrown entirely out of service by gates at either side of each combined inlet and outlet, giving each engine an independent steam supply from its own battery of boilers. The engine outlet curves over and into a Cochrane separator, also on the boiler-room side of the wall, the outlet from which passes straight through the wall and to the engine stop-valve. (See illustrations of piping connections presented on this page.) The engine exhaust comes straight back through the boiler-room wall at a little lower level to an atmosmosphere exhaust header. On the engine-room side of the wall each exhaust branches downwardly to a jet condenser, on the way to which it pases through an exhaust feed-water heater, made by the National Pipe Bending Company, a similar heater for live steam being installed beside it. Feed-water will be taken from the city mains, this expense being considered less than the boiler deterioration due to the oily feed from surface condensers. Running in from the harbor is a sluiceway 7 feet in height and 4 feet in width for the suction of the condensers, which discharge into a 36-inch pipe running out under the boiler-room. The engine-room, 240 by 82 feet in size, has walls built entirely of glazed brick up to the crane-ways, a height of 52 feet above engine-room floor. (See illustration presented on page 526.) Below it is a 9-foot basement, taking from the room all of the wiring and most of the piping. In a straight row on the side next to the boiler-room wall, with the shafts running lengthwise of the room, will be four vertical cross-compound McIntosh & Seymour engines with overhung cranks and alternating-current generators hung between the two main journals. These machines, as stated above, are rated at 2350 horse-power, with a guarantee at this load of 12½ pounds of steam per hp-hour at 160 pounds pressure condensing, and run at 120 r. p. m. This rating is based on a 23 per cent. cut-off, giving a large overload margin, the maximum cut-off obtainable with the valve gear being 75 per cent. of the stroke. The piston speed, since the stroke is 4 feet, is 960 feet per minute, a rather high figure for engines of this size, but rendered necessary by the direct connection of dynamos of the size and frequency employed. The engines are of the open-front marine type, provided each with a 50-ton, 16-foot fly-wheel, with a remarkably large hub, within which is contained the shaft governor. To give the proper speed control of these engines in synchronizing—that is, to bring any newly started engine running light down to the speed of its mates running loaded, in order to throw the machines in parallel—the governor is fitted with a hand speed-varying device, which operates on the weights through collars on the shaft. The engines are guaranteed to give a 1½ per cent. speed regulation between no load and full load, and also, on account of the fact that the generators are to be operated in parallel and are to run synchronous motors, the engines are guaranteed to give a very small variation in the speed during a rotation. The cranks are set at quarters, and the guarantee is that the maximum variation in angular position throughout the revolution from the mean position of absolute uniformity of rotation shall be one-tenth of one degree, or 1-3600 of one rotation—that is, the total change of angular position as compared with that of absolute uniformity of motion shall be two-tenths of one degree. The engines are very substantially built to give smooth running in spite of the high speed, the most interesting dimensions being those of the main bearings, which are each 21 inches in diameter by 42 inches in length, the shaft being forged to 26 inches between journals. Each crank pin is 10½ inches in diameter by the same dimensions in length, the crosshead pin having the same length, and 9½ inches diameter.

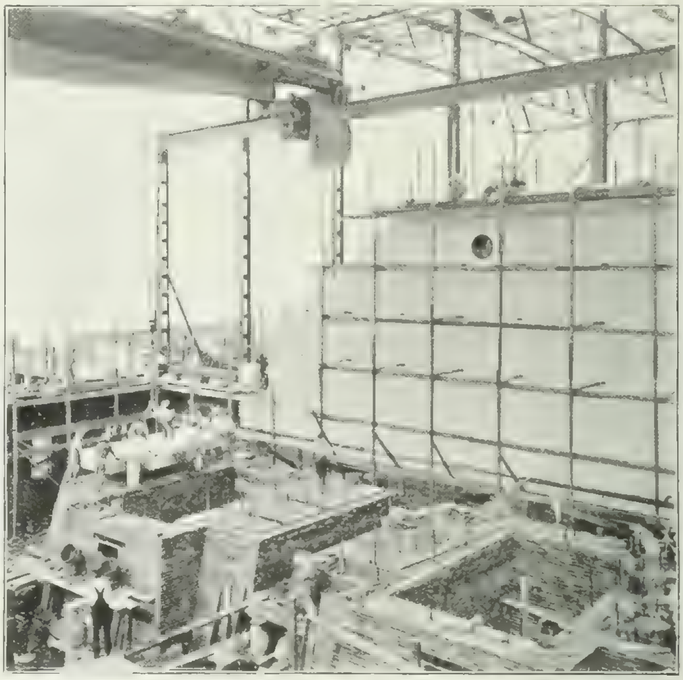
The valves are of the grid-iron plate type, multiported, traveling across the engine in the cylinder heads. The cut-off is effected by auxiliary grid-iron plates traveling on the backs of the main valves and driven by the shaft governor. Underhung beside the fly-wheel is the revolving field of a General Electric three-phase, 1500-kw, 60-cycle generator, guaranteed to carry a 50 per cent. overload for three hours and a 30 per cent. overload indefinitely, the machine being necessarily rated light on account of the regulation guarantee, which is 5 per cent. The diameter at the air gap is 16 feet, the number of poles on the rotating field being sixty. The machines will generate the line pressure of 2250 volts direct between corners of the delta connection. The armatures have two slots per pole per phase, each three-quarters of an inch wide and 2⅛ inches deep. They are coil-wound, with two turns per coil and the elements of two coils in each slot.

The main switches will be mounted on the engine foundations, and will be pneumatically controlled from the switchboard. The leads to the switchboard pass through vitrified conduits buried under the tiling in the concrete covering the steel-beam and double-brick arch floor construction. The switchboard, 100 feet in length, runs along the wall of the engine-room opposite the fire-room, and will be double-decked, a gallery 11 feet above the engine-room floor carying the machine panels and all the outgoing lighting feeders, the lower deck carrying the arc-light circuits and the controlling circuits of the motors mentioned below. The most remarkable feature of the switchboard is the use of aluminum bus bars, which will be mounted on a separate marble board under the gallery. They will have bolted connections throughout, large surfaces being provided, the joint being covered with shellac or some other substance to prevent corrosion.

Besides the four main steam engines there will be but one other steam engine in the station. This will drive one of the three exciters, the other two being driven by synchronous alternating-current motors. Three Goulds triplex boiler-feed pumps with double-reduction gears will also be driven by the same type of motors and fitted with by-pass valves to obtain variations in feed, and various auxiliary apparatus, such as the coal conveyors, etc., will also be motor-driven, only the Blake twin vertical air pump being steam-driven. Twenty 150-kw General Electric synchronous motors will be coupled each to two 160-light Brush multi-circuit arc machines, giving 7 amperes for the new enclosed arc lights which the company is now building in its own shops to replace the 10-ampere open arcs. This collection of sixty machines will be mounted on the heavy steel girder and brick arch floor, each set of three machines being on wooden bases to give them insulation from the ground.

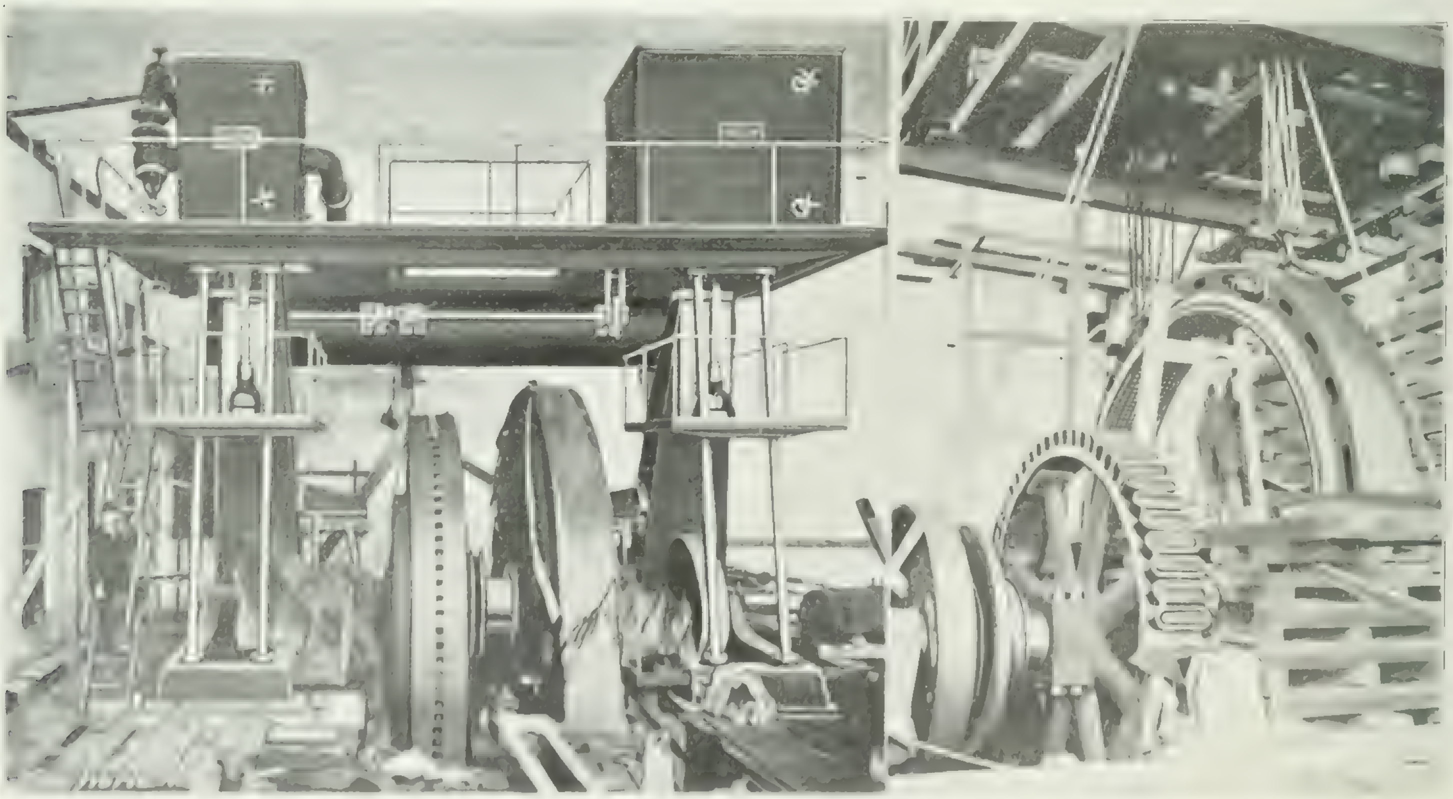
One 180-kw synchronous motor is also coupled to a 150-kw, 500-volt generator for carrying the night power load direct from the station, which load will be carried by a rotary transformer sub-station by day. Also coupled to the same pair is a 150-kw single-phase alternator to carry any feeder or feeders which may have a ground on one side. This is a novelty in central station work, but is apparently based on a serious weakness of alternating-current working. In large underground systems, worked as this one will be, on a single set of bus bars, there is a large capacity in the 2000-volt primaries sufficient to give considerable trouble from capacity currents through any ground or partial ground, often breaking down the in-

Over one end of the engine-room will be the offices, and above them will be a repair shop with a hatchway in its roof, into which the grab of the 25-ton traveling crane can be lowered. This crane is motor-driven, and is now in use with current derived from the existing stations for handling the apparatus as it is installed.



Engine-room on July 20, Showing Engine Foundations in Course of Construction.

The distributing system will be divided into lighting and motor circuits, the former single and the latter three-phase. The many lighting feeders, each with its own group of transformers, will be arranged on the switchboard so that they can be individually thrown between any two of the three-phase buses, so that the lighting



[illegible] Views of Two of the Generating Units in Course of Erection. September [illegible]

sulation of the [illegible]

[illegible]

load can be [illegible] by the switchboard attendant. The [illegible] the drop in the lighting [illegible]. The mains will run to the city, about [illegible] double [illegible] separate routes, each double conduit having twenty four ducts, twelve of which pass through manholes distinct from those of the other twelve. The submarine conduit for bringing one of these lines into the city was described and illustrated in The Electrical World of October 29, 1898.

To-lay out a system of this magnitude, with all the changes from high-frequency single-phase to a lower frequency multiphase, to provide for the gradual replacement of direct-current motors by those of the alternating variety, and to construct one station to carry continuously the whole load, is a problem in which slight errors would mean very serious consequences. The solution of these difficulties adopted by the officers mentioned above reflects no little credit on their engineering abilities.

Mr. Tesla's Application of Hertz-Wave Transmission.

Exercising their well-developed ability to make a startling piece of news of a very ordinary event, the daily papers have taken up Mr. Nikola Tesla's recent patent, No. 613,809, issued November 8, 1898, and made of it "the greatest marvel of the age." The facts, as set forth in the patent cited, are in brief as follows: Hitherto the only practical means of controlling the movements of a vessel, such as a torpedo or a torpedo boat, at a distance has been the use of a cable, the disadvantages of which are obvious. The plan proposed by the inventor is to provide any such craft with a coherer connected between the hull and an elevated terminal and to so arrange the propelling and steering mechanism, which is motor-driven with storage-battery supply, that it can be controlled by various relays and auxiliary devices actuated through the agency of the Hertz waves.

A View of the Coal Pocket, Boston Electric Light Company's Generating Station, on August 24.

A single coherer is used, the inventor preferring this to a plurality of coherers respectively syntonized to respond to waves of different frequency, although he states that he has "demonstrated the practicability of providing a great number of such receiving circuits—50 or 100 or more—each of which may be called up or brought into action when desired, without the others being interfered with." This coherer possesses some elements of novelty designed to yield a more uniform de-cohering action. It consists of a metal cylinder with insulating ends and a metal rod passing lengthwise through it. The cylinder normally stands with its axis vertical, and the de-cohering action consists of inverting it, throwing the granules or particles, which, according to the illustration, occupy about one-fifth of its length, from one end to the other. The patent also describes these granules as "manufactured by a special tool, insuring their equality in size, weight and shape, and uniformly oxidized by placing them for a given time in an acid solution of pre-determined strength. This secures equal conductivity of their surfaces and stops their further deterioration, thus preventing a change in the character of the gas in the space in which they are enclosed. I prefer not to rarefy the atmosphere within the sensitive device, as this has an effect of rendering the former less constant in regard to its dielectric properties, but merely secure a water-tight enclosure of the particles and rigorous absence of moisture, which is fatal to satisfactory working."

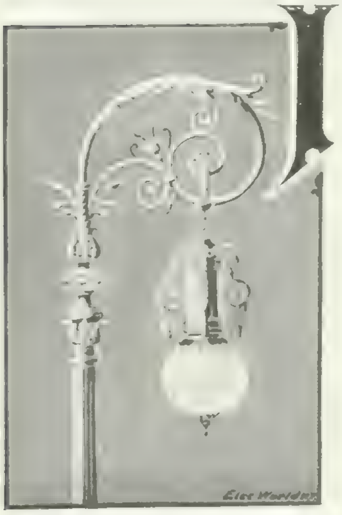
The auxiliary devices consist of ordinary relays, actuating a simple step-by-step escapement wheel, which in turn rotates brushes and commutators, affecting the various internal circuits of the boat. These differ in no essential respect from the rosettes or circuit controllers of synchronous printing-telegraph instruments, and many other means of accomplishing the same results by a different arrangement of details could, of course, be devised. There is apparently nothing broadly new in this part of the invention. The claims upon it, however, are very broad, the first claim reading as follows: "The improvement in the art of controlling the movements and operation of a vessel or vehicle herein described, which consists in producing waves or disturbances, which are conveyed to the vessel by the natural media, actuating thereby suitable apparatus on the vessel and effecting the control of the propelling engine, the steering and other mechanism by the operation of the said apparatus, as set forth." It is doubtful if this claim would withstand litigation in case of infringement, if it ever became possible to make such a system operative, as it is simply the use of the coherer as a relay for actuating a step-by-step mechanism, instead of a simple sounder. It is obvious that, unless Mr. Tesla has made revolutionary improvements in Hertz-wave apparatus which have not yet been disclosed, the coherer and auxiliary apparatus working therewith are altogether too delicate for the service proposed.

Mr. Tesla is quoted by the daily press in this connection as follows:

> "War will cease to be possible when all the world knows that the most feeble of the nations can supply itself immediately with a weapon which will render its coast secure and its ports impregnable to the assaults of the united armadas of the world. Battleships will cease to be built, and the mightiest armorclads and the most tremendous artillery afloat will be of no more use than so much scrap iron. And this irresistible power can be exerted at any distance by an agency of so delicate, so impalpable a quality that I feel that I am justified in predicting that the time will come, incredible as it may seem, when it can be called into action by the mere exercise of the human will.
>
> "My imagination fairly reels when I attempt to contemplate its countless possibilities. Already I hear the knell of the battleship and the monster gun. Their day has passed with the advent of a new and irresistible power, which gives to all nations an absolute power of defense against any attack.
>
> "England has until now boasted of her mastery of the seas, but her superiority has vanished and she is now no stronger than the weakest of the maritime nations, so far as her offensive power is concerned. England, who is now so diligently preparing for war, will awake to this unwelcome discovery to-morrow and will be utterly confounded; and France, against whom her armaments have been reported to be preparing, will rejoice in the discovery that she possesses an all-powerful weapon of defense.
>
> * * * * * *
>
> "But I have no desire that my fame should rest on the invention of a merely destructive device, no matter how terrible. I prefer to be remembered as the inventor who succeeded in abolishing war. That will be my highest pride. But there are many peaceful uses to which my invention can be put, conspicuously that of rescuing the shipwrecked.
>
> "It will be perfectly feasible to equip our life-saving stations with life cars, or life boats, directed and controlled from the shore, which will approach stranded vessels and bring off the passengers and crews without risking the lives of the brave fellows who are now forced to fight their way to the rescue through the raging surf. It may also be used for the propulsion of pilot boats, for carrying letters or provisions or instruments to inaccessible regions, for killing whales and for many other commercial or scientific purposes.
>
> "In order to give a practical illustration of this it is my intention to exhibit a model of a torpedo boat at the Paris Exposition and direct all its movements from my office in New York." * * *

It is probable that the movements will be directed by messages sent via the transatlantic cables; otherwise we would advise the use of the torpedo boat and its directing mechanism for transoceanic telegraphy.

Some French Electrical Machinery.



IN spite of the close intercommunication between America and Europe in the matter of technical and scientific developments, the apparatus devised in one country often differs quite radically from that in the other, owing perhaps to differences in taste and judgment, the outgrowth of racial characteristics. Particularly in the line of electrical machinery is this true, as its development has been so rapid that designers have gone ahead in each country on their own lines with hardly time to examine the work of their confrères speaking a different tongue, and, in spite of the publicity given by the technical journals, the engineering societies and books published on the subject, the designs of apparatus for the same purpose differ not only in details, but even sometimes in the principles involved. A study of the apparatus built in other lands is thus likely to be more profitable than that of the home product and should be encouraged in that it tends to suggest modifications, many of which may be improvements.

The product manufactured by Fabius Henrion, Nancy, France, who manufactures perhaps the most comprehensive line of electrical apparatus in the world, certainly far surpassing that of any one establishment in America, gives a most excellent opportunity to compare well recognized standard French designs with those of this country. The following details and illustrations of this machinery have been selected on the score of their interest, owing to the differences they show from American standards.

Fig. 3.

DIRECT-CURRENT MACHINES.

This French establishment manufactures in general three types of direct-current dynamos. In the line of constant-potential machines, the smaller sizes, that is, those up to 25-hp capacity, are bipolar, with a rectangular enclosing yoke of the magnetic circuit and [illegible] projections and poles bolted to the yoke. The field magnet is [illegible] with no [illegible] pole to pole. Each ring is [illegible] as may be seen by the illustration, Fig. 1, and flutes in the middle of the pole, both these details being for the purpose of minimizing the distortion of the field by the cross-magnetizing effect of the armature. The latter is drum-wound, with a core made up of laminations varnished and also separated from each other by thin parchment-like paper, and with no ventilating ducts or spaces.

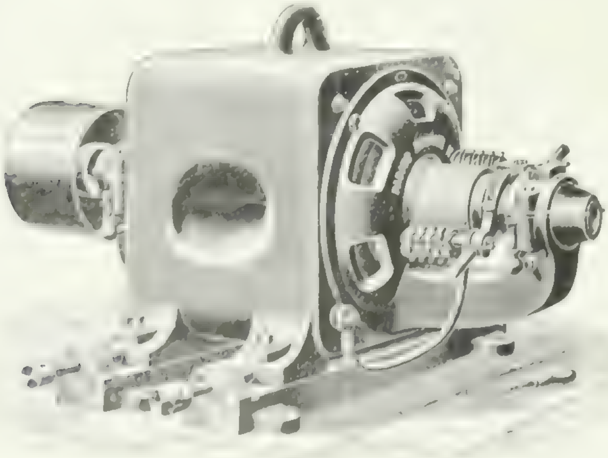


Fig. 1.

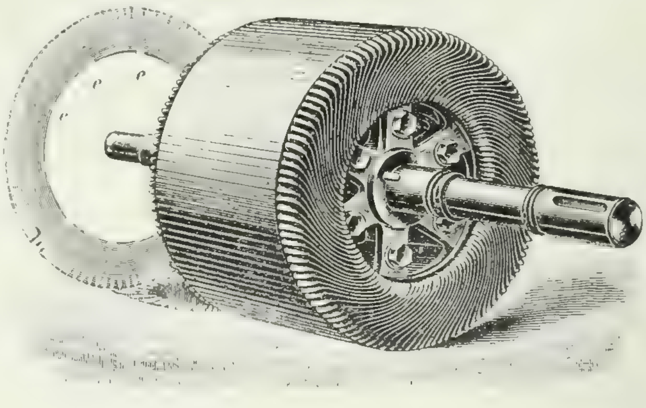


Fig. 2.

The teeth are T-shaped, with very narrow openings into the slots, as shown in the illustration, Fig. 2, although some machines are made with form-wound coils. The end connections are of the plain spiral variety.

The commutators are made large for the use of carbon brushes, the segments being of drop-forged copper, but differing from American practice in that the ends are not tapered to give a tight centripetal force in assembling. Two iron clamping rings, shown in Fig. 3, surround the straight projections of these segments, and this is claimed to be a great improvement over the conical devices. In the large machines the armature leads are soldered into the segments, and in the small machines screwed on. The carbon or graphite brush of an odd trapezoidal cross section is shown in Fig. 4, the smaller parallel plane bearing on the commutator. These brushes are electrolytically coated with copper and mounted in holders pivoted on brush-holder studs, about which they are rotated against the commutator face by leaf springs.

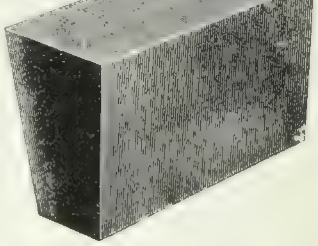


Fig. 4.

The bearings of these dynamos are of a very ingenious self-oiling and self-filtering type, well known in France as the design of Fabius Henrion, but differing from anything known in this country. As shown in Fig. 5 the shaft [illegible] carries loosely a ring *B*, considerably larger than itself, dipping into a tank of oil *K*. The ring is provided with small holes to carry up the oil and, in throwing it off by centrifugal action, the oil leaves the journal at the end of the sleeve, where it falls into a compartment, separated from that in which the ring dips, by two filters, through which it must pass to complete the circulation. The external sections of these filters incline in such a way that impurities caught thereon tend to fall into the bottom of the chamber, which is partly filled with water, the oil floating on the top of the water. This gives a continuous circulation with a

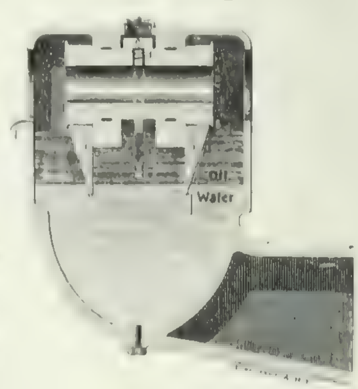


Fig. 5.

filtration of the oil every time it passes through the journal, making of each bearing a complete oil filtering and circulating system.

The larger machines, those above 25-hp capacity, are multipolar, with a similar arrangement of the fields to save weight and reduce the magnetic distortion. Fig. 6 shows a handsome design of belted generator with under-hung pulley. The brush holders are mounted on a ring at the outboard end of the commutator, a practice that has been largely abandoned in this country. Another detail that strikes the American eye is the casting of the lifting ring in one piece with the upper half of the field yoke.

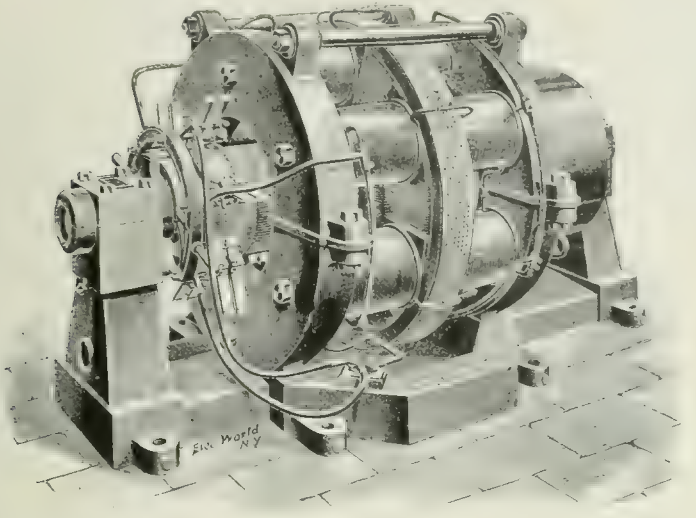

Elec World N.Y.

Fig. 7.

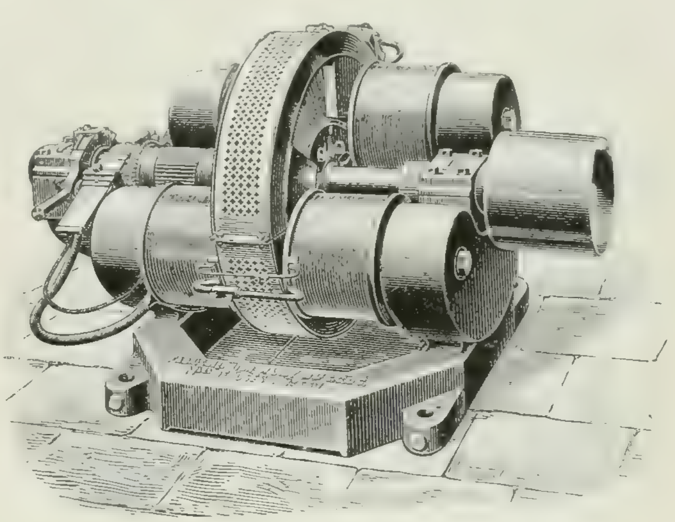


Fig. 8.

The third type of direct-current machinery is a classical French style, with smooth body armatures and radial active windings, such as that shown in a multipolar form in Fig. 7. This machine requires a short disc-like armature, cylindrical laminations, a very long shaft between bearings and many other peculiar features which have kept it out of American use, but it still seems to be favored by the French. An odd bipolar modification of the same machine, with a U-shaped yoke around the shaft at either end, is that shown in Fig. 8, and is used for constant-current series arc-light work, the regulation being obtained by varying the position of the brushes and thereby the reaction of the armature by means of a relay and magnetic pawl and ratchet-wheel governor, which is described below.

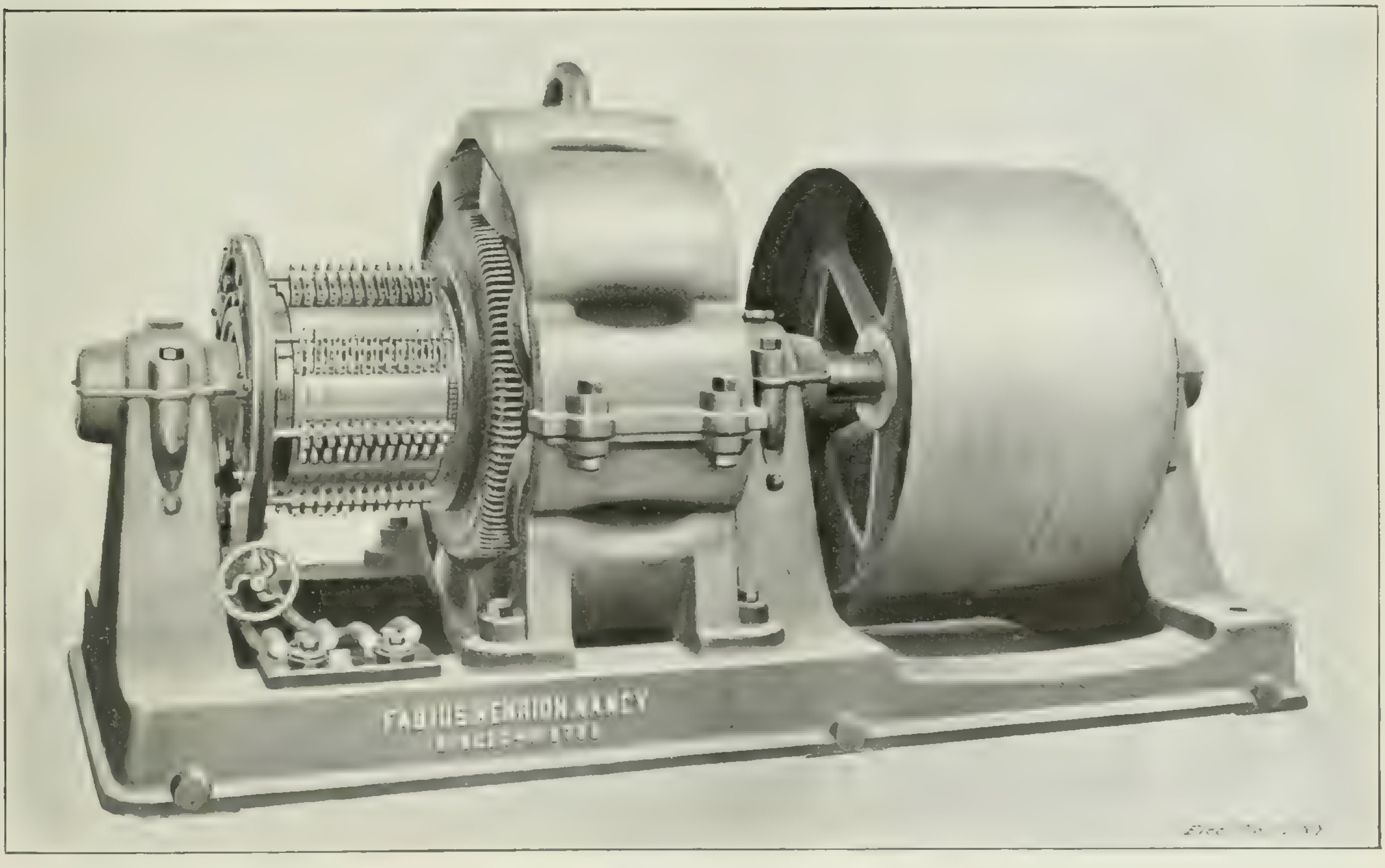


Fig. 6.—300-hp Multipolar Generator.

ALTERNATING-CURRENT MACHINES.

Of alternating-current generators and synchronous motors only the inductor type is made by Fabius Henrion.

These machines, as shown in detail in Fig. 9, differ radically from the types known on this side of the water, such as the Stanley machine, for example, in that the fixed armature windings run right through from end to end of the machine, the same coils thus receiving the magnetic flux from both rings of poles. To make such a machine give alternating currents, the poles of one ring are offset or staggered radially between those of the other ring; thus the flux linked with any one armature coil alternates with the movement of the rotor from a maximum in one direction to a maximum in the

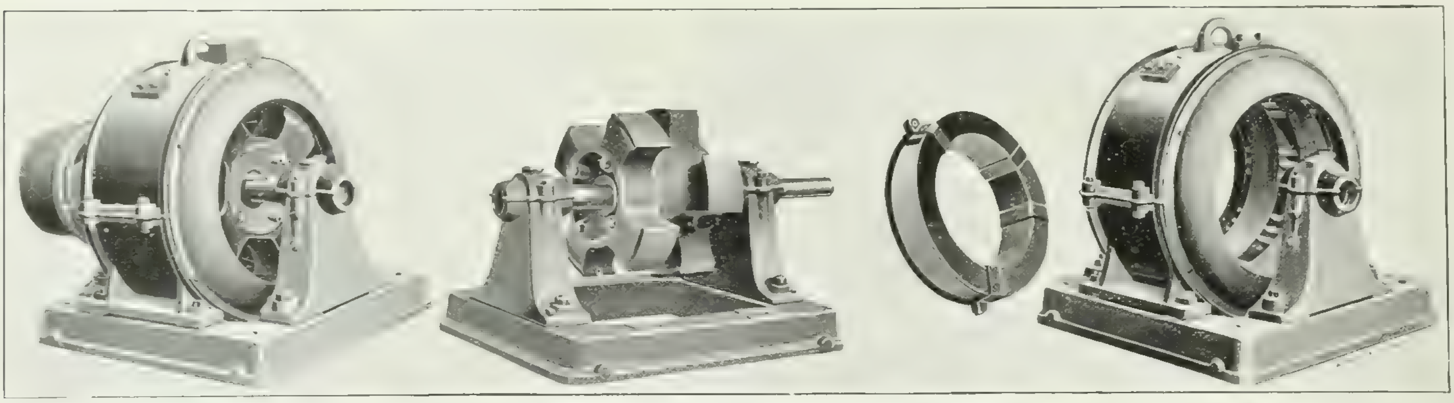


Fig. 9.—Assembled and Detail Views of Inductor Generator.

other, instead of from zero to a maximum as in American designs. The flux entering any part of the armature iron, however, does not change its sign, since the positive lines come from the poles of the one ring and the negative lines from those of the other.

In this way the double system of end connections in the middle of machines of the American type, a position difficult to reach for inspection and repairs, is replaced by straight exposed runs of the armature windings from one of the two rings of laminations to the other, the laminated iron not being continued across this space. In the French machine the conductors are tunnel wound in insulating tubes, which are continued right across this space. On account of these straight runs the field exciting coil cannot be placed in this position as in American types, but must have an external diameter less than the internal diameter of the fixed armature, and must fit down between the outwardly projecting poles of the rotor, which in turn must be divisible into two parts to allow the removal of the exciting coil. No such machine is on the American market, although a similar machine, known as the Fynn dynamo*, is manufactured in England. The rotating part, which is of cast steel, has no laminations at its polar extremities, but the latter are oddly cast with overhanging lips or horns on their inner edges and corresponding bevels at their outer edges, as though yielding to the inward pull of the lines of force. The machine shown has eight poles and a single-phase winding distributed in three closed tunnels over about one-half the pole angle. The end connections are protected by circular covers bolted to the yoke, the latter being divided in a horizontal plane, so that the upper half can be removed. The exciter is generally coupled to one end of the shaft, but the machine shown in the illustration has a flange on the main driving pulley [illegible] driving the exciter.

The same machine is put out as a synchronous motor, but for the majority of alternating-current motor work an induction machine is made. This is of the internal, rotating-secondary type with short-circuited or "squirrel-cage" rotors in all sizes up to 1½ horsepower, wound secondaries with collector rings in all sizes [illegible] intermediate sizes. One of the smaller sizes is shown in Fig. 10, its chief peculiarity to American eyes being the helical course of the secondary slots or bars, the purpose of which is not evident, especially as the primary slots are axial. The machine shown is four-polar, wound for three-phase currents, with two slots per pole per phase. The method of distributing the winding is clearly shown in the view with the end plate and rotor removed. The primary slots are open to the air gap, but not parallel sided, the opening being narrower than the maximum width of the slot, which is lined with a sleeve of insulating tubing projecting beyond the end of the slot and split down the opening, so that the wires can be laid in the slot instead of being drawn through. The method of grouping the end connections from the two slots per phase into one coil and binding them together with cord or rope is clearly shown in the illustration. The round tunnels of the rotor have a similar opening or slot narrower than the tunnel proper to reduce the self-induction.

The air gap is, of course, reduced to the lowest possible limit in order to get a low magnetizing current and good starting torque. To accomplish this both the interior surface of the stationary primary and the exterior surface of the rotating secondary are ground true after the laminations are assembled under hydraulic pressure, and a stout steel shaft is used running in journals of a composition specially prepared to give minimum wear. The motors are wound for the standard frequency of France, namely, 50 cycles per second, and the performance of one such three-phase motor rated at 5 horsepower is given in the accompanying diagram, Fig. 11. The weights, speeds and outputs of some of these motors may be of interest to compare with American figures. A 20 hp machine, for example, runs at 750 r. p. m. light and 720 loaded, and gives an efficiency at full load of about 88 per cent., with a power factor of 0.8. The weight of this machine is 850 kilograms (about 1900 pounds), and its listed price, with wound secondary and a primary winding suitable for 110 and 220 volts, is 3700 francs, about $750.

These motors will all start under full load torque with the secondaries short-circuited; in fact, their superiority in one respect to direct-current motors is exhibited by the claim that any of them will stand, when running at full speed and under full load, an instantaneous reversal of the direction of the rotation of the field

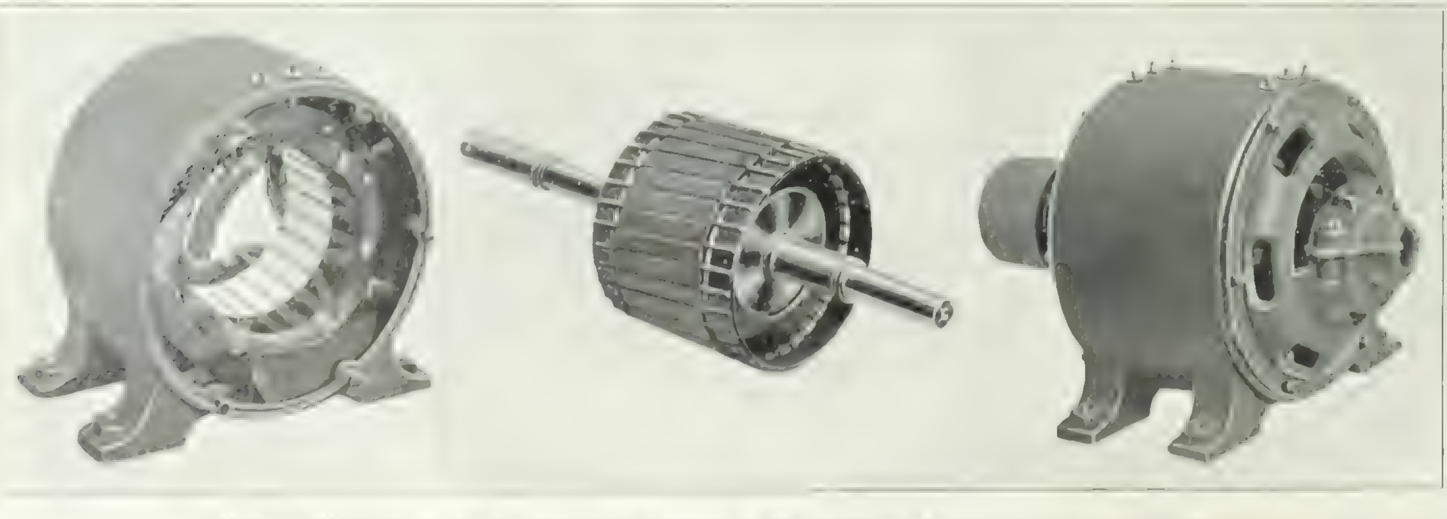


Fig. 10.—[illegible] Three-Phase Alternating-Current Motor.

without the interposition of any resistances. It is recommended, however, that the load be thrown off for starting by means of a loose pulley or clutch. A starting device commonly used with the wound secondaries is a three-part rheostat of a type quite generally employed with the apparatus of this make, although considered unscientific and unsatisfactory in this country. It is, in short, a water rheostat and, as shown in Fig. 12, is made up of three corrugated sector-shaped plates which may be lowered into the liquid or raised from it by rotating them about a common axis by means of a handle. The motors are also used with single-phase supply, the starting being effected with a phase-splitting device, consisting of a non-inductive resistance condenser.

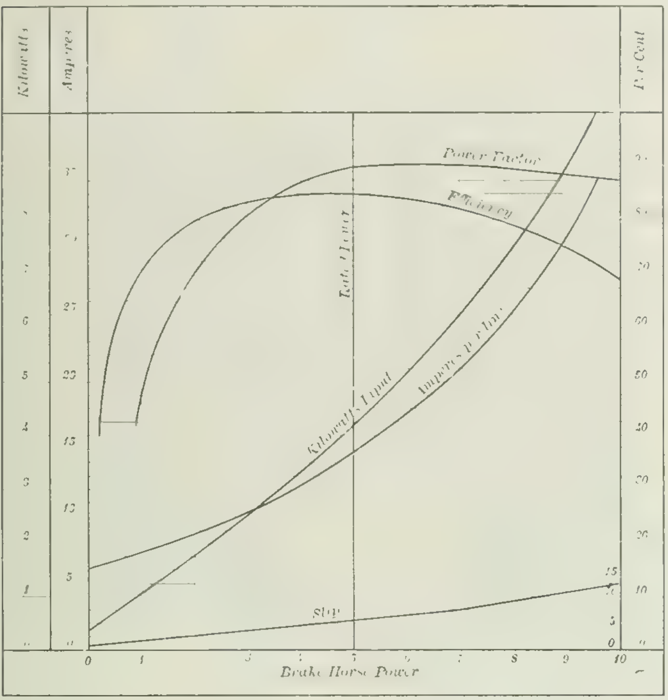


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FIG. 11.—PERFORMANCE OF 5-HP THREE-PHASE MOTOR.

CONTROLLING APPARATUS.

In the way of rheostats, switches, motor controllers, etc., the designs bear no apparent resemblance to those of the Yankees. A field rheostat is shown in Fig. 13, the resistance being in the form of vertical wire helices wound free of any supporting rods and in a single plane. An automatic motor speed regulator is shown in Fig. 14, the centrifugal governor operating an inclined rod carrying a number of branches like the teeth of a comb, which, as the rod is dropped by the governor, successively enter mercury contacts, varying the resistance in the circuit. Another form of water rheostat for direct-current work is shown in Fig. 15, this being in fact an automatic low-voltage release motor controller. A heavy counterweight raises the grid from the liquid, the water rheostat being

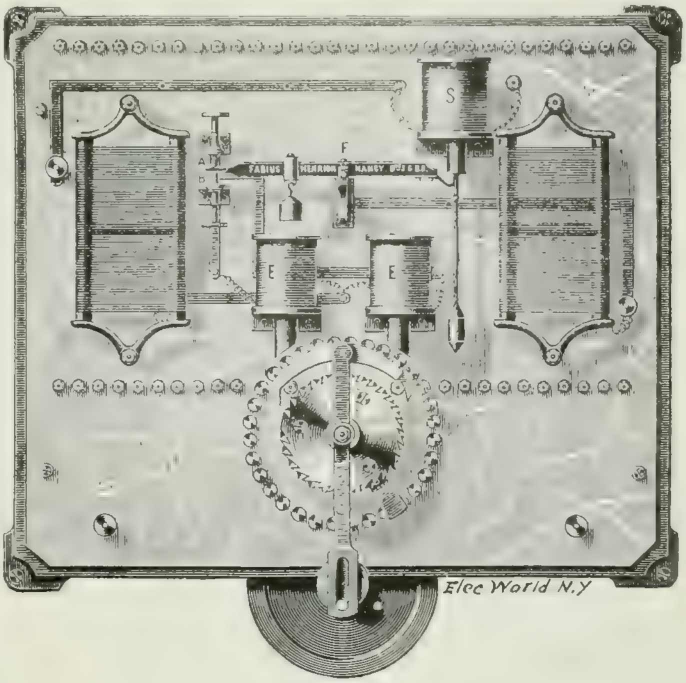

FIG. 16.

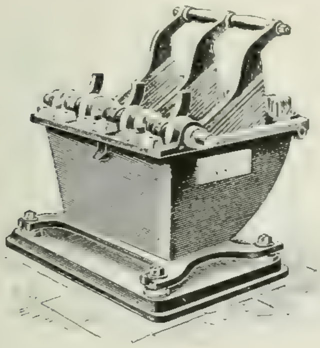

FIG. 12.

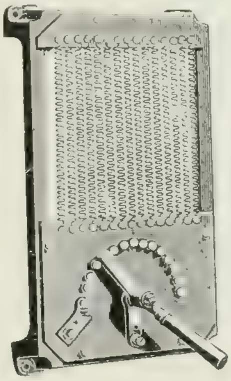

FIG. 13.

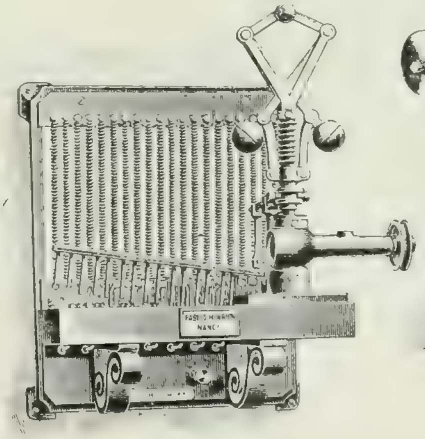

FIG. 14.

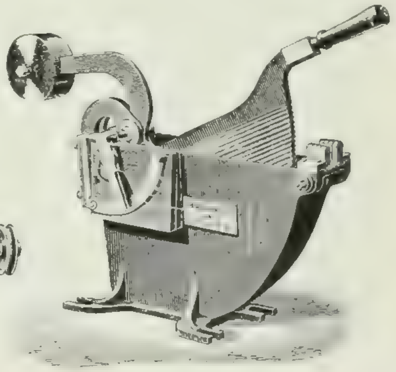

FIG. 15.

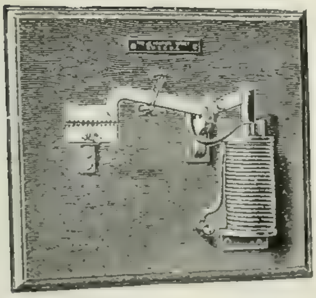

FIG. 17.

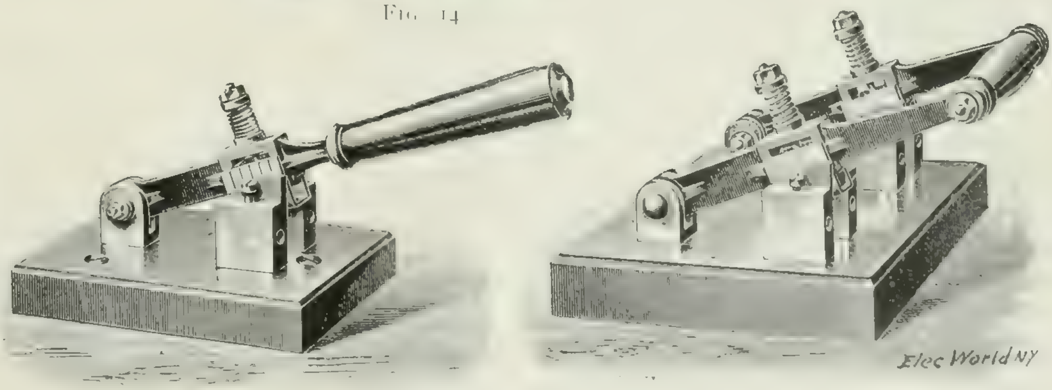

FIG. 18.

short-circuited when the grid is down by clips which grasp a copper blade close to the handle.

An automatic voltage regulator of the relay and ratchet and magnetized pawl type is shown in Fig. 16, this being used either with constant-potential or constant-current machines, in the former case varying the resistance of the field rheostat and in the latter case being mounted on the machine and varying the lead of the main brushes themselves. A magnet *S* operates contacts *A* or *B*, which respectively excite the coils *E* or *E'*, which in turn respectively attract the ends of the anchor escapement; this, being kept always in operation by the small crank and slotted crosshead shown below rotates the ratchet wheel in one direction or the other according to which magnet is energized. The ratchet wheel carries a contact sweeping over the studs of the rheostat sections.

Fig. 17 shows a lightning arrester with a magnetic device for increasing the air gap after the passage of the discharge.

In the line of switches, Fig. 18 shows a single-pole and a double-pole quick-break type with helical springs around bolts on the blades which pull the contacts up promptly when the pressure becomes sufficient to overcome the friction. The current does not pass through the hinge, but enters the switch blade through a heavy [illegible] through another clip [illegible] the other side [illegible]. The contacts are laminated [illegible] multiplicity of small wires rather than one large wire or strap, [illegible] out end clips. French circuit breakers are a little primitive as yet, [illegible] netically maintained in its closed position. It is intended for use in [illegible] tion

[illegible]

A complete line of measuring instruments is also put on the mar- [illegible] ply of a solenoid and a soft iron armature, the restoring force being gravity and the instruments, therefore, being non-polarized. A multiplier for use with voltmeters is shown in Fig. 23, with several positions of an adjustable handle whereby different multiplications can be obtained. Fig. 24 shows a type of instrument dependent on heating effects and useful, therefore, for alternating as well as direct currents, an alloy of silver and platinum being used. Fig. 25 shows an instrument designed more nearly on American lines, its principle being that of the D'Arsonval galvanometer with a spring restoring force, in order to allow its use in any position.

STORAGE BATTERIES.

Accumulators with plates electrically formed by the Planté process are also made by the same house, which has established at Pagny-sur-Moselle a hydraulic power station for the generation of the current needed in this tedious process of plate formation. Each plate, as shown in Fig. 26, is made up of a core with saw-tooth-shaped projections on either side at such a distance that even when formed there is considerable irregularity and consequent increased area of the surface. The core is made quite thick to give rigidity to the plates, which in turn are made in small sizes to reduce the tendency to buckling. For a 1000-hour battery at a ten-hour discharge rate, the average voltage per cell at this rate of discharge is 1.85 volts, the number of positive plates being 29, and the weight of the load being about 300 pounds per cell.

INCANDESCENT AND ARC LAMPS.

The incandescent lamps of Fabius Henrion have the name of the maker etched in the glass of each, with the figures of the voltage and the candle power. They are made with either of two efficiencies, 3 or 2½ watts, and the latter are listed in voltages up to 250 volts and candle powers as low as ten. Two filaments in series are used in the high-voltage lamps, with a small loop in the end of each [illegible] A complete line of [illegible] open arc lamps [illegible] both direct and alternating-current work, the direct [illegible] type, and the alternating current a small disc induction motor with a series magnet and a shunt magnet tending to drive the disc in opposite directions, no [illegible] to be necessary. The carbons for these arc lamps are a specialty of this house, the high- [illegible] volt age in a test made at the Central Laboratory of Electricity of the International Society. The potential difference across the arc varied no more than one volt in an hour's run. For the enclosed arc a special line of carbons has been brought out.

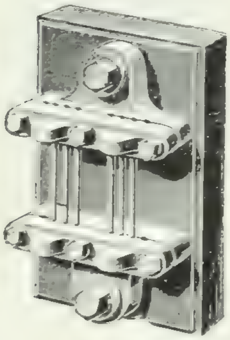
Fig. 19.

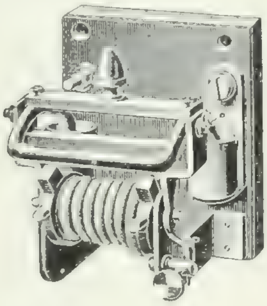
Fig. 20.

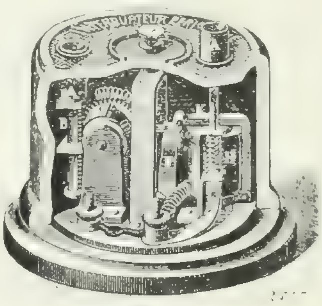
Fig. 21.

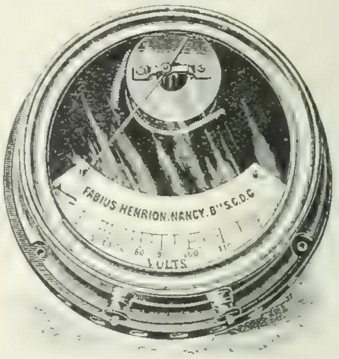

Fig. 22.

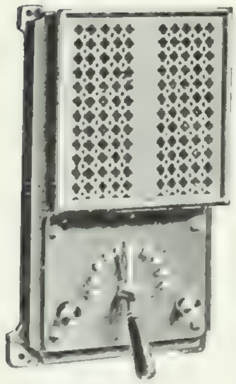
Fig. 23.

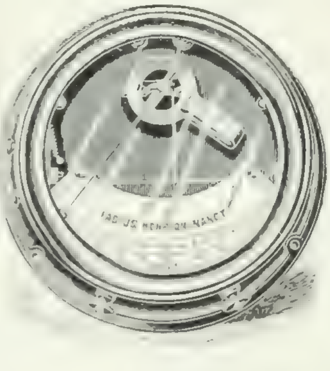

Fig. 24.

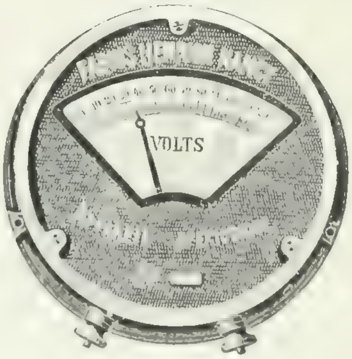

Fig. 25.

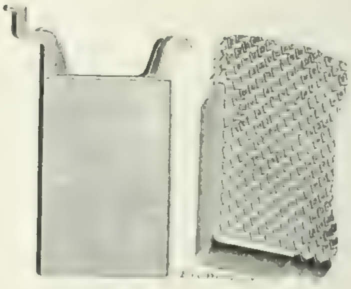
Fig. 26.

Alternating-Current Machinery.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

CHAPTER XXV.*

SINGLE-PHASE ALTERNATORS.

In continuous-current dynamos, having commutators of a fairly large number of segments, the magnitude of the e. m. f. does not vary with the shape, area or disposition of the pole-pieces relatively to the armature, provided that the same useful total magnetic flux enters the armature from each pole, and that the conductors are distributed over the surface of the armature with reasonable uniformity, so as to avoid marked pulsations of e. m. f. at the passage of the brushes from one commutator segment to another. Thus, if a continuous-current generator gives 500 volts at open circuit across its terminals, at a given speed of rotation and a given total useful magnetic flux passing through the armature from each pole, then it will continue to give 500 volts, approximately, under all conditions of variation in the shape of area of the pole-pieces so long as the total useful armature flux remains the same. The shape of the pole-pieces does not, therefore, enter into the question of e. m. f., except in regard to the subsidiary question of magnetic leakage, excitation, waste of energy in field coils, armature reaction, etc.

In the case of alternating-current dynamos, however, the magnitude of the e. m. f. generated depends not only upon the speed of rotation, number of armature conductors and useful magnetic flux passed through the armature from each pole, but also upon the distribution of the magnetic flux relatively to the armature conductors; i. e., upon the shape of the wave of the e. m. f., so that if we alter the grouping of the conductors on the surface of the armature, or the disposition of the magnetic flux through which they pass, we alter the wave of e. m. f. which is generated, and so alter within certain limits the magnitude of the e. m. f. Consequently an alternator which might give by voltmeter across its terminals on open circuit an e. m. f. of, say, 2000 volts effective, when the pole-pieces and armature conductors were arranged so as to give the greatest amplitude of sinusoidal wave, might give, say, from 1700 to 2300 volts when the pole-pieces and armature conductors were arranged so as to give a distorted wave of e. m. f.

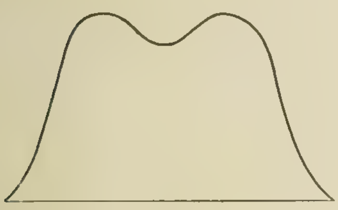

Fig. 144.—Flat Wave.

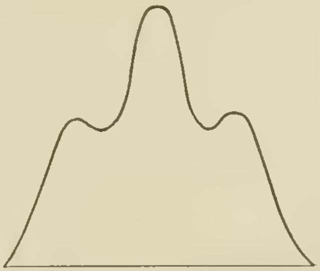

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Fig. 145.—Peaked Wave.

The designer of a continuous-current dynamo has therefore to shape its field poles with a view to securing sparkless commutation, reasonably low excitation loss and other conditions of good operation; while the designer of an alternating-current dynamo has to consider the shape of its poles and their disposition relatively to the armature conductors, in order to secure the highest available e. m. f. and best shape of the e. m. f. wave for the system to be operated.

If an alternator is designed to produce a sinusoidal wave of e. m. f., has p pairs of poles, and has to supply a frequency of n periods per second, its armature must make $r = \frac{n}{p}$ revolutions per second. Then the e. m. f. generated by the machine will be, on the basis of a sinusoidal wave,

$$E = \frac{\pi \sqrt{2}\, p\, r\, N\, \Phi}{100{,}000{,}000} \text{ volts effective, where}$$

N is the total number of loops connected in series on the armature, and Φ is the total useful magnetic flux in webers passing through the armature from each magnetic pole. Substituting the frequency n for $p\, r$ the formula becomes

$$E = \frac{\pi \sqrt{2}\, n\, N\, \Phi}{100{,}000{,}000} \text{ volts effective (sinusoidal wave),}$$

and if we substitute the angular velocity $\omega = 2\, \pi\, n$

$$E = \frac{\omega\, N\, \Phi}{141{,}400{,}000} \text{ volts effective (sinusoidal wave).}$$

The maximum e. m. f. at the peaks of the sinusoidal waves will be $E_{\max} = \frac{\omega\, N\, \Phi}{100{,}000{,}000}$ volts. Thus, if an alternator supplies 500,000 webers usefully through each pole into the armature and has 1000 turns in series, and gives a frequency of 60 cycles ($\omega = 6.2832 \times 60 = 377$) then its effective e. m. f. on open circuit, on the basis of a sinusoidal wave, will be

$$E = \frac{377 \times 1000 \times 500{,}000}{141{,}000{,}000} = 1333 \text{ volts effective.}$$

The actual e. m. f. might, however, be less than 1000 or more than 1500 volts, if the wave of e. m. f. were not sinusoidal.

If an alternating wave of e. m. f. be considered as consisting of a fundamental sinusoidal wave with superposed harmonics, then the effective e. m. f. will be the same whatever may be the phase of any or all of the harmonics with respect to the fundamental or to each other. The relative phase of the harmonics will, however, affect the shape of the wave of e. m. f., and thus have a decided influence upon the energy wasted in the iron cores of transformers or other apparatus connected with the circuit, a peaked wave of e. m. f. usually tending to reduce the loss, and a flat wave to increase it.

Whatever may be the shape of the wave of e. m. f. at no load, the effect of armature reaction under load is to bring about a distortion of the magnetic flux through the machine, so that the wave of e. m. f. becomes distorted to a greater or less extent as the load is applied.

The wave form of e. m. f. delivered by an alternator is usually approximately sinusoidal with armatures having a distributed winding or multi-tooth construction. On the other hand it is usually far from being sinusoidal in pole-wound armatures of the uni-tooth construction. Figs. 144 and 145 are general types of waves which may be obtained from such armatures, the former being a flat-topped and the latter a peaked wave. It may be considered that in each case the distorted wave is equivalent to a fundamental sinusoidal wave, with an addition of harmonics superposed upon it. It is not, however, necessary in dealing with the circuits supplied by such alternators to analyze the e. m. f. into harmonic components. For nearly all practical purposes the e. m. f. may be treated as if it were a sinusoidal e. m. f. of equal effective value. The principal difference is, that whereas the impedance in the circuit of an alternator producing a sinusoidal e. m. f. is $j\, x = j\, l\, \omega$, that is to say, a real reactance equal to the product of the self-inductance of the circuit and the angular velocity, the apparent reactance $j\, x$ in the circuit of an alternator producing a complex e. m. f. is an apparent reactance which is usually different from the product $j\, l\, \omega$. The apparent impedance of an alternator circuit is, therefore, not necessarily the same as the impedance which the circuit would show to a sinusoidal e. m. f., or which might be computed from its resistance and self-inductance. The apparent impedance is, however, the quantity which is actually observed, and it is the equivalent in the real circuit of what the real impedance would be in a simple sinusoidal circuit with no iron cores in its apparatus.

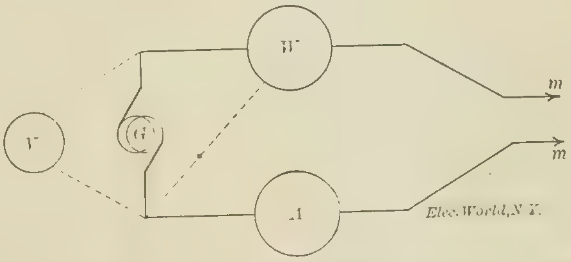

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Fig. 146.—Measurement of Impedance in a Circuit Operated by a Generator Supplying a Complex Wave of E. M. F.

In Fig. 146 G represents an alternating-current generator supplying a pair of mains $m\ m$ through an ammeter A and a wattmeter W. The voltmeter V also measures the effective pressure at terminals. Then if E be the e. m. f. indicated by the voltmeter and I the current strength indicated by the ammeter, the apparent impedance of the external circuit is $Z = \frac{E}{I}$ ohms. This, however, only determines the numerical value of the impedance and not its angle. If the circuit were reactanceless, so that the pressure and current were in phase, the power P, indicated by the wattmeter, would be

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*Continued from The Electrical World, February 5, 1898.

$$P = E\,I \text{ watts,}$$

but owing to the existence of reactance in the circuit, P is almost invariably less than $E\,I$. The power factor of the external circuit is, therefore, the ratio $\frac{P}{E\,I}$, and the angle of the impedance is the angle α whose cosine is equal to the power factor, or $\alpha = \cos^{-1}\frac{P}{E\,I}$. For example, if the pressure at the terminals of the alternator be $E = 1100$ volts, the current $I = 22$ amperes, the impedance $Z = \frac{1100}{22} = 50$ ohms. If the wattmeter shows $P = 20{,}000$ watts, then the angle is $\alpha = \cos^{-1}\left(\frac{20{,}000}{24{,}200}\right) = \cos^{-1} 0.8265$, since the apparent power is $1100 \times 22 = 24{,}200$, and by reference to a table of cosines this angle is $\alpha = 34° \; 15'$, Fig. 147. The apparent impedance is therefore either $Z = 50 \,/34° \; 15'$, or $50 \diagdown 34° \; 15'$, and the measurement does not directly determine whether the angle is positive or negative, since it does not show whether the current leads, or lags behind, the e. m. f. In practice, however, if there are no condensers or equivalent apparatus in the circuit, the current will lag behind the pressure, owing to the influence of inductance, so that the apparent impedance of the circuit is $50 \,/34° \; 15'$ ohms. Of this impedance the apparent resistance is $Z \cos \alpha$, or $50 \cos (34° \; 15') = 50 \times 0.8265 = 41.325$ ohms, and the apparent reactance is $50 \sin (34° \; 15') = 50 \times 0.5628 = 28.14$ ohms, so that the apparent impedance is $(41.325 + j\,28.14)$, and the circuit behaves as though the alternator gave a simple sinusoidal e. m. f. to a circuit of 41.325 ohms actual resistance, and 28.14 ohms actual resistance.

When a separately excited continuous-current generator running at constant speed is loaded, the e. m. f. at its terminals diminishes. partly owing to the drop of pressure in its armature resistance, and partly owing to the influence of armature reaction. In the case of a separately excited alternator the terminal e. m. f. diminishes, not only owing to armature reaction and drop of pressure in its resistance, but also owing to the drop of pressure in its reactance, and all three influences have to be taken into account.

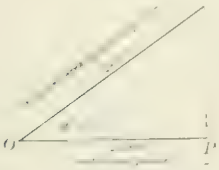


FIG. 147.—RATIO OF REAL TO APPARENT POWER.

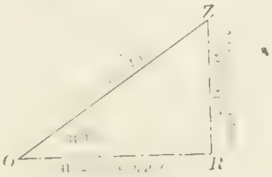


FIG. 148.—ANALYSIS OF APPARENT IMPEDANCE INTO APPARENT RESISTANCE AND APPARENT REACTANCE.

The resistance of an alternating-current armature is limited by the heating and energy loss permissible in the machine, and the drop of pressure in resistance may vary from 10 per cent. of the terminal pressure in a small alternator to 1 per cent. in a very large alternator in approximately the same ratio as in the case of a continuous-current generator.

The reactance of an alternator armature depends upon its self-inductance and the frequency of alternation. The reactance is in practice always greater than the resistance. The drop of pressure in reactance is, therefore, usually considerably greater than that in the resistance.

The reactance of an armature may in many cases be estimated by computation. Considering the magnetic circuit of the coils on the armature [illegible] unit current passing through these coils, under their own m. m. f., the reactance of the magnetic circuit of these coils or of the armature taking them collectively, usually depends not only upon the form and dimensions of the armature, but also upon the position of the armature coils relatively to the field poles, so that the self-inductance is not a strictly constant quantity, but fluctuates during each alternation, [illegible]. A rough measurement of the reactance can be obtained by keeping the field unexcited and measuring the impedance of the armature when running at normal speed.

The armature reaction depends not only upon the degree of excitation of the field coils and on the current passing through the armature, but also upon the phase of the armature current. When the current in the armature is exactly in phase with the e. m. f. generated therein, the reactive effect of the armature windings upon the magnetic circuit is practically negligible. When, however, the current in the armature of a generator leads the e. m. f. the armature windings aid the field windings to an extent depending upon the angle of lead, and thereby increase the generated e. m. f. On the contrary, when the armature current lags behind the e. m. f., the m. m. f. of the armature windings opposes to a greater or less extent the m. m. f. of the field windings, and thereby diminishes the magnetic flux in the circuit and the generated e. m. f. The armature reaction is, therefore, not only dependent upon the amount of load, but also upon the nature of the load; i. e., upon the angle of displacement between the e. m. f. generated in the armature and the current flowing through the circuit.

(*To be Continued.*)

Employers' Liability for Hazardous Electric Appliances.

BY R. D. FISHER.

The rapid advance of electricity within very recent years as a factor in commercial and economic affairs has given rise to a considerable body of statute law, and to numerous judicial decisions involving in some respects the creation of new legal rules, which concern chiefly the application of well-established principles to new conditions of fact and circumstances. A most valuable feature of legislation is the bulk of statute law enacted for the purpose of fixing the rights and liabilities of electric corporations of various kinds. The body of the law relating to the duties of companies as carriers of messages and of passengers, and their liability for negligence, has been many years accumulating, and has become to a great extent settled; but a different problem is presented with reference to extra hazardous appliances furnished to the employee which involve the liability of the employer to an injured servant in consequence thereof. The apprehension which a prospective loss of employment engenders often amounts to a coercive influence, and this being so, courts are at a loss to know how much allowance ought properly to be made for the action of that influence on the mind of the servant.

If it is assumed that the fear of losing remunerative work does not deprive of its voluntary quality the action of a servant who continues in his employment with a knowledge of the existence of conditions which make the risk of injury greater than that which persons engaged in the same class of work are ordinarily called upon to incur, the conclusion is inevitable that an employer is entitled to carry on his business with even the most defective and dangerous instrumentalities, provided the servant, either by his own observation or as a result of instruction and warning, has attained full comprehension of the hazard to which he is exposed by the use of these instrumentalities. This conclusion the courts have not been at all backward in drawing. The judgment that the master was not liable has induced legislatures to enact truck acts, factory acts and employers' liability laws. According to English law the master may be guilty of the most cynically reckless neglect of duty regarding the hazards of machinery, and yet not be liable. Lord Bramwell, in the case of Dynen v. Leach, 26 L. J., Exch. 221, said: "There is nothing legally wrongful in the use by an employer of appliances or machinery more or less dangerous to his workmen, or less safe than others which might be adopted. It may be inhuman so to carry on his plant as to expose his workmen to peril of their lives, but it does not create a right of action for an injury which it may occasion when the workman has known all the facts, and is as well acquainted as the master with the nature of the machinery and voluntarily uses it."

The following passage from a Connecticut case will suffice to show how closely the American judges have echoed the sentiment of their English brethren:

"Every manufacturer has a right to choose the machinery to be used in his business in the manner most agreeable to himself, provided he does not thereby violate the law of the land. He may select his appliances and run his plant with old or new machinery, just as he may ride in an old or new carriage, or occupy an old or new house, as he pleases. The employee having knowledge of the circumstances and entering his service for the stipulated reward cannot complain of the peculiar tastes and habits of his employer, nor sue him for damages sustained in and resulting from that peculiar service." (29 Conn., 548.)

Compare the language used by the Massachusetts Supreme Court to the effect that it is the legal right of every person to carry on a business which is dangerous, either in itself, or in his manner of conducting it, if it is not unlawful and interferes with no rights of other persons. (102 Mass., 572.)

So the Michigan Supreme Court construed the doctrine of assumption of risks very strongly in favor of the employer, saying: "Obvious imperfections in methods or machinery, existing at the time of the employment, cannot be made the basis of a liability in favor of an employee who suffers an injury in the cause of his employment, since the employer has the right to have and use imperfect methods and tools, and to ask others to enter his employ to aid him in such use, and in so doing does not undertake to insure the employee." (97 Mich., 265.)

The general rules governing the operation of electric plants so far as concerns the employees are the same as those governing the relations of master and servant in relation to other electric plants, viz., that an employee is supposed to accept the obvious risks of the employment, and cannot recover for accidents caused thereby. To show how low the standard of duty is fixed the Wisconsin Supreme Court (87 Wis., 387) held that where a motorman was obliged, after removing a trap-door in a car, to put his arm near the revolving axle and gearing in an attempt to clean the commutator, his coat sleeve being caught and his arm drawn into the gearing and mangled while so doing, he having been instructed for eight days in the duty of a motorman and having been employed three days before the accident happened, having also seen other motormen clean the commutator, the schooling given him was sufficient, and that it was an obvious risk of the employment for which no recovery could be had.

Electric cars sometimes, owing to defective machinery, act stubbornly. This trick is called by the motormen "bucking," and may produce serious results. In Minneapolis a car so bucking threw the motorman over the dashboard, and then starting again ran over and killed him. The motorman had been employed a year. He notified the company of the defective machinery, and repeated attempts were made to remedy it. The court held the company liable in this case because it had notice of the habits of the car and had failed to remedy it in that it failed to replace a defective field coil in the rear motor, and it was negligence in the repairer not to remedy this defect, knowing of the bucking habit of the car. (54 Minn., 504.)

If the degree of care which the servant must exercise in order to escape injury is greater than that which, considering the exigencies of the work and other matters which are likely to divert his attention and produce a temporary forgetfulness of a known danger, it is reasonable to demand from men of average prudence and powers is reasonable to demand from men of average prudence and powers ought to bear the responsibility of any accident which may occur, quite irrespective of the question whether the servant was or was not aware of the nature and extent of the danger. The acceptance of this principle would involve an implied agreement of the servant to use ordinary diligence in the discharge of his functions, and make it a breach of duty in the master to keep his instrumentalities in such a condition that ordinary diligence will not always save the servant from injury. It would simply make his liability dependent upon whether he had or had not acted unreasonably, and therefore negligently, in holding out inducements to do work which could not be performed safely without the exercise of a degree of care which no fair-minded, considerate person would demand from a servant. This would prevent the cruel abuse of the doctrine of assumption of risks which has done so much to embitter the feelings with which capitalists or operators are regarded by the working classes of the country.

An Automatic Clutch for Motors with Low Starting Torques.

An ingenious automatic releasing clutch is used with single-phase induction motors made by the Elektricitats-Actien Gesellschaft, and described in London "Engineering." The clutch contains a liquid which, as the speed rises by centrifugal action, bulges out a flexible diaphragm, bringing the clutch surfaces into contact, the pressure of which becomes greater and greater with increased speed. In this way synchronous alternating-current motors and single-phase induction motors can be automatically relieved of their load on starting and automatically coupled to it when the speed rises to a proper point.

A Gift in Memory of Dr. John Hopkinson.

In his opening lecture to the engineering students at Cambridge University on October 14, Professor Ewing stated that a gift of £5000 had just been made by Mrs. Hopkinson in memory of Dr. John Hopkinson, the sum to be expended in an addition to the engineering laboratory. Professor Ewing said also: "I feel impelled to add a few words as to the loss which our profession—the profession on which you look forward to entering—has met with in the untimely death of Dr. Hopkinson. If I were to select any name to put before you as that of an engineer whose work and methods you would do well to follow, it would be his. He was a peculiarly conspicuous example of that union of scientific knowledge and genius with practical sagacity which goes to make a great engineer. His work was brilliantly original. In more than one department he led the way where a great host is now following; and his work was as sound as it was brilliant. His opinion was constantly being sought, partly because it was always fair and unbiased—his character was too fine for anything mean or unworthy to find a place—and partly because his judgment came near to being infallible. You know that he took in Cambridge the most distinguished place that any student can take. He at once plunged into engineering work, and from that time to the end his professional life was an unbroken series of successes. But he made time for much original work of lasting value in science, and the world of pure physics is deploring his loss as much as it is deplored by engineers. Such a man may, I think, be said to live on, not only in the results of his work, but in the force of his example. Dr. Hopkinson took from the first a warm interest in this laboratory and in the establishment of an Engineering Tripos at Cambridge. It was only a few days before his death that he spoke to me of his intention to promote a subscription for the much-needed extension of the laboratory. It is a peculiar pleasure to me to think that this laboratory will, through the noble gift of Mrs. Hopkinson and of his son and daughter, be henceforth associated with his memory and name."

Electrical Advances in Japan.

The second electric railway undertaking in Japan is the Hoshu electric railway, which will run from Beppu to Oita, in Kyushu. Work was suspended for a while owing to financial difficulties, but these have now been overcome and the construction is steadily advancing. The contract for all materials was let to the Saiga Electric Company, of Kyoto, which company in turn ordered the following pieces of main apparatus: Two Lancashire-type boilers of 160 horse-power each (made in Japan); one 160-hp McIntosh & Seymour high-speed engine; one six-pole, 110-kw General Electric railway generator; ten No. 21 Brill trucks and twenty 25-hp railway motors. The rails, generator and motors have arrived, and the work of installing them has begun. The engineers in charge of the work are Mr. H. Maki and T. Saiga, president of the Saiga Electric Company.

A striking example of modern industrial processes surrounded by the quaint beauties of old Japan is the case of the tobacco factory of the Murai Brothers Company, in the ancient capital of Japan, Kyoto. In this factory the electric distribution of power is used, the amount being 200 horse-power, and upon its tower has recently been placed a large searchlight. Our Japanese correspondent naïvely advises us that the present name for the searchlight in Japanese is tan-kai-to, which means the lamp which shines over the sea in the night, this form of apparatus having been first used in the navy, but hereafter, on account of its adoption on land, the name will probably be changed.

An Ingenious Electric Brake.

A combination of foucault currents and friction braking designed to give a more uniform retarding effort over a wider range of speed than either gives alone has recently been patented in England by the Helios Company. A group of stationary magnets attract a rotating armature, the releasing force being a light spring. At high speeds centrifugal weights properly attached to the armature prevent its being attracted by the magnets, but the action of the latter causes powerful foucault currents. As the speed comes down and these currents become weaker, the centrifugal force of the rotating weights is finally overcome by the magnetic attraction, the armature closes on the pole pieces and further retardation is obtained by mechanical friction.

DIGEST OF CURRENT ELECTRICAL LITERATURE AMERICAN AND FOREIGN

By Carl Hering.

Dynamos, Motors and Transformers.

MOTORS.—Lond. "Engineering," Oct. 28.—In this continuation of a descriptive article on the Schuckert Company (see "Digest" last week) a number of well-illustrated descriptions of several forms of their motors are given, including also some electric hoists.

CONTINUOUS-CURRENT DYNAMOS. Guilbert. "L'Eclairage Elec.," Oct. 22.—Brief, illustrated descriptions of various recent improvements, taken from patent specifications.

ALTERNATING CURRENTS OF ANY FREQUENCY.—"Elec. Rundschau," Oct. 15.—Brief, illustrated description of the Union generator, taken apparently from patent specifications. It is a continuous-current generator with movable brushes.

DYNAMOS.—Lond. "Elec.," Oct. 28.—Brief, illustrated descriptions of the Jackson dynamos, which are wound on the Sayers system. They are said to be sparkless at all loads without a change of position of the brushes, even with considerable overload. The illustrations show only the external views and the description is very brief.

BEST THICKNESS OF TRANSFORMER PLATES. Bledell, Klein and Thomson. "Science," Oct. 31.—A brief notice of an A. A. A. S. paper giving a curve of the relation between the thickness of the plate and the total loss due to hysteresis and eddy currents, from which it was found that the curve has a broad, flat minimum extending from about 10 to 15 thousandths of an inch in thickness.

ARMATURE WINDINGS. Rice. "Amer. Elec.," Nov.—A description of telescope windings, which are used on direct-current machines intended for very large currents at low voltages. There are several separate windings arranged side by side on the same armature, but not connected with each other; the brushes, which are very wide, connect the various circuits in parallel.

MULTI-CIRCUIT DYNAMO. Murphy and Van Saun. "Amer. Elec.," Nov.—A description, accompanied by a number of curves, of a test of a Rushmore multi-circuit direct-current dynamo, which will supply two or more independent currents at different voltages. The results are claimed to show that the machine is entirely commercial and can be used in many cases with great economy. The machine itself has already been described in THE ELECTRICAL WORLD.

Lights and Lighting.

NEW INCANDESCENT LIGHT.—"L'Elec.," Oct. 29.—A short note on what is called a discovery, which, it is claimed, will probably revolutionize electric lighting. It is being experimented with by the Ganz Company, of Budapest. The incandescent part consists of a tube of alumina of 0.3 mm in diameter, which is heated to incandescence in the open air, thus requiring no bulb and being cheap to construct. These tubes have been kept incandescent for more than 700 hours without any apparent change. The only difficulty is that the material will not conduct while cold, but this is overcome by a preliminary heating, during which time the lamp is lit by means of platinum wires. The results of experiments are said to be quite satisfactory.

ARC LAMPS. Richard. "L'Eclairage Elec.," Oct. 22.—Brief, illustrated descriptions of various improvements taken from patent specifications.

THEATRE LIGHTING.—Lond. "Elec. Rev.," Oct. 28.—A brief, illustrated description of the plant in a new theatre at Plymouth.

Power.

ELECTRIC MOTORS IN MACHINE SHOPS.—Lond. "Engineer," reprinted in the Lond. "Elec.," Oct. 28.—A long editorial discussing the question of the relative economy and advantages of the electric and the shaft and belt systems. It is thought that the electrical enthusiasts overdo the advocacy of electrical driving; [illegible] to be used to drive dynamos, which in turn drive motors attached to six screw shafts, each carrying three screws and making 2500 revolutions per minute; it is reported that Edwin S. Cramp has said of this that it is not only in every way feasible, but is a decided improvement on the Turbinia (in which the propellers are driven directly by steam turbines and therefore run too fast); he believes that there will be a decided economy in fuel and steam, that the use of a dynamo and motors to run the shafts is a decided gain, and that the greater distribution of the power over six propellers is a good feature.

THE MIDLAND RAILWAY LIGHT AND POWER PLANT.—Lond. "Engineering" and "Elec. Eng.," Oct. 28.—A reprint of the paper which was abstracted in the "Digest" Oct. 22, but including the illustrations, which were not contained in the reprint previously noticed. Among other things he stated that the efficiency of the ordinary belt and shaft transmission at the workshops of that railroad was as low as 28 per cent., and in many other places no higher than 20 per cent. There was considerable difference of opinion in the discussion as to the relative advantages of separate driving and group driving; Langdon advocates separate driving wherever more than 1 horse-power is needed; Harris and other speakers claim that the question of first cost often rendered it inadvisable to use separate motors for each machine, even when these are of considerable size.

COMBINED LIGHTING AND POWER PLANT FOR DOCKS. Aldridge. Lond. "Elec. Eng.," Oct. 28.—A reprint of a short Brit. Assn. paper describing briefly several plants and showing the advantages of combining the lighting and power plants instead of using electricity for lighting only and hydraulic power for the cranes. He considers the subject from the dock owner's point of view. At Copenhagen all the power and light is supplied from one plant; the load diagram is given; there is an accumulator in connection with the plant; the total capacity is 1250 horse-power, 900 of which is for motors. If they were separate plants at least two-thirds of the steam plant would have to be for lighting only, and this part would be idle for at least two-thirds of the day. At Rotterdam electric cranes are also used; a table gives the details of the working costs for 1896, and another one more briefly for 1897. At Southampton there is a hydraulic and an electric plant, but the boilers are common to both; a load diagram for a week is given. The plant at Cleveland, Ohio, is well spoken of, and it is said that the electrical machinery for handling goods is much more developed there than in England. In using electric power, extensions can be made at much less cost; an advantage over hydraulic power is that there is no danger from the freezing of water in winter. One of the reasons why electric power is used so little in England is that most docks and harbors are already equipped with the hydraulic system. It is thought that electric plants can be erected at a price which will compare favorably with the hydraulic system.

ELECTRICAL POWER FOR BRIDGE CONSTRUCTION.—Lond. "Elec. Eng.," Oct. 28.—A note on the use of electric power in the erection of a 900-foot span at Budapest, where only electric power is used. In driving the piles the electric ram drove forty per day, while a steam ram drove only thirty, and was therefore abandoned. An electric windlass and a number of electric pumps are used. The advantages of electric power during the six months' use in this plant have been established, so that in future only electric motors will be used for these purposes.

HIGH-TENSION PLANTS.—Lond. "Elec. Eng.," Oct. 28.—An answer to a request to compare the high-tension continuous system with the high-tension alternating one, in capital, cost, repairs, and maintenance. It is thought that the capital outlay is in favor of the alternating-current plant; this is also true, as a rule, for repairs and maintenance; greater experience with the continuous-current system, however, may change this.

SHOREDITCH DUST DESTRUCTOR. H. E. Kershaw. Lond. "Elec." and "Elec. Eng.," Oct. 28.—A brief reply to the criticism of Baker (see "Digest" last week). It appears that Baker had submitted a scheme for the dust destruction, which was rejected. (The present writer is chairman of the lighting committee.) Baker's estimate is based on a twelve months' expenditure and a nine months' income and includes the first quarter, which is invariably a heavy loss to any undertaking. In the course of a few weeks the official report will be made public; at present he can only say that the combined scheme has made a profit in the first year's working, after making all allowances, of $10,000 net. Besides this, they are paying back about $[illegible] a year for interest and capital, which means that in thirty years the combined plant will be paid for, and that this therefore covers depreciation and maintenance charges. A letter by Robinson, the clerk of the vestry, is published in part in the "Elec." and in full in the "Elec. Eng." He also points out the errors in Baker's estimate.

BLAST FURNACE GAS.—Lond. "Engineering," Oct. 28.—A note giving the results of tests made by Witz with a 200-hp gas engine operated by gas from blast furnaces. The tabulated results are given; the gas used per break hp-hour was 117.6 cubic feet; the average calorific value of the gas was 110.2 thermal units per cubic foot.

TRANSMISSION OF POWER. Siemens. "Engineer," Nov. 1.—An abstract of his paper, which was noticed in the "Digest" Oct. 15.

PRINTING ESTABLISHMENT. Damon. "Elec. Eng.," Nov. 10.—The beginning of a description of the electric equipment of the Conkey printing establishment in Indiana. See The Electrical World of Nov. 12 for a full description of this plant.

Traction.

POLYPHASE TRACTION.—Lond. "Elec.," Oct. 28.—An editorial discussing the relative merits of the usual continuous current, the combined polyphase-continuous current and the polyphase-current systems. In the interference with telephones and telegraphs the polyphase motor system is at a great disadvantage; in Lugano, where the latter system is used, the telephone system has been thrown into great confusion, while on the Jungfrau Railway the disturbance is still too great for the satisfactory transit of messages. In the electrolytic action of the leakage current the polyphase current is undoubtedly superior; if with the continuous current the insulated return is adopted the system would be better than the polyphase. The advantages from an engineering or economic point of view are discussed; the absence of a commutator is an advantage; the polyphase motor can be more compactly and economically constructed and is lighter for the same speed and output, besides requiring only stationary transformers, but the latter is not so great an advantage as it might at first seem, as the rotary transformer requires remarkably little attention, as shown in Dublin, for instance, where the sub-stations are in charge of boys; polyphase motors are not necessarily cheaper, as the magnets have to be laminated; in regulation the continuous-current motor has the advantage. Brown advocates regulation of polyphase motors in part by alternation of the stator circuits from the star to the mesh formation, and by cutting out a certain number of poles, thereby altering the speed of synchronism (as he is the designer of the Lugano, Gornergrat and Jungfrau railways it is probable that this system of regulation is adopted there). The power factor of polyphase motors is always less than unity, and the trolley wire would therefore have to carry more current. The conclusion is that on the whole the advantage lies with the continuous-current motor systems, and that the combined polyphase-continuous will in general be the most economical to adopt where the feeders are long or where there is an advantage in placing the power station at some distance.

THOMPSON-WALKER SYSTEM.—Lond. "Elec.," "Elec. Rev." and "Elec. Eng."—A brief account of an inspection of the experimental track at Willesden; the system itself was described in The Electrical World Oct. 22. The danger of leaving the plugs alive is so great that the Board of Trade would not sanction any system in which this is possible; it is claimed that in this system it is almost inconceivable that this should happen; the mechanism is less likely to get out of order. It is absolutely essential that a live piece of iron at 500 volts should be immediately over and in contact with the plug, in order to make it live; other systems depended upon the proximity of either a piece of iron or an electrical conductor. Among the effects to be guarded against is leakage from a feeder to a dead contact; in this system the contact knobs are so surrounded by permanently earthed metal casings that any leakage escapes to earth and cannot reach the knob; if any leakage should occur a fuse is blown. The mechanism in the box is completely enveloped in paraffin oil, thus preventing sticking; moreover, the circuit is broken between carbons before it is broken at the mercury surface. The car contains a small 500-volt accumulator to make the skate alive, should it pass over a dead plug and thus lose its current. To remove the mechanism below the plug was found to take only thirty-seven seconds, or to replace it, one minute. A table is published comparing the cost of the two systems; for a single-track overhead-trolley system the maximum cost is $45,000 per mile; for the open conduit system $57,000, and for the present contact system about $47,500, as a maximum; thus the latter is but little more expensive than the overhead equipment. As it is operated at 500 volts it may be combined with the overhead trolley system.

ACCUMULATOR TRACTION.—"Elek. Zeit.," Oct. 27.—A communication by Zacharias referring to the recent paper of Schiemann (see "Digest" Oct. 29). He claims the importance of discharging all the batteries in series, instead of dividing them into groups, is very great, and that the tests described are therefore unsatisfactory as far as it concerns the accumulators; there are difficulties involved in charging when the cells are unequally discharged. For indicating the amount left in the batteries he suggests the use of a voltmeter which is read while the current is being used; the lights in the cars would also give an indication. In a reply by Schiemann he said the tests were only made to study the action of the motors and not the batteries.

ELECTRIC TRACTION.—"L'Ind. Elec.," Oct. 25.—Abstracts from the report of the committee sent to the United States by the Orleans Railway, of France, to report on electric traction to replace steam on the steam railroads. Their conclusions are that although such installations are not numerous in the United States, the results have shown that no technical difficulties have interfered with their success; the practical success of the contact rail or wire with sliding contacts has been demonstrated; electric locomotives have been constructed of much higher power than is required for the heaviest trains on French railroads.

ELECTROLYSIS OF PIPES AT DAYTON. Brown. "Elec. Eng.," Nov. 3.—An abstract of a paper read before the Mun. Impt. Assn. at Washington. He refers to the recent tests in that city, which were noticed in the "Digest" Oct 22. He brings out the fact that formerly cast iron pipes were considered safe against electrolysis, but that these tests have shown that this is not the case in that city. Pipes from 1.5 to 2 miles from the power houses were subject to electric corrosion; near one power house the pipes were 9 volts positive to the rails; in his opinion all mains and service pipes in that city are seriously injured where subjected to 3 volts or more for two years or more, when within 4 feet of the rails. The tar covering on the pipes seems to be no protection whatever, as the surface of the pipes is changed into a soft black material resembling graphite. He believes that with an expenditure of $5000 to $7000 for proper electrical connections all water pipes in that city could be maintained negative to the rails; the pipes would then "harden" and any further electrolysis would add a layer of metal to them instead of injuring them. In conclusion he adds a few practical suggestions; it should not be imagined that because the pipes are not leaking or bursting that they are safe from electrolysis, for they may be getting weaker day by day; the best course to be adopted is mutual action; no more lead or wrought iron service pipes should be put down, but instead, wooden pipes with a close spiral of hoop iron covered with asphalt should be used; the same pipe should also be used for new mains in districts that might be affected; in danger districts two or more consecutive lengths of these wooden pipes should be inserted in the water or gas mains, thus breaking their electrical continuity; the space around them should be filled with broken stone and connected with a drain, if possible; midway between the wooden sections pilot wires should be attached, leading to a central office; also similar wires to the nearest rails; electrical tests should be made daily, and any section which is positive should at once be cut into smaller sections, and the railway company should rebond its line in that district.

MULTIPLE UNIT SYSTEM IN CHICAGO. Shepard. "Elec. Eng.," Nov. 3.—A short article on the Sprague system, used on the Chicago South Side Elevated Road, in reply to a recent criticism of Cravath. Elevated railroad service is essentially acceleration, as the rest of the energy is inconsiderable in comparison. In order to keep down the braking speed a low maximum speed is required and to obtain this in the shortest time a rapid acceleration is necessary. The limit to possible acceleration is not one of personal comfort, but of adhesion, and it can be accomplished only when every wheel of a train is a driver. The equipment is designed for a 15-mile schedule; the maximum possible current will develop a torque which is sufficient to come within the slipping point of the wheels. Such a system does not conduce to the lowest average current consumption, which is in excess of the ratio of the squares of the scheduled speeds; with ten seconds' stop at each station and an actual 15-mile schedule, the current consumption was found to be 1.54 kw hours per car mile. The locomotive system must operate at a low acceleration compared with independent cars. He fails to see how Cravath's criticism can hold for actual conditions of service; this was, that the use of so many small motors would give a lower efficiency than single-motor cars at the head of a train. As compared with the locomotive system the features of the multiple unit system are that for any given schedule the first cost is lower, the cost of operation is lower, there is greater facility for car movement at lower maximum speed, and there is greater resultant safety.

RECENT IMPROVEMENTS IN MECHANICAL TRACTION.—"St. Ry. Jour.," Nov.—An abstract of a paper read by Ziffer, of Vienna, before the meeting of the International Permanent Tramways Association at Geneva in August. He takes up the following subjects: Steam motors; stored steam locomotives; compressed air motors; cable railways; gas, benzine and petroleum motors; electric traction by accumulators; electric traction by overhead wires; electric conduit systems; mixed electric tramway systems; and service conduit systems; and describes briefly the improvements made during the last two years, and in a general way discusses the cost of operation. In his conclusions he states that while it would be impossible to fix upon any one system as the best without examination into the local conditions, it is undoubtedly true that the trolley system is the one most generally adopted, and is the most simple, the most economical and the one which has given in practice the best results up to the present time. The paper seems to be similar to the one noticed in the "Digest" Oct. 29.

SPECIAL CARS IN BROOKLYN.—"St. Ry. Jour.," Nov. 10.—Six cars are described. One is a special car employed by the superintendent in making inspections of the road. Two others are private parlor cars owned by prominent officials of the company; one of these has a novel portable turntable, consisting of a hydraulic jack carried underneath the car and used at crossings where there are no connecting curves. The car is run to the centre of the crossing and lifted up by the jack and then swung around by hand until the wheels are directly above the other track, when it is dropped into place. A fourth car is used in construction and line repair work. It has a tower, which can be raised and lowered by a windlass, and a movable platform, all of which can be brought flat with the top of the car. In the interior are carried all materials required for building new line and for quick repairs. When used for putting up new trolley wire, the new wire is kept on a large insulated reel within the car, and the end is led out through the roof of the car over a brass pulley; the end of the wire is then clamped to the end pole or span wire, and the car proceeds, reeling out the wire. The wire is alive and the car proceeds under its own motive power, taking current from the new wire. When the first span or bracket pole is reached the car is stopped and the men on the platform make the connection between the wire and its insulator, and they then proceed to the next span or pole; this simplifies the work, as one mile of trolley wire can be taken down and new wire put up and all connections made in twenty minutes. The fifth car described is a convertible car, employed by the company. In plan it is constructed nearly like the ordinary open summer car, with ten cross seats, one on each platform; but the eight seats within the body of the car are arranged in pairs of two each, facing each other, making four open spaces. The entrances are all on one side. In summer the windows are removed, but in winter the car is inclosed with four side doors. The side windows are stationary in winter and cannot be lowered, but at each end are two large windows, which are movable. The company has 250 cars of this type. For transporting long (60-foot) rails it employs a special platform car. This car is 40 feet long, and is mounted on double trucks equipped with very small wheels. Two motor cars are used to move this car, one to push and one to pull it. This tends to prevent possible accident if one of the draw-bars should break on a grade. The draw-bars connecting the car with the motor cars are 15 feet in length.

GLASGOW.—"St. Ry. Jour.," Nov.—A description of a section of 2½ miles of trolley road recently built in Glasgow by the municipality. The rails weigh about 100 pounds per yard and rest on a concrete base about 6 inches deep. The power station contains three tandem compound engines, each connected with a 200-kw generator. The boilers are equipped with automatic stokers. The cars are mounted on double trucks, with entrance at the side of the car. Most of them are single-deck, but some are double-deck. The wheels are of chilled iron. The fares are graded according to the distance traveled.

ALGIERS.—"St. Ry. Jour.," International Edition, Nov.—This railway, which has a length of about 9 km, was put in operation last April. There are numerous grades, the highest being 8 per cent.; the gauge is 1.055 metres. The engines are horizontal condensing Corliss, two in number, and of 350 horse-power each. Each engine drives a 200-kw generator. There are eighteen motor cars and an equal number of trail cars; the motor cars are divided into two compartments, one for first-class and one for second-class passengers. Each compartment has room for ten seated passengers, and each platform accommodates ten passengers, making forty passengers for the car. The cars are equipped with two motors each, and electrical brakes.

THE GRATZ-MARIA TROST RAILWAY.—"St. Ry. Jour.," Nov.—This railway has a length of 5.2 km and a gauge of 1 m. In the power station are two six-pole, compound-wound generators of 135 amperes at 600 volts. There are eight motor cars and four trail cars. The cylinder dimensions of the engines are 280 mm and 400 mm by 220 mm. Superheaters for raising the temperature of the steam from 135° C. to 250° C. are used.

DUBLIN. Boyd. "St. Ry. Jour.," Nov., International Edition. —A review of the financial report of this company for the past year, with an estimate of future earnings.

HONOLULU AND ITS STREET RAILWAYS. Cicott. "St. Ry. Jour.," Nov.—A short, illustrated description.

EVAIN-LES-BAINS.—"St. Ry. Jour.," International Edition, Nov.—An illustrated description of this small three-phase railway plant. Other descriptions have already been noticed.

CENTRAL POWER PLANT.—"Sc. Am.," Nov. 12.—An illustrated description of the 70,000-hp power station of the Metropolitan Street Railway Company, of New York, including illustrations showing it in course of construction.

ORGANIZATION AND OPERATING METHODS OF THE UNION TRACTION COMPANY, OF PHILADELPHIA. [illegible] company's plan of organization is first described and illustrated by a diagram. The remodeled Thirteenth and Mount Vernon Street power station is fully illustrated. [illegible] generator. By a special construction the magnetic strength of the different field [illegible]

RELATIVE COST AND PROFITS OF CABLE, ELECTRIC AND HORSE RAILWAY OPERATION IN NEW YORK. [illegible] Nov.—A [illegible] Metropolitan Street Railway Company, of New York city, [illegible] 000,000 car miles. The company's private records of operating costs have been most carefully kept and correctly distributed to the different motive powers, so that the comparative statements are exhibited in the large table accompanying the article, which is a transcript of these private records. It is said to be the most interesting and valuable statement, based on the actual practice of the costs of operation by electricity and cable in the same city and under the same conditions, which has ever been published. The cost of electric operation for the year, with everything in a transition state, is shown to be 10.23 cents.; of cable operation, 16.42 cents, and of horse operation, 17.87 cents. For the 4,000,000 electric car miles run during the last three months, the cost of operation for the underground conduit system has been reduced to 10.05 cents.

BRITISH COLUMBIA RAILWAY.—"Railway and Shipping World," Oct.—Extracts from the accounts of this line for the year ending in March.

STREET RAILWAYS IN THE UNITED STATES IN THE HANDS OF RECEIVERS.—"St. Ry. Jour.," Nov.—A table giving names of companies, miles of track, number of cars, date of receivership, funded debt, gross receipts for last year obtainable, and the name of receiver.

MUNICIPALISM IN THE BRITISH TRAMWAY FIELD. McCallum. "St. Ry. Jour.," International Edition, Nov.—This tendency is shown by the recent offer of the municipality of Glasgow to build an interurban electric railway line between that city and a neighboring town. Glasgow already owns and operates its own tramway system. Municipal ownership and operation of tramways is common in England, but no effort has heretofore been made by a municipality to own and operate tramways or railways outside of its own boundaries. The city of Manchester is also proposing to follow the same course, and bills to secure the necessary permission will be presented at the next meeting of Parliament. The writer condemns the policy from both an economical and political standpoint, and states that municipally operated tramways have not proved as economical as those under private ownership.

CONDUIT CONSTRUCTION.—"St. Ry. Jour.," Nov.—A statement showing how about 12 miles of electric underground conduit construction was completed and put in operation within ninety days, in New York city.

THIRD-RAIL SYSTEM. Maxham. "Elec. Eng.," Nov. 3.—A brief, illustrated description of his system, which was exhibited at the Mechanics Fair in Boston. The conductor lies in a hollow rail, which is in sections, and is made alive by a mechanical device consisting of a wheel, which depresses a mechanism which connects the feeder to that section of the rail.

HANDLING BATTERIES FOR VEHICLES. Dolnar. "Amer. Mach.," Nov. 10.—An illustrated description of the plant for handling and charging batteries used by the New York electric cabs.

ELECTRIC CARRIAGES.—"West. Elec.," Nov. 5.—Some very brief descriptions of eight different vehicles made by the Fisher Company.

TENTH CONVENTION OF THE INTERNATIONAL TRAMWAYS ASSOCIATION. Ziffer. "St. Ry. Jour.," Nov. —An extended report, and claimed to be the first published, of the convention held in Geneva August 24-27. The subjects discussed were the proper length of car body, double trucks and radial axles, brakes, proper size of engines for railway power stations, rail bonds, storage batteries for traction, advantages and disadvantages of different electric tramway systems, and the relative advantages and disadvantages of all the mechanical methods of traction. A digest of the discussion is given, and the different points of electric tramway interest in the neighborhood of Geneva visited by the delegates are described and illustrated.

Installations, Systems and Appliances.

INTERRUPTION OF SUPPLY AT BRIGHTON.—Lond. "Elec.," Oct. 28.—A brief account and discussion of a recent interruption of half an hour. A 220-kw armature developed a short-circuit and for some unexplained reason all the dynamos running at that time immediately dropped their minimum cut-outs, thus interrupting the whole supply of 9000 amperes. The practice at that and at several of the largest stations in that country is to use no excess current cut-outs between the dynamos and the bus bars, but only minimum cut-outs; this would appear to afford an absolute safeguard against what actually occurred at Brighton; if excess current cut-outs or fuses were used with each dynamo a sluggishness of the minimum cut-out in the case of an armature short circuit would blow the excess current cut-outs of all the other machines; but for all the minimum cut-outs to act it was essential that the current from the dynamos must have been greatly reduced and this can only be explained by the behavior of the dynamos themselves. It is hardly probable that the short circuit sufficed to pull the machines up "dead" for an instant; the speed was probably greatly reduced while a reaction of the large currents in the armature tended to weaken the fields, and it is just conceivable that these two causes reduced the current sufficiently to release the cut-outs. Another fact might have contributed to the remarkable result: two small machines were also running in parallel with the others, being provided with ordinary fuses and no minimum cut-outs, but these fuses did not blow; their speeds may have been less affected than that of the larger ones. To replace the minimum cut-outs by return current cut-outs would probably be effectual, but there is a prejudice against their shunt winding; to separately excite the dynamos might lessen the probability of such an accident, although it may not be an absolute safeguard. For the present it is likely that the minimum cut-outs will be discarded in place of extremely heavy excess cut-outs.

CENTRAL STATIONS AND CONSULTING ENGINEERS.—Lond. "El'ty," Oct. 28.—A long series of four illustrated articles giving portraits and brief biographies of four consulting electrical engineers, followed in each case by an illustrated description of a plant designed by him. The following are the subjects: "Robert Hammond and the Leeds Electric Lighting Station;" "Prof. A. P. W. Kennedy and the Edinburgh Central Station;" "E. Manville and the Shoreditch Central Station;" "H. F. Parshall and the Tees-Side Electric Tramways."

HULL.—Lond. "Elec. Eng.," Oct. 28.—A brief, illustrated description of this plant, to which some 44,000 lamps of 8 candle power are connected. There are two high-pressure direct-current sets of 2000 volts, which is transformed down at sub-stations by direct-current transformers, the same as in the so-called Oxford system.

LLANDUDNO.—Lond. "Elec.," Oct. 28.—A brief, illustrated description of this lighting station which is worked in conjunction with a refuse destructor plant, although the generation of steam does not depend entirely on the refuse.

PARIS. Laffargue. "L'Ind. Elec.," Oct. 25.—A short summary of the changes made in the central stations in Paris during the past two years.

LARGE BATTERY.—"L'Ind. Elec.," Oct. 25, and "L'Elec.," Oct. 29.—A note stating that at Antwerp a Tudor battery has been added to the new station, consisting of 140 cells, having a capacity of 6090 ampere hours at a rate of 609 amperes; the normal charging current is 1500 amperes; it will give 1350 amperes during three hours, or 3000 on an emergency; the total power is 800 kw, and it is therefore thought to be the largest battery installed.

SMALL POLYPHASE STATION.—"Amer. Elec.," Nov.—An illustrated description of the Hackensack plant, which is said to be a good example of small multiphase installation. There is one generator of 350 kw giving three-phase current of 2500 or 5000 volts, and two smaller machines.

WASHINGTON. Hopkins. "Elec. Eng.," Nov. 3.—An illustrated description of the new station of the United States Company. The description refers chiefly to the mechanical and engineering features. The continuous-current three-wire system is used in connection with a storage battery having a capacity of 16,000 lamp hours at an eight-hour rate of discharge.

BROOKLYN.—"Power," Nov.—An illustrated description of the large 3000-hp steam-driven dynamo for this station; the description refers chiefly to the engine.

CHICAGO PUBLIC LIBRARY.—"Engineer," Oct. 15.—An illustrated description of the power plant.

UNITED STATES CRUISER NEWARK. Countiss. "Amer. Elec.," Nov.—An illustrated description of the electric equipment of this steamer.

LIGHTING ARRESTERS. Raymond. "Amer. Elec.," Nov.—Brief, illustrated descriptions of a number of different forms of lightning arresters. No comparison of the merits of the different forms is made.

Wires, Wiring and Conduits.

RULES AND REGULATIONS.—"Elek. Zeit.," Oct. 27.—A reprint of a short report made to the German Government by a committee of the Union of German Electricians, concerning the question of what voltage should be considered dangerous. Tests were made in a chemical factory where the workmen had to handle alkalies, acids and salts. Experience has shown that under normal conditions the insulation resistance of a human being is so high that voltages up to 250 are not dangerous; in order to determine the dangerous voltages under abnormal conditions, such as in these chemical works, a number of measurements were made of the insulation resistance of workmen, who were tested in the condition in which they were while at work. The electrodes were clasped in the hands and the resistance measured; under normal conditions values were found between 900 and 2000 ohms, and it is therefore not the case that the resistance diminishes by handling these chemicals. Great differences in insulation were found in the workmen under normal and abnormal conditions, and these are due to the footwear and the resistance of the floor; the shoes worn were mostly of wood. Under normal conditions the resistance from hand to earth out of twenty-four workmen was for seventeen about 150,000 ohms, for seven between this and 50,000, and for the others between 17,000 and 14,000 ohms. Under abnormal conditions the resistance varied greatly; values from 1700 to 900 were found; in another case 2400 to 1100; the mean under abnormal conditions is about 2000 to 3000, while for the normal it is about 100,000. It is therefore concluded that the rules and regulations which have recently been adopted in that country need not be altered for normal conditions; the portion referring to abnormal conditions, however, is very important. This refers to the continuous current, as at present it has not been determined whether the alternating current is any more dangerous.

RULES AND REGULATIONS.—"L'Elec.," Oct. 29.—A reprint of recent French laws concerning aerial conductors.

INTERIOR WIRING. Knox. "Amer. Elec.," Nov.—Brief descriptions of various systems of feeders and mains.

Electro-Physics and Magnetism.

CORPUSCULAR THEORY OF ROENTGEN RAYS. Walter. "Wied. Ann.," No. 9; abstracted in Lond. "Elec.," Oct. 28.—He works out a theory similar to that of Vosmaer and Ortt, the truth of which is said to appear obvious and palpable at first sight. He supposes that Röntgen rays are discharged cathode particles; they are therefore not deflected by a magnet; after striking the anticathode and discharging themselves they are reflected in a diffused manner and penetrate the walls of the tube. These particles must be much smaller than the electro-chemical ions. That Roentgen rays have a penetrating power is due to their electric neutrality; a copper bullet, for instance, could penetrate a forest of magnets easier than an iron bullet.

CURRENTS GENERATED BY ROENTGEN RAYS. Winkelmann. "Wied. Ann.," No. 9; abstracted briefly in Lond. Elec.," Oct. 28, and "Am. Jour. of Sc.," Nov.—He studied the property discovered by Perrin, that differences of potential are produced between two different metals when exposed to X-rays; a small constant current was observed.

RECOVERY OF ROENTGEN RAY TUBES. Machado. "Comptes Rendus," 126, p. 1341; noticed briefly in "Science Abstracts," Sept.—He wraps the tubes surrounding the stem of the cathode with a flexible metallic sheet of tin, lead or platinum, or surrounds it with an insulated coil of copper wires. With this arrangement it is claimed that exhausted tubes recover in a few seconds. No further description is given in the abstract.

ROENTGEN RAYS. Roentgen. "Ann. Phys. Chem.," 1, p. 18; abstracted at considerable length in "Science Abstracts," Sept.—This appears to be the same paper as was abstracted in the "Digest" a number of months ago.

LUMINESCENT LAMPS. Wiedemann. "Wied. Ann.," No. 9; abstracted briefly in the Lond. "Elec.," Oct. 28.—Before concluding that the luminescent lamp is the light of the future, it should be determined what the expenditure of energy is for producing this pure light. He therefore determined both the heating and the lighting of a luminescent screen by the impact of cathode rays. He found that the heating accompanying a brightness of one candle was about 1 gr. calorie per second, which means that only about 5 or 7 per cent. of the incident energy is converted into light. In the Puluj lamp the heating per candle power was 3 watts, which is very nearly that in the ordinary incandescent lamps.

VACUUM TUBES VS. COHERERS. Righi. "Nuovo Cimento," July; abstracted in the Lond. "Elec.," Oct. 28.—He describes a vacuum tube which he invented and which seriously rivals the coherer for detecting waves. The details are not given, as they are said to be too complicated; the tube shows a continuous streak of light, which breaks up under the influence of electric waves into positive strata, dark spaces, and cathode light; the cathode is a wire and the anode a disc; the conditions are resumed after the radiations cease; the effect is also produced when the radiation impinges on some portion of the circuit not too far away from the tube. Besides the optical phenomenon there is also a change of resistance, the current often increasing three times when the tube lights up. It has the advantage not to require a special mechanism for restoring the original resistance.

HERTZIAN WAVES. Holzmueller. "Elec. Rundschau," Oct. 15.—The beginning of a reprint of a long paper on the nature of Hertzian waves. It is not elementary in character.

CONTACT ELECTRICITY. Murray. "Roy. Soc. Proc.," 63, p. 113; abstracted at some length in "Science Abstracts," Sept.—An experimental investigation to elucidate and measure the variation of contact electricity due to changes in the state of that portion of the surface of each conductor which was separated from the other by an insulating medium.

ALTERNATING-CURRENT CALCULATIONS. — Lond. "El'ty," Oct. 28.—The first of a series of articles on the arithmetic of alternating-current distribution in the form of problems and their solution. The graphical method will be used largely, and a knowledge of the ultimate principles of working is supposed.

TWO PHYSICAL HYPOTHESES.—"L'Ind. Elec.," Oct. 25.—A brief criticism by Brylinski of the recent paper by Juppont (see "Digest" Nov. 5). He claims that the first hypothesis is based on an error of definition, and that the second one is also based on an error. This is followed by a long reply by Juppont, in which he gives a supplementary explanation. In an editorial note it is claimed that the differences are due chiefly to a confusion between physical magnitudes and the units which serve to measure them.

LIGHT FROM ELECTRODES IN ELECTROLYTES. Braun. "Wied. Ann.," May; abstracted in "L'Eclairage Elec.," Oct. 22.—When an alternating current is passed through an aluminum electrode in sulphuric acid a phosphorescent light is produced at the electrode; this he investigates.

CONDUCTIVITY AND DISSOCIATION. Noyes. "Zeit. Phys. Chem.," 26, p. 699; abstracted briefly in the "Zeit. f. Elektrochemie," Oct. 27.—A criticism of the claim of Van Laar that the measurements of conductivity are not a good means of measuring the electrolytic dissociation; the present writer claims they are.

THE MOHEGAN DISASTER AND MAGNETIC DISTURBANCES. Ruecker. Lond. "Elec." and "Elec. Rev.," Oct. 28.—A few notes from a daily paper in reply to the suggestion that the wreck of this steamer may have been due to local deviation of the compass. He states that such deviations are more likely to occur on land near the disturbing cause than at sea, where they must be separated by a greater distance. It is not impossible that the compass of a ship in relatively deep water might have been appreciably affected for a distance of 3 or 4 miles by a concealed centre of magnetic disturbance; one such case is cited. As no disturbance on land was noticed in this case, it is not likely that this was the cause.

MAGNETIC HYSTERESIS. Neithammer. "Wied. Ann.," No. 9; abstracted briefly in Lond. "Elec.," Oct. 28.—An abstract of an article which appears to be the same as the one already noticed in the "Digest" Oct. 29 and Nov. 5.

RELATION BETWEEN STRUCTURAL AND MAGNETO-OPTIC ROTATION. Wright and Kreider. "Am. Jour. of Sc.," Nov.—They investigated experimentally "whether, if the optically active molecular structure or aggregation were affected in a magnetic field, it would be influenced thereby to an extent sufficient to show in its final optical properties, which would seem probable, providing the interatomic or intramolecular forces are electrodynamic." The results show no marked and indisputable evidence of the influence of the magnetic field upon actively optical structure, but they seem to indicate a disturbance of the equilibrium by the magnetic field.

CHANGING CATHODE RAYS INTO LIGHT. Wiedemann. "Wied. Ann.," 9, p. 61; noticed briefly in the "Am. Jour. of Sc.," Nov.—He measured the proportion of energy of the cathode rays which is converted into light rays, and found that this proportion was of the same order as that in the case of photo-luminescence, and is very small. (This is apparently the same article as the one noticed above.)

RESISTANCE OF IRON WIRES. Merritt. "Elec. Eng.," Nov. 10.—A very brief abstract of his A. A. A. S. paper. He gives the results of measurements made by Denio of a number of different iron wires, so as to determine their resistance with alternating currents of 135 pounds, and with direct currents. For small currents the resistance was the same, but as the current increased that offered to alternating currents became greater, reaching a maximum; the greatest was usually about three times the normal; for very heavy currents the resistance again decreased, owing probably to the partial saturation of the outer layers of the iron.

A. A. A. S. MEETING.—"Science," Oct. 31.—Titles of the papers at this meeting, with brief abstracts of some of them. Quite a number of the papers are on electrical subjects; they are too numerous to be noticed here separately. In one on hysteresis by Thiessen he showed that the hysteresis loss for constant magnetizing fields increases with the temperature if the field is weak, but the opposite is the case when the iron is nearly saturated. In one on determinations of dielectric strength by Gray he showed that the dielectric strength of air is the same for alternating currents of ordinary frequency as it is for static charges. In one on polarization in the zinc, zinc-sulphate cell, by Anthony, he shows that what is called polarization is not due to the accumulation of hydrogen, but to the fact that the hydrogen originally dissolved in the acid and condensed on the plates has been used up. In one on the electrical resistance of lead amalgams at low temperatures by Gressman he shows among other things that there is a sudden decrease of resist- [illegible]

SILICON AND MAGNETIC PERMEABILITY. Caldwell. "Science," Oct. 31.—A brief notice of his A. A. A. S. paper, in which he shows that the permeability increases with the amount of silicon present in the iron.

Electro-Chemistry and Batteries.

[illegible] Lond. "Elec. Rev.," Oct. 28.—A short article. He believes the electrolytic refining of nickel will be as important in the nickel industry as that of copper is in its industry. Foerster, in an article recently noticed [illegible] Germany and the other in Russia, who are producing electrolytic [illegible]

process (see "Digest" Nov. 12 and 5). According to Kershaw's description, the idea of using fatty rubber is now abandoned; but the process of burnishing with soft rubber was patented years ago. It appears to have been found necessary now to exclude all fat and grease from the sheepskin rubbers; in France the Elmore process is now very remunerative and is a great success, as the profit last year was over a quarter of a million of dollars, while this year it will be much larger; this was due to a sufficient working capital.

CARBIDE FURNACE. Memmo system. "Zeit. f. Elektrochemie," Oct. 27.—An illustrated description of this furnace.

IMPURITIES OF CALCIUM CARBIDE. Moissan. "L'Eclairage Elec.," Oct. 22.—A reprint of an Academy paper.

RAPID-CHARGING CURVES FOR ACCUMULATORS. Girault. "L'Ind. Elec.," Oct. 25.—An article in which he deduces mathematically an equation which gives the value of the current when Planté accumulators are charged rapidly from a source of constant voltage. The equation is in the following form: The current at any given time is equal to a constant plus a coefficient multiplied by the voltage raised to a negative power, the index being a constant multiplied by the time; the algebraic values for these constants are given; they contain such factors as the active surface of the positive plate, and that of the peroxide before and during the charge. It applies to any voltage, provided it is not too great. He then applies it to a Blot accumulator, giving the results of the calculated and observed values; these curves seem to agree remarkably well with each other.

ACTION OF ACCUMULATORS. Hoppe. "Elec. Rundschau," Oct. 15.—He discusses the theory in connection with the van't Hoff and Arrhenius theories. He concludes that the accumulator is a true reversible cell which should operate without loss if it were possible to obviate the concentration currents. In order to increase the efficiency of accumulators one should therefore give attention to the differences of concentration, as all other methods will be of no avail.

Units, Measurements and Instruments.

GALVANOMETER COILS. Fabry. "L'Eclairage Elec.," Oct. 22.—An article on the magnetic field at the centre of a cylindrical coil and the construction of coils for galvanometers. In constructing such coils it is necessary to calculate the proportions which under given conditions will give in the central portion the most intense magnetic field. The solution afforded by Lord Kelvin is not satisfactory, and the present writer solves the problem in a more direct way. He assumes a cylindrical coil wound with uniform wire and calculates tables and curves which enable one to find rapidly the value of the magnetic field and therefore to find the most favorable conditions for producing the maximum field. The author assumes the interior diameter to be given; the best results will be obtained by making the external diameter 3.09 times, and the length 1.88 times the internal diameter. But without affecting the intensity of the field appreciably one can depart considerably from these dimensions, assuming, however, that in each case the cross-section of the wire is so chosen that the resistance has the desired value, namely, equal to that of the external circuit. It is an advantage to use wires of successively larger diameters for the outer layers, as in this way the constant of the coil may be increased about 60 per cent.

MEASURING ENERGY IN THREE AND FIVE WIRE CIRCUITS. Bary. "L'Ind. Elec.," Oct. 25.—A short article in which he gives briefly the approximate formula for the power in five-wire circuits based on the assumption that the voltage is the same on all four branches, but that the total voltage may vary; in that case the power is equal to the mean voltage—that is, one-fourth of the total—multiplied by the sum of the following currents: Twice the first, plus the second, plus the fourth, plus twice the fifth, referring to the currents in each of the five wires. In a meter, therefore, the windings which carry the currents in the outside wires should be double those for the currents in the intermediate circuits, and there is no winding for the middle wire. The formula is not quite correct and the error is always to the disadvantage of the consumer; this he shows. The plants should therefore be so arranged that the currents in the intermediate wires are practically negligible. In the three-wire system the error becomes greater the smaller the neutral wire.

EFFECTS IN SUBMARINE CABLES.—Lond. "Elec. Rev.," Oct. 28.—An abstract of the article by Murphy (see "Digest," Oct. [illegible] It is claimed that Schaefer not only did not disprove the strict accuracy of Kennelly's law, but results [illegible] to establish the law; moreover, the values of [illegible] calculated by Schaefer's formula are often more exact without the correction mentioned by Murphy.

SIMPLE MEASURING INSTRUMENTS. Child. "Amer. Elec.," Nov.—Illustrated description of simple forms of volt, ampere and watt meters.

Telegraphy, Telephony and Signals.

ELECTRIC BELLS. Hall. Lond. "Elec. Rev.," Oct. 28. [illegible] one blow on closing the circuit and another on opening; there is no circuit-breaker, but a device for continuous ringing is briefly described; it is wound up and is at the push-button end.

TELEGRAPHS AND TELEPHONES IN PERSIA.—"Jour. of Soc. of Arts," reprinted in Lond. "Elec.," Oct. 28.—A short account of their development and present state.

AMERICAN TELEPHONE PRACTICE. Miller. "Amer. Elec.," Nov.—In this continuation of his serial he gives illustrated descriptions of a number of protective devices.

SUBMARINE TELEGRAPH CABLES. Webb. "Elec. Eng.," Nov. 10.—A long review of the recent large work by Bright, and including numerous interesting abstracts from it concerning the history, the construction and the working of submarine cables.

Miscellaneous.

ELECTRIC HEATER. Reyval. "L'Eclairage Elec.," Oct. 22.—An illustrated description of the Le Roy system. For the heating material he uses what he calls a "log" (Fr. buche) or rod made of agglomerated silicon as pure as possible. It is contained in a glass tube and the ends are provided with suitable terminals, so that these tubes can readily be inserted in spring clamps, which act as terminals; the tubes are exhausted. The temperature of the rod is about 700° to 800° C.; the oxidation of the material is prevented by the exhaustion of the air. The advantages claimed are that it replaces very long and fine wires, as its resistance is very high; the resistivity is about 1400 times that of carbon and more than 200,000 times that of German silver. For the same amount of energy, therefore, its length may be made less and the cross-section greater than that of a wire or carbon, thus making a more practical form of apparatus; the quantity of energy per unit of surface is much greater. Several forms of apparatus are described.

ELECTRICITY AND RHEUMATISM.—"L'Elec.," Oct. 29.—A note stating that Dr. Lindermann, at a recent medical congress, stated that he had made a number of cures of very severe cases by the use of the dry heat from an electric heater. The heat is produced in a closed vessel into which the affected member is placed, the temperature being increased up to 150° C. The worst cases require a dozen treatments.

PARIS EXPOSITION.—"L'Elec.," Oct. 29.—A brief description of the water castle and luminous fountains which are to form one of the attractive features at this exposition.

CURRENT STRENGTH OF LIGHTNING. Wurts. "Elec. Eng.," Oct. 27.—A short article on some recent observations in the Catskills. In one case the lightning struck a tree 200 feet from a hotel, passed down part way, then jumped to a telephone wire, setting the booth on fire, and finally grounded through a gas pipe, although the hotel was well protected by lightning rods; the current was not sufficient to melt the telephone line wire; he estimates that the current strength was at least hundreds, if not thousands, of amperes; one of the remarkable features is that it should leave the tree and pass through several hundred feet of horizontal iron wire and jump through air spaces instead of following the lightning rods. Another stroke passed part way down a tree, but then jumped to a neighboring fence post to ground in preference to passing through the roots.

LIGHTNING STROKE.—"Elec. Eng.," Oct. 27.—A photograph of a lightning stroke, showing some peculiar effects, which are discussed by Prof. E. Thomson. The lines appear blurred in a certain direction, and he believes this was produced by a motion of the camera. He considers it a common mistake to assume that a lightning discharge occupies an exceedingly brief time, and cites cases in which a trail was left in the air for a few seconds, long enough to be shifted and distorted by the wind; moreover, lightning discharges repeat themselves sometimes with great rapidity along the same path. He believes it a mistake to suppose that all lightning discharges are of the nature of very high frequency currents; some doubtless are, but it is probable that the oscillations are sometimes slow, sometimes fast, or that there are no oscillations at all.

PARIS EXPOSITION.—"Elec. Eng.," Oct. 27.—An illustrated article showing views of the grounds, giving the classification of the exhibits and other similar information.

ELECTRIC SIREN.—"Amer. Elec.," Nov.—A short article calling attention to the great inefficiency of whistles and suggesting a more economical substitute for plants, in which a motor and an air compressor are used for operating a whistle or siren. If a thin sheet of iron be placed over an alternating-current magnet a most piercing, penetrating noise will be emitted, which can be heard for miles, especially if provided with a device of the megaphone character. It would be very much lighter than the electric compresser, would not be less efficient, and has the advantage that it may be controlled from a distance.

ELECTRICAL PARADOX. Blake. "Amer. Elec.," Nov.—If a battery having 1.5 volts be connected to a conductor carrying a large current, at two points between which the drop of potential is 1 volt, but of opposite polarity to the terminals of the battery, then it will appear that the main current would be stopped by the small battery because it is impossible to have two currents in opposite directions in the same wire. If this is true it would also be true for a much smaller battery applied to points nearer together. He admits that the result cannot be credited.

The Inductor Alternators of the Royal Electric Company.

A new competitor in the manufacture of alternating current generators has entered the lists in the Royal Electric Company, of Peoria, Ill. This company has designed a line of inductor machines, well enclosed by the cast-iron of the stationary armature and with a graceful and pleasing contour. The machine is of the central-fixed concentric field-coil type, with two rings of outwardly projecting steel poles, one polarity to either side of the field winding, throwing out the lines of force radially to two inwardly projecting rings of laminated armature teeth wound as usual, with machine-formed coils fastened in the slots by keystone-shaped wedges. The armature coils are attached to each other with connectors, and any one or more may be, of course, promptly cut out in case of trouble. The terminal panel on the side of the machine is fitted with a cover to prevent accidental exposure to the high-voltage terminals. The regulation is stated to be within 2 to 5 per cent., depending on the size of the dynamo. The machines before shipment are subjected to a high insulation breakdown test, those for 1000 and 2000 volts being tested for five times their normal voltage, respectively.

A New Binding Post.

The following illustrations show a new binding post which is manufactured by the Williams Electric Company, Cleveland, Ohio, under patent owned by the company, and applied to its double and single pole receivers and the magneto bells.

Fig. 1 is an elevation in one direction. Fig. 2 is the cross sectional in showing how the binding post is applied to the cabinet work of the magneto bells.

The body or base piece of the binding post is formed from spring sheet Craig silver, and has turned up from the same piece of metal two spring slips, *s*, which form a saddle or rest for the receiver-cord tip, *t*. Screw *b* on being rotated in the right-hand direction screws through the nut until one side of the screw head grips the receiver-cord tip *t*, and on further rotation the screw locks the connection, screw *b* forces down the spring saddle *s* by spreading the limbs slightly outwardly until the screw engages the upwardly-turned flange or base piece *p*, and in this manner forms a perfect spring lock for the receiver-cord tip.

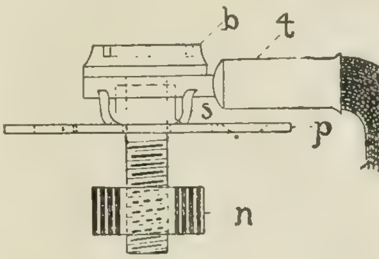


FIG. 1.

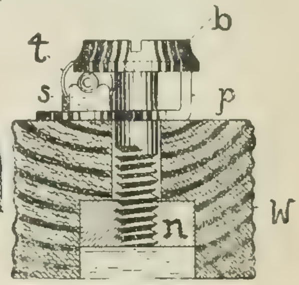


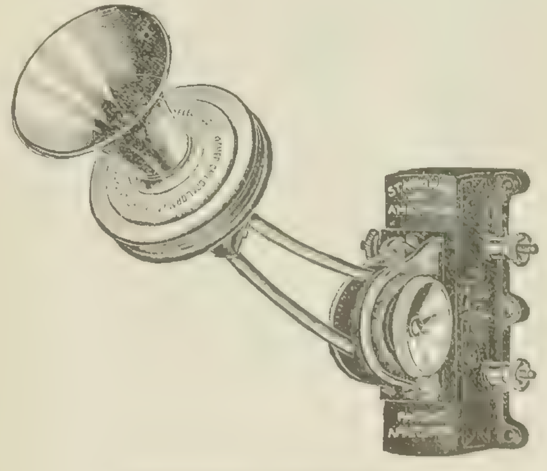
FIG. 2.

Fig. 1 shows the binding post just after the screw head has engaged the receiver-cord tip. Fig. 2 shows the binding post after screw *b* is forced down until it engages flange *p*; resistance is offered to the movement of the cord tip in either direction by the tendency of either one of the limbs to straighten up and grip the cord tip still tighter.

An Improved Adjustable Telephone Arm.

The Schmidt & Bruckner Electric Company, New York City, is now placing upon the market a new style of adjustable telephone arm, which embodies several new departures from the ordinary black enameled arm.

The principal objection of the standard arm is the cord adjustment on the side. This has been the bugbear of many a telephone inspector on account of the liability to broken and poor connections. The inartistic appearance of the arm has also caused much contention. The Schmidt & Bruckner Electric Company has constructed and applied for a patent on an arm that overcomes the above-named objections, and combines, it is claimed, excellence in electrical and mechanical design with an unequalled handsome appearance.



ADJUSTABLE TELEPHONE ARM.

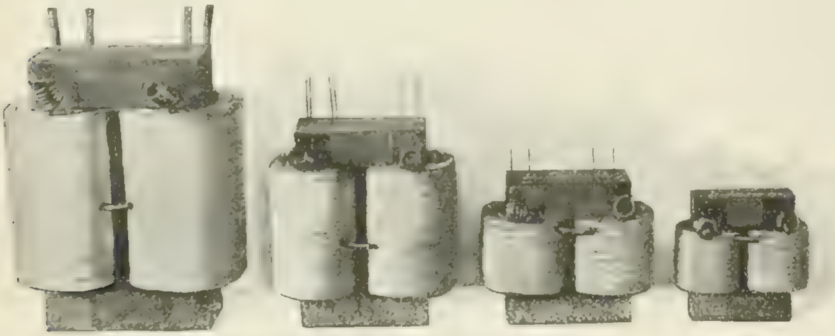
Two strong steel rods connect the transmitter with the base and serve as conductors for the two sides of the circuit. At the base these rods are set in a hard-rubber socket, and connect with springs on the inside of the socket. These springs are of phosphor bronze, V-shaped and make rubbing contacts with the side flanges, and thereby allow for full play of the arm. A heavy finger nut of special make regulates the pressure of the springs and tension of the arm. The flanges are fastened to a block of hard rubber on the front of the coil box, and thus are insulated from each other. In the base is set a specially wound coil easily removed when repairs are necessary.

The transmitter is of the American coal-grain pattern, and may be detached from the arm by the removal of one screw. All parts, in fact, are distinct in themselves, and may each be removed separately.

This arm the company claims is a distinct advantage over other forms of arms, as it materially cheapens and quickens repairs.

A New Line of Transformers.

The Lakon Company, of Elkhart, Ind., has just published a booklet in which is described a new line of transformers recently placed upon the market by this company. These transformers are of the oil type, and although they may be used without oil the company strongly advises the use of oil in all sizes, since it aids in the dissipation of heat and prevents the deterioration of insulation due to high temperatures. A pair of very strong and simple all-porcelain fuse boxes is furnished with each transformer. The method of hanging is very simple. The light Lakon hanging hook can be held in position, and lag screws and bolts put in place by one man, and when the transformer is raised to be hung upon the hook it can be swung into any position and quickly and easily lowered into the hanging hook.


7½, 4, 1½ and ½ Kw Transformers.

A transformer having a high full-load efficiency will not necessarily have a high all-day efficiency, and it is the all-day efficiency which is important. In order to secure such an efficiency, these transformers have been designed for a very low core loss, and good regulation is secured by a simple arrangement of the windings and a liberal use of copper. The primary and secondary cables are brought out on opposite sides of the case through heavy porcelain bushings, and are firmly cemented into the porcelains so that there will be no chafing or wearing away of the insulation where the cables come through the case.

The aging of the iron has been investigated by this company, and it will replace within two years any transformer that shows any marked change in efficiency due to this cause.

In the Lakon transformer the coils are so arranged that a very large surface of copper is exposed to the oil so that the temperature is kept down to a very low degree.

The transformers are designed to withstand a high breakdown test between the primary and secondary and between primary and core. While a very high insulation between primary and secondary is a safeguard against burn-outs [illegible]

[illegible] Hanging Device.

[illegible]

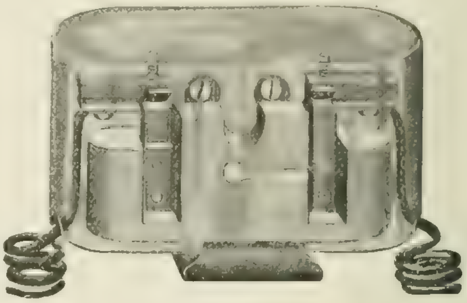
The ground shields will prevent the lightning discharge from appearing on the secondary circuit, but it is not a protection to the transformer.

The company manufactures transformers for alternating-current arc lamps, step-up and step-down transformers and transformers for special purposes, such as electro-cautery, electric welding or testing purposes.

A Power Circuit Arc Lamp.

Following next in the line of enclosed arc lamps developed by the General Electric Company a substantial, simple and efficient power circuit lamp has been perfected for use two in series on 220-volt circuits, or five in series on 500-volt circuits. It is manufactured in both single and double globe types.

To conform to insurance regulations covering the use of arc lamps on high voltage circuits a safe, positive and reliable cut-out is incorporated in the lamp, together with an extra set of resistance coils. Should the carbons stick or the lamp for any reason fail to operate, the cut-out sends the current through these subsidiary resistance coils instead of through the carbons, without detriment to the lamp. The efficiency of this cut-out has been demonstrated by cutting out lamps in circuit and allowing them to remain cut out for several consecutive hours, without resultant injury either to coils or lamp. The carbon is fed by a double-cam clutch, smooth and positive in action. An adjustable resistance in the upper part of the lamp allows it to be employed two in series on circuits of 200 to 240 volts or five in series on circuits of 500 to 600 volts. With one 12-inch positive and one 5½-inch negative one-half inch carbons it burns after one trimming for from 130 to 150 hours, and after the run the remainder of the positive carbon can be used in the lower carbon holder for a second run of equal duration. The current required is five amperes.


Transformer Fuse Box.

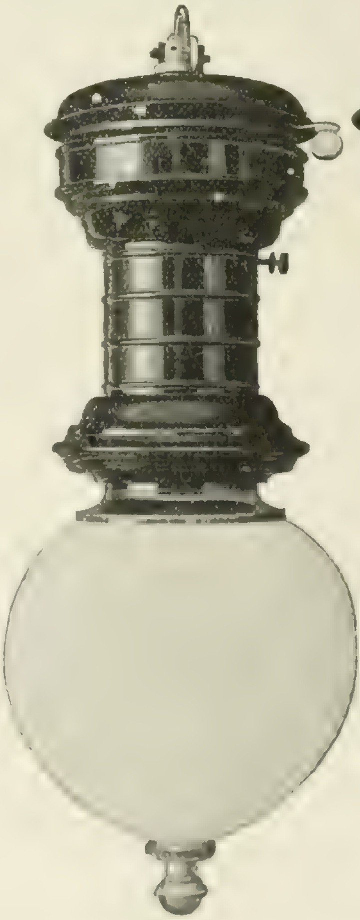


Fig. 1.

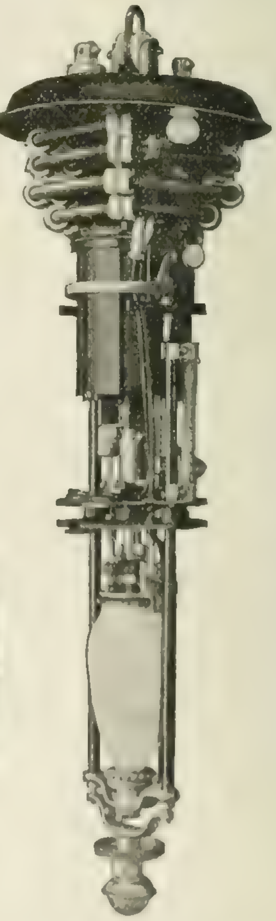
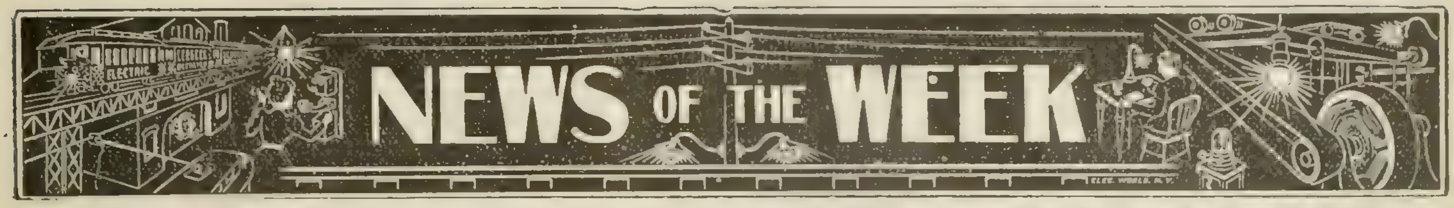


Fig. 2.

The lamp is furnished with the globe lowering device, which, it is stated, has been fitted to [illegible] General Electric enclosed arc lamps, and which permits the globe to be lowered gently by merely turning a milled thumb screw at the side of the casing. Power circuit lamps are furnished in weatherproof [illegible]. Fig. 1 shows the weatherproof casing and Fig. 2 the internal mechanism.


ELEC. WORLD, N.Y.

NEWS OF THE WEEK

Special Correspondence.

NEW YORK NOTES.

THE NEW YORK ELECTRICAL SOCIETY.—At the next meeting of this society, which will be held at the College of the City of New York, Lexington Avenue and Twenty-third Street, at 8 P. M., November 17, Mr. E. H. Johnson will lecture on "Surface Contact Railways, with Special Reference to the Johnson-Lundell System."

MR. JOHN T. McKEEVER, JR., was a member of the committee of arrangements for the theatre party referred to in THE ELECTRICAL WORLD of November 5, and is also a member of the permanent committee appointed to look after similar affairs in the future. His name was inadvertently omitted from the committee membership list published in the issue referred to. He did excellent work on the committee.

MESSRS. H. B. COHO & CO. have given up their quarters at 30 Cortlandt Street, New York. Mr. Coho has opened an office at 143 Liberty Street, where he will act as New York manager of the Eddy Electric & Manufacturing Company, of Windsor, Conn. The affairs of H. B. Coho & Co. are in a rather complicated condition, and a meeting of creditors has been called to determine the future of the business.

TECHNISCHER VEREIN VON NEW YORK.—The regular monthly meeting of the Technical Society of New York was held Saturday evening, November 12, at the headquarters in Congress Hall, 192 Third Avenue. The paper of the evening was one presented by C. G. Buchanan, entitled "Zerkleinerung und Magnetische Reinigung von Erzen"—"The Pulverization and Magnetic Concentration of Ores."

BROOKLYN ELEVATED PROPERTIES SOLD.—On Thursday of last week were sold under foreclosure proceedings to Mr. F. B. Olcott, the Brooklyn Elevated Railroad, the Union Elevated Railroad and the Brooklyn Bridge & Seaside Elevated Railroad. Mr. Olcott is president of the Central Trust Company and chairman of the committee having in charge the reorganization of the railroads named. The proceedings were taken on behalf of the Central Trust Company. Mr. Olcott made one bid on each of the roads as follows: The Brooklyn, $1,750,000; the Union, $3,075,000, and the Seaside, $682,500. The consolidated company will be known as the Brooklyn Union Elevated Railroad Company, and it is stated that Mr. Frederick Uhlmann, the present receiver of the three roads, will be elected president of the reorganized company.

THE ELEVATED ROAD'S LOST BUSINESS.—The annual report of the Manhattan Elevated Railroad Company, while not having any direct bearing on electrical interests, is peculiarly interesting to electric railway people as showing the effect of improved street surface transit upon the business of the elevated road. The gross earnings (the report covers the year ended September 30 last) as compared with those for the previous year show a loss of $155,266, and the net earnings decreased $93,916. Apart from the financial aspect of the report the most significant feature is the decrease in the number of passengers carried, the loss being 3,556,500. This, however, probably does not represent the actual loss, because the aggregate number of passengers carried on all lines is rapidly increasing from year to year, and if the company had held its own against the competing surface roads the number of passengers carried would not have been the number carried in 1897, plus the 3,556,500 lost this year, but an increase over this sum, representing the company's share of the increased business. Of course, the surface lines got all of the additional business, besides that lost by the elevated road. The latter concern has been showing negative results ever since the underground system was laid down on the surface roads, and there is no reason to doubt that the losses will continue in an increasing ratio as the new electric surface lines are opened up. It is evident that radical improvements over existing methods of operation will have to be introduced in order to meet the advantages offered by the surface lines in convenience of access to the cars and speed. The adoption of electric power on the elevated road and quicker transit between stations would, partially at least, retrieve the lost business.

THE NEW ELECTRIC LIGHT, HEAT & POWER COMPANY.—If rumors indicate anything progress in the affairs of the recently organized New York Gas, Electric Light, Heat & Power Company is keeping apace, and if the company is as busy as the various reports would seem to indicate electric lighting interests in Greater New York are soon to lose their present identities and become constituent elements of one vast organization. THE ELECTRICAL WORLD has kept its readers informed as to developments in connection with this new enterprise, as interpreted from the standpoint of the interested outsider, and as time passes and new theories of the company's plans arise it is likely that the truth is being gradually approached in one direction or another. One of the latest reports anent the situation is that the electric lighting companies in Greater New York, with one or two exceptions, have now passed or are rapidly passing into the control of a single syndicate. According to this story the Mount Morris Electric Light Company has just been acquired. It is pointed out that in view of the purpose and ability of the electric traction companies of Greater New York to manufacture and sell surplus power the possibilities for electric lighting are greater now than ever before. In this connection it is interesting to note the report that the Metropolitan Street Railway Company has made an arrangement with the Consolidated Telegraph & Electrical Subway Company whereby the latter concern shall have the use of the ducts now being laid by the railway company. The fact has been pointed out in these columns that the Metropolitan Street Railway Company in advancing its new electric work is laying a large number of ducts, apparently far in excess of its own requirements. Whether the report last referred to be true or not it certainly has the appearance of a reasonable explanation for the use of so many ducts. The Third Avenue Railroad Company is also preparing to lay a large number of ducts in connection with the reconstruction of its lines to the underground conduit system. This matter was more particularly referred to in the last issue of THE ELECTRICAL WORLD. If, as reported, the Metropolitan Company, has rented or leased its surplus ducts to the Subway Company, the Third Avenue Company, too, will probably have ducts to rent.

THE PEOPLE'S TELEPHONE CORPORATION OF NEW YORK is soliciting orders for its service. Its message service rates, as shown on the order blanks, are as follows:

No. Messages.	Rate.	Additional Messages.
*300	$22.50	10c.
400	30.00	9c.
500	37.00	8c.
600	43.00	7c.
700	48.00	6c.
800	52.00	5c.
900	56.00	4c.

*Residence only.

All instruments installed under the order are to be efficient, long-distance telephones on metallic circuits, connected with the central office or exchange by private wires; extension telephones on the same line and within the same building will be furnished at $1 per month, and the schedule rate for calls, no charge being made for installation; original installation without cost to the subscriber. The order covers a period of five years, during which time the company agrees that it will not increase the charge to subscribers for telephone service. The company agrees to maintain uninterrupted service (accidents, the elements and action of the authorities excepted), and to allow subscribers pro-rata rebate for all interruptions exceeding forty-eight hours, after notice in writing. Among the inducements offered the company promises a superior system, rapid service, new instruments and first-class modern equipment throughout; a charge of $100 per year for unlimited service, with 100 free coupons good for use at any pay station; an arrangement with message service subscribers by which they receive a liberal division of pay-station tolls; a private line residence service as low as $30 per year; a group-line residence service, unlimited calls, at $1 per month. A statement of the benefits of a five-year order for unlimited service is given. It shows a cost in that time of $450, after deducting the value of 500 coupons at 10 cents each. This, the statement represents, means a saving of $750 to the subscriber for five years' service, as compared with the charge made by the existing company for similar service.

NEW ENGLAND NOTES.

THE ANNUAL MEETING of the West End Street Railway Company will be held in Boston on November 22.

MR. J. H. HALLBERG is the designer of the handsome line of lamps now on exhibition by the Standard Thermometer & Electric Company at the Mechanic Fair in Boston. In the issue of November 12 it was stated that these lamps were designed by Mr. Upton. Mr. Upton writes to say that this is not the fact, and that the lamps were all designed by Mr. Hallberg, the electrician of the company.

MOTOR-CARRIAGE CONTESTS.—An interesting competition between various types of motor carriages took place at the Charles River Park, Cambridge, on the afternoon of November 9, under the auspices of the Massachusetts Charitable Mechanic Association. Prizes to the value of $1100 were offered by the management, and a large number of people witnessed the novel spectacle, which certainly proved to be a very interesting attraction. The various carriages paraded from the Mechanics Building to the park and then around the circuit of the track, passing in review before the spectators. In the parade were vehicles representing the electric, steam and gasoline methods of propulsion. The first event was the speed contest, a two-mile pursuit race. No electrical vehicles took part in this race, which was won by the De Dion gasoline tricycle in 5 minutes and 1 2-5 seconds; the Whitney steam carriage came in second. In the brake-efficiency contest the Riker electric carriage, made by the Riker Electric Motor Company, of Brooklyn, took the first prize, stopping at 6 feet 1 inch, the Haynes gasoline carriage taking second prize. The next contest was as to manageability, and was won by the De Dion tricycle. The Riker electric carriage, which was 4 feet 8 inches wide, did some excellent work in this contest. The severest test of all was the hill-climbing contest, the Stanley steam carriage leading, followed by the Whitney steam carriage. The Riker electric carriage reached over 62 feet in three trials, the Stanley steam carriage making but one trial on a rush, and covering a distance of 80 feet in 4 3-5 seconds. The prizes will be awarded and announced later.

PHILADELPHIA NOTES.

MR. C. W. KENNEDY, who, jointly with Messrs. Frank A. Pocock and Ralph Ashley, invented an electric vehicle which was exhibited at the Philadelphia Electrical Exhibition last June, is fitting up a factory at 3728 and 3730 Mt. Vernon street, this city, where electric carriages, delivery wagons and launches will be manufactured. An illustrated description of this vehicle was published in The Electrical World of June 25, among the notes of the electrical exhibition.

THE FRANKLIN ELECTRIC SUPPLY HOUSE, 506-508 Cuthbert Street, Philadelphia, of which Mr. H. P. Feister is proprietor, is sending out to the trade a card expressing thanks for the liberal patronage extended to this new concern, which was started on July 1 last. The enterprise was launched with a "few wagonloads of goods," and the business has grown to such an extent in this short time that there is but little in the electrical line that this house cannot supply. It has made arrangements with the best manufacturers for the sale of their products.

FRANKLIN INSTITUTE.—At the stated meeting of the chemical section of the Franklin Institute, held on the evening of November 16, Mr. George D. Burton, of Boston, read a paper on "The Burton Electric Process of Unhairing and Tanning Skins." The process was exhibited in practical operation at the meeting. On the evening of November 22 Mr. A. J. Wurts will read a paper before the electrical section on the subject of "Lightning and Lightning Arresters," and will make experimental demonstrations, and before the same section, on the evening of December 13, Prof. Arthur J. Rowland will read a paper on "Commercial Photometers and Light Standards."

THE ANNUAL MEETING of the Electrical Trades Association was held on the evening of November 4 at Soulas' Café in this city. An excellent bill of fare was served, and an enjoyable and profitable time was spent by those who were present. The entertainment included vocal and instrumental music, and remarks were made by several gentlemen. The old officers were unanimously re-elected, as follows: Charles E. Trump, of the Novelty Electric Company, president; C. M. Wilkins, of Partrick, Carter & Wilkins, vice-president; W. H. Hollar, secretary and treasurer; Miss E. A. Symms, assistant secretary; Frank D. Sweeten, A. Bournonville and H. G. Kepler, executive committee. Other gentlemen present at the meeting and dinner were: E. W. Wilkins, of Partrick, Carter & Wilkins; G. A. and G. W. Vallee, of Vallee Brothers & Co.; H. C. Roberts, of the H. C. Roberts Electric Supply Company; George F. Klemm, of Klemm & Co.; Frank H. Stewart, of Frank H. Stewart & Co.; I. C. Walker, of Walker & Kepler; L. P. Clark, of L. P. Clark & Co.; Winford Lewis, of the Novelty Electric Company, all of Philadelphia, and A. N. Palmer, of A. N. Palmer & Co., Baltimore.

"THE STATUS OF ELECTRICAL INVENTION" was the title of a paper read before the electrical section of the Franklin Institute on November 8, by Mr. William A. Rosenbaum, patent solicitor, of New York. The speaker treated the question somewhat from the standpoint of the patent lawyer in that he adapted the technical meaning of the word "invention" instead of its popular meaning. Each of the main branches of the science of electricity was taken up in turn, and the inventions therein referred to and described which have been responsible for, or have directed the lines of, its development. Thus, in the building up of a branch of the art, certain inventions appear from time to time, from which spring new lines of development or improvement, and these, which the speaker termed the "milestones in the progress of invention," were briefly described and the proper places in the art located. This material will no doubt be useful to future investigators. The paper closed with the prophecy that, "wireless" telegraphy now being a fact, we shall ere long be able to telephone without wires, have electric lights without wires, ride in electric cars propelled by electricity delivered thereto from a stationary dynamo without connecting wires, and transmit electric power, in general, without wires.

BUFFALO AND NIAGARA FALLS NOTES.

IT IS EXPECTED that the new electric power house in Buffalo to be used for lighting the city will be started up in a small way during the week. Probably a single arc-light circuit will be tried at the start.

THE NIAGARA power current is reported to have weakened at Lockport one day this week, so that the cars and lights threatened to wait a while, but without explanation the current resumed full force after a little time. It is reported that something went wrong at the power house end of the line, although there was no interruption in Buffalo. In fact, this line has been operated practically without trouble since the time it was inaugurated.

THE ENTIRE PLANT of the Niagara Power Company's system, from the discharge of the tail-race of the wheel-pit to the further extremity of the wires, is said to have cost about $7,000,000. The 50,000 horse-power reported to be now [illegible] power being used in the operation of new factories and trolley plants. This [illegible]

[illegible] subways for the burying of its wire service in the city. [illegible]

CHICAGO NOTE.

[illegible]

can War, with Handy Atlas Maps," and now extends a cordial invitation to those handling or using American Circular Loom flexible conduit, Boston Electroduct steel tube, Gordon or Law primary batteries, Welsbach or New Era electric gas lighters or Standard knife switches to call at his office and secure a copy of this excellent work.

ST. LOUIS NOTES.

REMOVING POLES FROM THE STREETS.—The Missouri Edison Electric Company has a force of men at work removing 1500 poles from the streets of St. Louis. All trace of the old overhead wires of the company will soon be removed.

PROPOSED MUNICIPAL ELECTRIC LIGHT PLANT.—It is probable that the Board of Public Improvements will send an ordinance to the Municipal Assembly, providing for a municipal electric light plant. President McMath has expert assurances that such a plant could be erected by January 1, 1900, when the present contract expires. The board is forced to this alternative by the persistency of the Council in filing bills for letting a lighting contract. If the Council turns down the municipal ordinance, then the board will have to let a temporary contract.

PEOPLE'S RAILWAY SALE.—The decree in the suit of Louis M. Rumsey et al., against the People's Railway Company was approved and ordered filed by Judge Wood in the Circuit Court last week. The indebtedness of the defendant company is set forth as follows: Taxes and assessments, $24,453.72; first and second bond issues, aggregating $200,000; coupons on third mortgage bonds; special tax, $15,000. Charles C. Maffit is appointed special commissioner and is ordered to receive no bid for less than $200,000. The proceeds of the sale will be devoted to the payments of costs of court, taxes, coupons and principal of third mortgage bonds. What remains goes to the heirs or assigns of the defendant company. Mr. Maffit is directed to sell the road in sixty days.

FIGHTING THE JULIAN LAW.—The St. Louis & Suburban and St. Louis & Meramec River Railroad companies made return to the petition for a writ of injunction filed a few days ago in the Circuit Court. The petition for an injunction was filed by the Cass Avenue & Fair Grounds Railway, basing its claim upon the "Julian law," approved April 9, 1895. The defendants in their answer say the "Julian law is null and void," and cite the statutes. The answer also accuses the plaintiff of having acted in bad faith, and not according to the principles of equity, and therefore the defendants were precluded from obtaining a temporary or permanent writ of injunction even if the Julian law be valid. The answer is long, and recites other instances of confliction between the Julian law and the constitution. Thus far, the defendants allege, they have expended $5,839.86 in the laying of tracks and construction along four squares on Fourth Street.

PACIFIC COAST NOTES.

THE PRINEVILLE (OREGON) TELEPHONE COMPANY is expecting to extend its lines to The Dalles, via Antelope and Sherar's Bridge.

THE MARKET STREET RAILWAY COMPANY, San Francisco, has filed a petition to be permitted to use electricity on several streets which it now covers with a horse-car system. Some changes may have to be made in the routes, however, to avoid double tracking in the wholesale district.

AN OPPOSITION TELEPHONE COMPANY, to be backed by Rudolph Spreckels, who recently realized a million or more by selling his interest in the Hawaiian Commercial Company, will, it is reported, be established in this city. The story goes that Mr. A. C. Henney, a Guatemalan inventor, has a telephone on which he has obtained patents in several European countries, and which can be constructed at less cost than the Bell instruments. Mr. Spreckels denied that he would become interested in a company.

MR. L. D. TANDY, a representative of the General Electric Company, of Schenectady, N. Y., has been in Oakland, Cal., for several weeks studying the Southern Pacific Railroad Company's local and suburban system of handling passenger traffic in connection with the Oakland-San Francisco ferries. He will report to C. P. Huntington who favors an electric system as to the feasibility of substituting trains of electric cars for the present trains drawn by steam locomotives. Local officials do not consider the prospects good for handling the heavy traffic by electric cars.

MR. J. H. THATCHER, superintendent of the Oregon Telephone & Telegraph Company, recently received from General Manager Sabin, of the Sunset Telephone Company, instruction to take immediate steps to connect all of the towns in Tillamook and Clatsop counties with the Pacific Coast system, [illegible]

CANADIAN NOTES.

[illegible]

THE ELECTRIC STREET RAILWAY COMPANY, of Toronto, Ont. [illegible]

THE CITY OF HALIFAX, N. S. [illegible]

[illegible]

PROF. R. B. OWENS, the new professor in charge of the electrical department of McGill University, Montreal, is introducing a new feature which will be of great value not only to the students but will also confer great benefits upon the general public. This will be a standardizing laboratory. There will be a room devoted to high-potential machinery, where a voltage of 200,000 will be obtainable. There will be machines of the various types, and new types of high-tension transformers and alternating-current machinery are being installed.

WITHIN another year Quebec city, it is said, will be one of the best lighted cities in the world. It will have no less than three companies converting water powers in the vicinity into electricity. They will be the Montmorency Falls Company, the Chaudiere Company, now in course of formation, and the Jacques Cartier Water Power Company, which has already commenced to build at the falls of Jacques Cartier River in Valcartier, some 18 miles from the city of Quebec. This company will also build large pulp and paper mills at the falls.

THE MOST startling offer for the supply of electric power yet made in the city of Toronto, Ont., was among the tenders received by the Board of Control of that city this week. A company has put in a tender to light the city streets and supply energy for manufacturing purposes at the rate of 1c. per horsepower per hour. Its capital, it states, will be $5,000,000, and when the dividends reach 10 per cent. it offers to light the streets at cost price. It will also establish a manufactory of electrical supplies, and the profits of this will come under the same agreement.

OFFICIAL OPENING OF THE TRANSMISSION PLANT of the Cataract Power Company of Hamilton, Limited.—On Saturday, November 12, the formal opening of the 20,000-volt, 35-mile power transmission system between Decew Falls and Hamilton, Ont., was celebrated by a visit of the officers, engineers, stockholders and visitors from Hamilton and neighboring places to the power house. The party numbered about 200. After inspecting the system refreshments were served in the wheel and generator room. The toasts and speeches evidenced a strong local patriotism and pride in this Canadian development of Niagara power, for such it really is. On the return the party visited the step-down transformer station.

General News.

THE TELEGRAPH AND TELEPHONE.

GREENSBURG, KY.—The Green County Telephone Company has been incorporated with a capital stock of $3500.

KENTON, OHIO.—The Kenton Telephone Company, with $30,000 capital, has been incorporated to operate a telephone system from Kenton to Marion, Marysville, Bellefontaine, Wapakoneta and Lima. The incorporators are Ed. L. Barber, James S. Brailey, J. C. King, C. E. Guilford and Horton Park.

SUFFOLK, VA.—A charter has been granted to the Isle of Wight Telephone & Telegraph Company. It authorizes the erection of a telephone line between Suffolk and Smithfield. It will connect here with the Southern States Telephone Company. The officers are: J. W. Thomas, Smithfield, president; J. U. Burgess, Suffolk, vice-president; J. W. Holloday, Smithfield, secretary and treasurer; W. N. McAnge, Suffolk, general manager.

COLUMBUS, OHIO.—The Ohio Telephone Company has been incorporated with a capital stock of $100,000. The incorporators are Messrs. R. E. Jones, T. A. Simons, David C. Beggs, F. D. Simons, Howard Park, Captain L. D. Myers and William C. Orr. The corporation is formed for the purpose of constructing, building and acquiring in the State of Ohio and elsewhere lines of telephone and carrying on the telephone business. The main office of the company will be located in Columbus.

CANANDAIGUA, N. Y.—The Empire State Telephone Company has abandoned several of its lines in this county, taking out the instruments from a number of offices and cutting the wires. The offices thus closed are Bristol, Bristol Centre, East Bloomfield, West Bloomfield, Bristol Springs, Naples, Honeoye, Reed Corners, Rushville, Miller Corners, Middlesex and Vine Valley. This action, it is stated, was taken to avoid litigation with certain farm owners along the roads through which the company's poles are erected and wires strung.

ELECTRIC LIGHT AND POWER.

SANTA FE, N. M.—An electrical generating plant is to be built at Cochiti to be run by water power, and which, it is thought, will supply the entire camp with power.

CAMDEN, N. J.—The Citizens' Light, Heat & Power Company has been incorporated to manufacture electricity for light, heat and power. Capital, $100,000. Incorporators: Andrew S. Scull and Joachim R. Moon, of Camden, N. J.; Wesley Bartine, Philadelphia.

ROCHESTER, N. Y.—Papers incorporating the Rochester Electric Service Company of Rochester have been filed with the Secretary of State. The new concern is capitalized at $1000. Its objects are stated to be to manufacture electricity for light, heat and power in Rochester. The directors for the first year are: John W. Cook, Jr., Frederick Fish, Miner S. Horton, George B. Newman, all of Rochester.

TRENTON, N. J.—The movement for the formation in Trenton of a new electric light company, with a plant to be operated by the waters of the Delaware through the erection of a dam on the Pennsylvania side of the river, is being pushed successfully forward, and has reached that state of development which means the absorption of the existing electric light company. Colonel A. R. Kuser is one of the active men in the new company now being formed.

THE ELECTRIC RAILWAY.

OSWEGO, N. Y—Oswego will have no street-car service of any kind for the next month or six weeks. Justice Wright at Rome has granted an order on motion of N. S. Bentley, attorney for Receiver Tidman, allowing the closing of the entire road until the completion of the pavement in East Bridge Street.

MIDDLETOWN, N. Y.—The Middletown-Goshen Traction Company has passed into the hands of a receiver. W. B. Royce, of this city, was appointed sole receiver of the company by Judge Roger A. Pryor. It is a voluntary dissolution on the part of the company, the application being made by President McKeige.

JERSEY CITY, N. J.—Mayor Hoos has signed an ordinance granting a franchise to the North Hudson County Railway Company to operate the cars on the Grove Street line, connecting Jersey City with Hoboken, with electricity, instead of horse-power. The franchise is perpetual, and the company agrees to pay the city $600 a year.

MIDDLEBORO, MASS.—Another street railway company is being formed to build a road to connect the New Bedford, Middleboro & Brockton line, through Lakeville and East Taunton, with Taunton. It will be known as the Taunton & Middleboro Street Railway Company, with capital stock of $55.000. The route selected is from Middleboro town house, through Precinct village to East Taunton, to the terminus of the East Taunton street railway in that village.

PERTH AMBOY, N. J.—The municipal authorities have granted a franchise for the construction of a trolley road to run through the city. It is the purpose of the projectors of the company to form connections with the Consolidated Traction Company by which direct communication with the surrounding country can be had. The officers of the company are: President, Leonard Lewisohn; vice-president, C. J. Wittenberg; secretary and treasurer, J. C. McCloy.

LEGAL NOTES.

FREIGHT ON STREET RAILWAYS.—Judge Prentice of the Superior Court at Hartford, Conn., on November 8 denied the application of the city of Hartford for an injunction to restrain the Hartford Street Railway Company from transporting freight through the streets of the city. The judge says that this right was granted in the legislative act on street railroads adopted in 1893, that act reading that street railways may transport persons and property, including merchandise.

THE ENCLOSED ARC LAMP.—Following is a copy of the final decree of Judge Lacombe, of the United States Circuit Court for the Southern District of New York, dated November 5, in the case of the Marks Enclosed Arc Light Company, complainant, against the Electric Construction & Supply Company, Fred. A. Kinsman and Charles E. Rocap, defendants, and in favor of the complainants:

Upon the annexed consent and the bill of complaint herein, and the defendants having settled with the complainant for the profits heretofore realized by the defendants from the manufacture (but not from the use) of the lamps made by them and for all damages heretofore realized from the sale (but not from the use) of the said lamps heretofore made by the said defendants and for the costs and disbursements of this action, it is ordered, adjudged and decreed:

1. That the complainant, Marks Enclosed Arc Light Company, is a corporation duly organized and existing under and in pursuance of the laws of the State of New York, and is the owner of United States letters patent No. 520,996, granted to Louis B. Marks and Clarence Ransom for certain improvements in electric arc lamps, dated June 5, 1894, and of all the exclusive rights therein and thereby granted and secured.

2. That the said United States letters patent No. 520,996 and claims 1 and 2 thereof are good and valid letters patent.

3. That the defendants, Electric Construction & Supply Company, Fred A. Kinsman and Charles E. Rocap, confederating with others, have infringed and have caused to be infringed the said letters patent No. 520,996 and claims 1 and 2 thereof, and each of them, by making, using and selling electric lamps known as the "Kinsman" lamps, and by making said lamps and selling them to their customers for use, with the knowledge and intent that the same were to be used in infringement of said letters patent No. 520,996, and in infringement of claims 1 and 2 thereof, and with the knowledge and intent that their customers in using the said lamps would practice and employ the methods set forth and claimed in claims 1 and 2 of said letters patent No. 520,996.

4. That an injunction issue herein directed to the said defendants, Electric Construction & Supply Company, Fred. A. Kinsman and Charles E. Rocap, perpetually enjoining and restraining the said defendants, their officers, employees, agents, servants, clerks and attorneys, and all persons acting under them or their authority, or in privity with them, and each and all of them, from infringing the said letters patent No. 520,996, and particularly from infringing claims 1 and 2 thereof; and from making, using, selling, offering for sale, or causing to be made, used, sold or offered for sale, any electric arc lamps embodying or employing in their operation or use the method or methods set forth in claims 1 and 2 of said letters patent, and from making, using, selling or offering for sale, or causing to be made, used, sold or offered for sale, any electric arc lamp like or substantially like the lamp heretofore sold and offered for sale by the defendant Electric Construction & Supply Company, variously described by the defendants as the "Kinsman" Lamp, the "Kinsman 150-Hour Lamp" and the "Kinsman Long Burning Arc Lamp.

PERSONAL NOTES.

MR. R. E. INSKEEP is receiving congratulations on the fact that he has been appointed general manager of the Akron Electrical Manufacturing Company, of Akron, Ohio. Mr. Inskeep has been doing good work for the company for some time, and well deserves the promotion.

MR. W. F. D. CRANE, of the Porto Rico Construction Company, is at present in New York on a business trip. Mr. Crane is enthusiastic over the electrical possibilities of Porto Rico, and says that much work in the line of electric railways and power transmission will shortly be undertaken there.

MR. CYRUS O. BAKER, JR., is so well known to readers of THE ELECTRICAL WORLD that a reproduction here of his latest photograph and a few words regarding him will be welcome to many. Mr. Baker was born in Newark, N. J., on October 12, 1857, and acquired his education in the same city. He received a special training in metallurgy, particularly as applied to the rare and precious metals. He is senior member of the firm of Baker & Co., whose platinum products are so extensively used in the electrical arts and industries, especially in the manufacture of incandescent lamps. This firm believes that it is entitled to the unique distinction of being the only refiner of crude platinum on this hemisphere. Mr. Baker is of an enthusiastic nature, and believes in the advancement of all legitimate means to promote good fellowship and closer community of interests among those engaged in electrical pursuits. He was one of the incorporators of the old Electric Club of New York, and labored faithfully in its behalf. For a number of years he has gratuitously acted as master of transportation of the National Electric Light Association, and in the fulfillment of the duties of this position has made for himself a host of friends. Mr. Baker was president of the Electrical Exhibition Company, which conducted the electrical exhibition at Madison Square Garden last May, and is a member of the New York Electrical Society, the Magnetic Club and the American Institute of Mining Engineers.

CYRUS O. BAKER, JR.

OBITUARY NOTE.

MR. LATIMER CLARK, the well-known electrical engineer, died suddenly at his residence in Twickenham, London, on the morning of October 30. Mr. Clark was born at Great Marlow on March 10, 1822, and was, therefore, seventy-six years of age at the time of his death. He is known to the electrical fraternity all over the world mainly through his connection with submarine telegraph enterprises and the construction of submarine cables. He introduced many improvements in the English telegraph system, and in 1860 a report by him on the subject of underground telegraph wires was prepared and was embodied in the government report on the subject in 1861. In 1860 he was nominated a member of the committee jointly appointed by the government and the Atlantic Cable Telegraph Company to inquire into the whole subject of submarine telegraph cables. His work in this connection was very valuable and embodied the researches and experiments that had been made up to that date. In the same year he went into partnership with Sir Charles Bright and for ten years after carried on extensive work in the construction and laying of submarine cables. Mr. Clark was the inventor of the well-known standard cell which bears his name, and was author of several important contributions to scientific literature. His "Elementary Treatise of Electrical Measurements" has been the standard work on this subject since the time of its appearance, in 1868. Mr. Clark was a fellow of the Royal Society and past president of the Society of Telegraph Engineers and Electricians, having held the office of president in the year 1875 before the change of name. Mr. Clark's remains [illegible].

Trade and Industrial Notes.

THE FOSTORIA INCANDESCENT LAMP COMPANY has opened an office in the White Building, 95-97 Liberty Street, New York City, which is in the charge of Mr. H. [illegible] as Eastern representative. [illegible] will [illegible] Carbon Company, of Fos[illegible].

MR. CHARLES WIRT, [illegible] street, Philadelphia, has secured additional space, which will be devoted to the manufacture of the Wirt rheostats. [illegible] the large number of steps incident to the peculiar construction used.

[illegible] Manufacturing Company, Columbus, Ohio, [illegible]

THE [illegible] COMPANY, [illegible]

[illegible]

the machinery, stock and material of the Diamond Electric Company, and will continue the manufacture of Scheeffer wattmeters and Scheeffer transformers, aiming to retain the quality and high efficiency for which these instruments are known. The new company states that it has no connection whatever with the Diamond Electric Company, and is prepared to promptly fill all orders for its meters and transformers. The officers of the new company are E. H. Couch, president; A. B. Fink, secretary and manager; W. F. Heyle, treasurer; G. A. Scheeffer, superintendent.

THE B. F. STURTEVANT COMPANY, Boston, Mass., in its October Bulletin—F—brings prominently to the notice of the electrical trade the principal features of its direct-current motors and generators. These machines are of the bipolar and multipolar types, and of medium speed. In the motors, the bipolar machines are made in seven sizes, ranging in capacity from 1 to 15 horse-power; the multipolar motors are made in nine sizes, ranging from 9 to 125 horse-power. The bipolar generators are made in seven sizes, ranging from 1 to 12½ kilowatts, and the multipolars from 7½ to 80 kilowatts, nine sizes of the latter type being listed. These machines, as illustrated in the bulletin, have the appearance of being massive and compact, and are evidently well designed.

THE SCHMIDT & BRUCKNER ELECTRIC COMPANY, 211 Greenwich Street, New York City, reports that it is receiving many orders from all parts of the country for its new adjustable telephone arm, which is described and illustrated elsewhere in this issue. The company is branching out into many specialties, both as regards interior and exchange apparatus, and invites an inspection of its products and its manufacturing facilities for turning out fine work. It makes a specialty of selling transmitters separately, and reports that the demand for these instruments is continually increasing on account of their ability to withstand the wear and tear of telephone service. The company states that it will be pleased to send a sample of its new telephone arm or other parts to any one desiring to investigate its apparatus. A copy of a handsome "poster" will be mailed on application to the company.

A NEW SECTIONAL CONDUCTOR RAILWAY SYSTEM.—That the closed conduit sectional conductor railway system is to find a successful field seems to be the growing opinion among the manufacturing companies. The Johnson Company, of Lorain, Ohio, is working steadily in this line, as is evidenced by patent No. 613,794, issued November 8, 1898, to W. M. Brown and assigned to this company, this patent covering improvements on the previous designs of the same inventor. The switch as described is operated by an electromagnet carried on the car, the switch obtaining a frictionless pivot by floating on mercury and giving a double break on opening, one between the switch and the contact rail and the other between the switch and a mercury terminal. One end of the switch mechanism is grounded in the open position, so that should a connection or an arc be held across the openings the fuse supplying that switch would be blown.

THE CHICAGO RHEOSTAT COMPANY, 1649-1650 Marquette Building, Chicago, has just issued a very complete and handsomely gotten-up catalogue of its manually-operated and self-starting motor rheostats and dynamo field rheostats. Some very clear half-tone illustrations of the various types of apparatus produced by this company give an excellent idea of their construction, which embodies interesting electro-mechanical features. The principal points of the automatic starter, the overload starter, the plain speed regulator, the automatic speed regulator and the overload speed regulator, are pointed out, and the self-starting rheostats are similarly treated. The catalogue includes a very comprehensive telegraph code to facilitate ordering by wire, and instructions are given for guidance in wiring and operating the apparatus. The design and workmanship of this company's rheostats are the result of several years' experience in this line of manufacture, and represent the most advanced engineering practice.

THE JULIUS ANDRAE & SONS COMPANY, Milwaukee, Wis., manufactures a line of telephones and electrical supplies which command favor in the electrical trades. In a catalogue just issued the various types of telephone apparatus manufactured by this company are illustrated and concisely described. The object of this company has been to approach as nearly as possible perfection in telephone apparatus, and to this end it has employed busy brains and clever fingers. It is with confidence, therefore, that it offers its products to the trade as the most carefully made instruments that capital, mechanical skill and energy can produce, and claims that its telephones are mechanically and electrically perfect. Among the illustrations presented in the catalogue are the Andrae standard instruments embracing exchange sets of various designs, long distance desk telephone fitted with Ericcson coal-grain microphone and double-pole receiver, long-distance swinging arm desk set, and intercommunicating sets. The Standard No. 9—an exchange and long-distance instrument—is fitted with the company's improved Andrae carbon transmitter and single-pole receiver. The magneto bells are wound to 10,000 ohms for bridging service and 1,000 ohms for regular exchange service. Besides these instruments there are listed and illustrated switchboards, magneto bells, receivers, extension bells, testing bells, etc., and a complete line of telephone line construction supplies. The concern is now in its thirty-ninth year.

THE MONTAUK MULTIPHASE CABLE COMPANY, 100 Broadway, New York, is making an exhibit of its interior thermostatic electric fire cables at the exhibition of the Massachusetts Charitable Mechanic Association now being held at Boston. Mr. Lucian W. Jenney, who was in charge of this company's exhibit at the Electrical Show at Madison Square Garden last May, has supervision of the exhibit in Boston. "The Scientific Australian," which is published in Melbourne and Sydney, Australia, in a recent issue gives an account of a test in Melbourne of a new fire alarm apparatus in which the Montauk thermostatic cable was used. The continuous thermostatic properties of the cable were demonstrated to the great satisfaction of those who witnessed the tests, and the usefulness of the cable in connection with the apparatus tested on this occasion was very successfully shown. At the annual convention of the International Association of Fire Engineers, which was held in St. Louis last October, a demonstration was made by Chief Bosch, superintendent of the fire alarm telegraph system of Newark, N. J., of the application of the Montauk multiphase thermostatic fire detective cable to the auxiliary fire alarm system. The exhibition, it is said, demonstrated to the convention the benefits and advantages of the use of the auxiliary fire-alarm system in conjunction with the fire detective cable. It was shown that the cable is absolutely and solely a thermostat, the application of the flame of an ordinary match thereto causing the alarm to sound.

COCHRANE FEED WATER HEATERS AND PURIFIERS.—Among the recent sales of Cochrane feed water heaters and purifiers the Harrison Safety Boiler Works, Philadelphia, report the following: The A. I. Root Company, Medina, Ohio, 300 horse-power, special; Wapakoneta (Ohio) Electric Light & Power Company, 425 horse-power; Latrobe Steel & Coupler Company, Melrose Park, Ill., 1000 horse-power; the Monessen (Pa.) Steel Company, 1250 horse-power; Fish Brothers Wagon Company, Racine, Wis., 500 horse-power; National Tube Works Company, McKeesport, Pa., 3000 horse-power; Cherry Valley Iron Company, Leetonia, Ohio, 1750 horse-power; Delaware & Hudson Canal Company, Olyphant, Pa., 2500 horse-power; Edwardsville (Ill.) Electric Light & Power Company, 150 horse-power; Raritan Copper Works, Perth Amboy, N. J., 1000 horse-power. Recent sales of Cochrane separators include the following: George V. Cresson Company, Philadelphia, 7-inch horizontal; Compania Cervecera, Toluca, Mexico, 6-inch horizontal; Ashland (Ky.) Steel Company, 4-inch horizontal; A. A. Sanborn, Boston, 10-inch horizontal; Johnstown & Gloversville Gas Company, Gloversville, N. Y., one 3-inch and one 4-inch horizontal; Simonds Manufacturing Company, Chicago, 5-inch vertical; United States Navy, 4-inch horizontal; Standard Oil Company, Whiting, Ind., three 6-inch oil-ammonia; Boston & Maine Railroad, two 6-inch horizontal; Massachusetts Institute of Technology, Boston, 8-inch horizontal; Barr Pumping Engine Company, Boston, 5-inch horizontal; Beaver Traction Company, Beaver, Pa., one 12-inch and one 5-inch vertical; George F. Blake Manufacturing Company, Boston, 4-inch vertical and one 3-inch vertical; Shenango Valley Steel Company, New Castle, Pa., 12-inch horizontal; Hoopeston (Ill.) Electric Company, 6-inch horizontal; Southern Electric Railroad Company, St. Louis, Mo., 12-inch horizontal; Chicago Brass Company, Kenosha, Wis., 6-inch vertical; Mystic (Conn.) Electric & Gas Lighting Company, 5-inch vertical; De La Vergne Refrigerating Machine Company, New York City, 5-inch horizontal oil-ammonia.

THE ENCLOSED ARC LAMP.—It was not until Mr. Louis B. Marks' invention of the enclosed-arc method of operation, in 1894, and his elaborate investigations into the adaptation of carbons for this purpose that the closed-globe arc-lamp problem was solved. Then there were no enclosed lamps in general use in any country in the world. To-day they are extensively used in every civilized country on the globe. They have not only displaced the old-style open-arc lamps, but have opened up new fields for arc lighting which could not previously be filled either by the incandescent lamp or by the open-arc lamp. Within the brief space of four years this new industry has sprung up, and over 75,000 lamps of the enclosed-arc type, all designed and operated in accordance with the broad claims of the original Marks patent (No. 520,996), June 5, 1894, have been sold in this country alone. Add to this number the many thousands that have been sold in Great Britain, France, Germany, Canada, South America, etc., and it is safe to say that over 100,000 of these lamps are now in daily use. The revolution created by the advent of the enclosed-arc lamp may truly be said to be unparalleled in electric-lighting annals, not even excepting the incandescent lamp itself. The first two claims of the Marks patent No. 520,996 are as follows: 1. The method of operating an arc lamp on constant potential circuits, which consists in confining the arc within an enclosure, restricting practically all the drop of potential in the arc circuit to the arc and continuously maintaining said drop at a point which prevents an excessive flow of current. 2. The method of operating an arc lamp, consisting in confining the arc within an enclosure from which the air is excluded or to which it has difficult access, and maintaining a long arc to produce a larger than normal drop of potential, whereby an arc light of normal intensity may be maintained by an amperage lower than normal. In THE ELECTRICAL WORLD of October 29 last was published a brief reference to the decision of Judge Coxe in favor of the Marks Enclosed Arc Light Company, in its suit against the Washington Mills Company, New York, which used General Electric lamps, and among the legal notes in this issue is given the final decree of Judge Lacombe in the case of the Marks Enclosed Arc Light Company against the Electric Construction & Supply Company, Fred. A. Kinsman and Charles E. Rocap, in favor of the complainant.

Business Notices.

THE ILLUSTRATIONS in this issue were made by the Photo-Engraving Company, 9-15 Murray Street, New York City.

THE BATTLESHIP WISCONSIN will be launched in San Francisco, Saturday, November 26. The official train carrying State officials and the christening party will start from Marinette, Milwaukee and Chicago, Saturday, November 19, going via the Chicago, Milwaukee & St. Paul Railway. Stops will be made at St. Paul, Tacoma, Portland, San Francisco, Los Angeles and Denver. Pullman palace sleeping cars, dining cars, observation cars for the exclusive use of the party for the entire trip, under the direction of Mr. Reau Campbell, general manager of the American Tourist Association. A limited number of tickets at reduced rates, covering all expenses, will be sold; they include railway and sleeping car fares, meals in dining cars, hotels, carriages, etc. For details address the American Tourist Association, 1124 Marquette Building, Chicago.

UNITED STATES PATENTS ISSUED NOVEMBER 8, 1898.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

613,647. INSULATOR FOR INCANDESCENT ELECTRIC LAMPS; C. W. Brown, of Boston, Mass. App. filed Dec. 15, 1897. The described reversible insulator formed of non-conducting material internally threaded, having about centrally a thickened peripheral ring, and at either side thereof thinner end portions projecting longitudinally from and of less diameter than said ring. (This patent was issued November 1.)

613,663. CONNECTOR; F. E. Case, of Schenectady, N. Y. App. filed Aug. 5, 1898. As a new article of manufacture, a terminal having a longitudinal slot, a screw and a pin in line with the slot, and a depression in the back of the terminal at the end of the slot.

613,669. BRUSH HOLDER; A. E. Doman, of Elbridge, N. Y. App. filed Feb. 4, 1898. In a brush holder, the combination of a frame or support provided with a concave socket and brush clamp, provided with a convex projection having a substantially universal movement in said socket, substantially as described.

613,688. ELECTRIC SWITCH; F. A. La Roche, of New York, N. Y. App. filed Dec. 28, 1897. In an electric switch, a bridge, plates adapted to be connected with one end of a circuit, a pivot carried by said plates, and carrying said bridge and provided with a threaded portion, an arm working on said bridge portion and directly connected with said bridge, whereby said arm moves in unison with said bridge, a means of preventing said pivot from turning in said plates, and jaws adapted to receive said bridge and to be connected with said circuit.

613,705. ELECTRIC TIMING RACE APPARATUS; J. I. McDonald, of St. Joseph, Mo. App. filed Jan. 4, 1897. A racing time apparatus, consisting of a dial, a main hand and an auxiliary hand, both co-operating with the dial, mechanism for actuating said hands, electrical devices for temporarily arresting the auxiliary hand and separate electrical devices for stopping the main hand, at will, substantially as described.

613,708. ELECTRIC RAILWAY; Jas. F. McLaughlin, of Philadelphia, Pa. App. filed May 2, 1896. In an electric railway, an exposed circuit terminal consisting of a plug in the road-bed, composed of a body portion, a removable contact face, and locking mechanism for holding the latter against accidental removal, substantially as described.

613,713. TROLLEY-POLE GUIDE-ROPE; S. R. Parks, of Central Falls, R. I. App. filed Aug. 4, 1897. The combination of a flexible tubular rope, funnel, trolley wheel and pole, substantially as described.

613,732. BICYCLE; M. J. Steffens, of Chicago, Ill. App. filed Sept. 29, 1897. In a bicycle or similar vehicle, the combination of a pulley having a periphery rounded in cross-section, means for rotating the pulley, a driving wheel having a periphery rounded in cross section, and a belt cup-shaped in cross section running around the periphery of the driving wheel and between the wheel and the ground, whereby leverage is obtained and slipping prevented, substantially as described.

613,735. ELECTRIC CIRCUIT CONTROLLER; N. Tesla, of New York, N. Y. App. filed April 19, 1898. In a circuit controller, the combination with rigid and fluid conductors adapted to be brought intermittently into contact with each other, thereby making and breaking the electric circuit, of means for imparting rotary motion to both of said conductors.

613,744. MECHANISM FOR HOLDING TROLLEYS TO THEIR WIRES; W. R. Weaver, of Covington, Ky. App. filed Oct. 9, 1897. In a trolley, the wheel and pivot rod and holders, each having an arm provided at its free end with a point, these points extending down below the horizontal plane of the immediate adjacent part of their respective arms, and adapted to be in close conjunction when the arms are closed together, and means for causing the holders to unite their arms above the conductor wire, substantially as described.

613,778. INDICATOR SIGNAL; P. Rabbidge, of Sydney, N. S. Wales. App. filed Feb. 1, 1897. The combination with a permanent magnet, of a soft-iron armature therefor, consisting of two parts, one of which is attached to one pole of the magnet and the other being adapted to slide through the other pole of the magnet toward and away from the fixed part, a button carried by the outer end of the movable part of the armature, an electric coil around the two parts of the armature and adapted to demagnetize the latter, the said armature parts acting as a core for the said coil, and means for forcing the movable part of the armature outwardly when the latter is demagnetized.

613,794. ELECTRIC RAILWAY; W. M. Brown, of Johnstown, Pa. App. filed Jan. 22, 1898. A current conveying switch having a normal position in which it is connected with one side of the circuit, and a temporary position in which it is connected with the opposite side of the circuit and with the conductor section.

613,809. METHOD OF AND APPARATUS FOR CONTROLLING MECHANISM OF MOVING VESSELS OR VEHICLES; N. Tesla, of New York, N. Y. App. filed July 1, 1898. The combination with a source of electrical waves or disturbances of a moving vessel or vehicle, and mechanism thereon for propelling, steering or operating the same, and a controlling apparatus adapted to be actuated by the influence of the said waves or disturbances at a distance from the source.

613,853. ELECTRIC REGULATOR; W. H. Chapman, of Portland, Me. App. filed March 24, 1898. In an electric regulator, the combination of a solenoid having a differential winding mounted on a tube or cylinder and having its magnetic core fitted as a piston to said cylinder, a passageway leading from one end to the other of said cylinder, and means for closing said passageway to a greater or less degree.

613,858. CAP FOR ENCLOSED ARC LAMPS; C. E. Harthan, of Lynn, Mass. App. filed April 23, 1898. In a cap for the cylinder of an enclosed arc lamp, the combination of a flange which rests on the top of the cylinder, a second flange situated below the first, a hub connecting the two flanges and acting with the flanges to form a chamber, a carbon opening in the hub, and a plurality of small chambers also formed in the hub, which surround and communicate with the carbon opening.

613,864. PHOSPHORESCENT ELECTRIC LIGHTING; D. McF. Moore, of Newark, N. J. App. filed Dec. 17, 1896. In a circuit interrupter working in a vacuous receptacle exhausted to a high degree, a supporting frame for the working parts composed of aluminum.

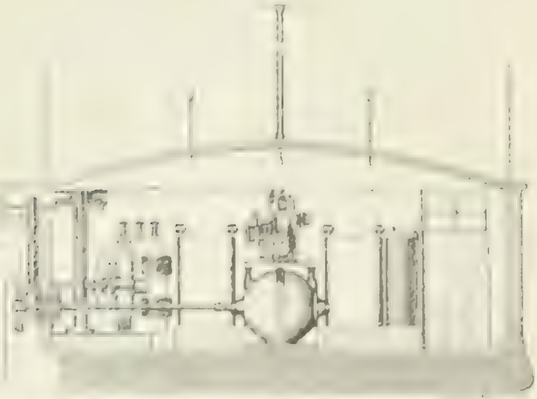
613,877. ALARM; C. A. Deal, of Chicago, Ill. App. filed July 29, 1897. An electric alarm system for banking houses and other establishments, comprising a series of levers arranged vertically below the counter, said levers being pivoted each at one end and carrying a shoe at the other, a metallic contact spring located in the path of the shoe, and plates also underneath the counter, said plates and levers being connected to wires extending from a battery and bell, substantially as described.

613,880. GENERATING AND DISTRIBUTING ELECTRIC ENERGY; C. M. Green, of Cleveland, Ohio. App. filed April 18, 1896. A method of connecting a constant-current dynamo having two or more armature circuits with two or more lamp circuits, consisting in arranging the connections so that one or more of the armature circuits of the dynamo shall be interposed between the lamp circuits and the voltage kept within safe working limits.

613,881. GENERATING AND DISTRIBUTING ELECTRIC ENERGY; C. M. Green, of Cleveland, Ohio. App. filed Dec. 23, 1896. The combination in a dynamo-electric machine, of an armature having its coils or bobbins divided into two or more successive or adjoining sets, light insulation between the individual coils or bobbins of each set and heavier insulation between the set of coils or bobbins, substantially as described.

613,882. GENERATING AND DISTRIBUTING ELECTRIC ENERGY; C. M. Green, of Cleveland, Ohio. App. filed Dec. 23, 1896. The combination with a dynamo having a series of separate armatures, of a series of external circuits corresponding with the number of armatures, said external circuits being arranged in series with the armatures and in series with each other.

613,894. DYNAMO AND ELECTRIC MOTOR FOR DRIVING VEHICLES; J. V. Sherrin, of Ramsgate, England. App. filed Aug. 17, 1896. An electric motor, comprising a driving shaft, field magnets in a frame revoluble therewith, an armature rotating on said shaft, a stationary sleeve between the hub of the field-magnet casing and the shaft, said hub rotating on the said sleeve and said shaft rotating in the said sleeve, and speed-reducing gearing connecting the armature and the field-magnet casing with the shaft, some of the gearing carried by said sleeve.



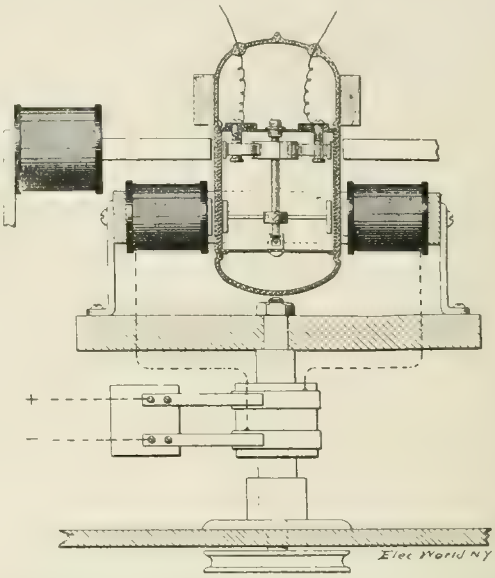
No. 613,809.—Method of and Apparatus for Controlling Mechanism of Moving Vessels or Vehicles.

[illegible] INSTRUMENT FOR MEASURING ELECTRIC CURRENTS; [illegible]

[illegible] ELECTRIC LIGHTING SYSTEM FOR VEHICLES; [illegible]

threaded portions engaging with the screw-threaded portions of the aforesaid spider.

613,967. STATION INDICATOR; James E. Carter, of Bridgeport, Cal. App. filed Oct. 2, 1897. In a station indicator, the combination of a guide roller having a series of pins or projections thereon, a strip or band containing the names of different stations passing over said guide roller and provided with openings in which said pins or projections are adapted to fit, a spirally grooved roller in the grooves of which said pins are adapted to fit, and means for rotating said spirally grooved roller, substantially as described.

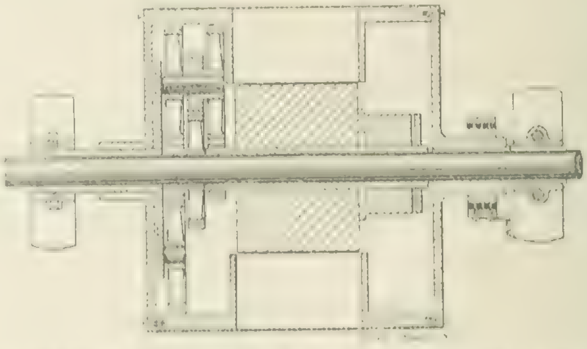


No. 613,864.—Phosphorescent Electric Lighting.

613,990. APPARATUS FOR FREEING, LIGHTING OR EXTINGUISHING GAS BURNERS; P. Guyenot, of Aix-les-Bains, France. App. filed Dec. 18, 1897. An apparatus for freeing and lighting gas burners having a burning tube, a lighting tube and a platinum wire, with a guard forming a chamber around the wire closed except at the top to keep the wire from burning in contact with the air.

614,012. PRIMARY BATTERY; C. Koenig, of Berlin, Germany. App. filed Feb. 16, 1898. In primary batteries the provision of two or more pairs of concentric elements with insulating pots between each pair and suitable exciting paste between each set of elements, all as a means for obtaining a fairly constant high-voltage current from a cell of small size, substantially as described.

614,025. BRUSH HOLDER FOR DYNAMO ELECTRIC MACHINES; G. L. Pratt, of Atlanta, Ga. App. filed June 2, 1898. The method of preventing unnecessary wear between the parts of a current-collecting device, which consists, first, in automatically making contact during the transmission of current, and secondly, automatically breaking the contact when the current is cut off, substantially as described.



No. 613,894.—Dynamo and Electric Motor for Driving Vehicles.

[illegible] AERIAL ROPEWAY; J. W. White and H. White, of Widnes, England. App. filed [illegible] A system of electrical traction comprising [illegible] sectional lines of [illegible] ropes, one line being the conductor and [illegible] the return line, rocking rails between the sections, electrical [illegible] alternate rocking rails of the conductor line whereby every [illegible] section of each line is normally a conductor, and alternate rocking rails [illegible] contact with the intermediate sections of the line [illegible] intermediate sections, the said rocking rails [illegible] connected being arranged to cut [illegible] the portion of the line [illegible] by the trolley whereby an [illegible] trolley automatically cuts out of circuit the section rope which [illegible] in circuit the section of line which it enters upon, substantially as described.

The Electrical World.

VOL. XXXII. NEW YORK, NOVEMBER 26, 1898. No. 22.

PUBLISHED EVERY SATURDAY BY

THE W. J. JOHNSTON COMPANY,

9 Murray Street, New York.

Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York.

New England Office, 620 Atlantic Ave., Boston.
Western Office, 936 Monadnock Block, Chicago.
Philadelphia Office, 929 Chestnut Street.

SUBSCRIPTION IN ADVANCE, ONE YEAR, $3.00,

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THE ELECTRICAL WORLD,

9 Murray Street, New York.

VOL. XXXII. NEW YORK, NOVEMBER 26, 1898. No. 22.

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MULTIPHASE TRANSFORMERS.

A type of apparatus not made in this country, but quite generally used in European power-transmission plants, is the multiphase transformer. A good example of this machine is described and illustrated on page 554 of this paper. In this particular instance it is of the core type designed for three-phase working, each phase having but a single core instead of the two cores which would be necessary were three separate single-phase transformers used. The three cores are magnetically cross-connected at their ends by common laminæ and form a mutual common return for the lines of force between the two systems of end plates. The structural advantages obtained by this construction are instantly recognizable, three separate single-phase transformers such as would be used for the same service in this country requiring, if of the core type, six cores, six sets of end plates, six primary and six secondary coils, an exact duplication of the number of parts, although, of course, of smaller dimensions. The simplification, the advantages of insulation and the cheaper construction of the larger sizes per unit output are obtained by the union of the three transformers into one. The possibility of this union depends, of course, on the mutual relations of the three electromotive forces, the vectorial representations of which must form a closed triangle, which—translated into iron and copper—means that the lines of force set up in the three cores will at all instants exactly balance each other.

Multiphase transformers are also often made up in the shell type, and besides the advantages of increased size and reduced number of parts in this type there is or may be an immediate economy of iron, the three tongues of the shells, for example, serving as magnetic common returns and reducing the amount of iron needed to complete the magnetic circuit by as much as perhaps 25 per cent. In the case of the core type, illustrated in this issue, the fact that the three cores are a mutual common return is not only based on the principle that the vectorial representations of the three electromotive forces form a closed triangle, but in turn, neglecting the magnetic leakage, compels this condition. The same effect necessarily follows also from the delta connection of the three windings. By connecting the windings in a star or Y system, which necessitates that the currents in the three phases shall be mutually dependent, it is possible that such a multiphase transformer could be made to give a mutual balancing action much like that of a running synchronous or induction machine.

THE LIMIT OF LONG-DISTANCE POWER TRANSMISSION.

Ever since the now classic transmission of power from Lauffen to Frankfurt, 112 miles, those who believe that "electricity is still in its infancy," who are also, as a rule, those who have no comprehension of the difficulties involved in rearing the infant, have pictured future plants transmitting power from almost anywhere to anywhere else that their fancy or wishes may have inclined them, and particularly from Niagara Falls to New York and Chicago. Through the almost infinitely painstaking care of the engineering departments of the companies undertaking high-tension distribution the difficulties and dangers and breakdowns of such plants have gradually been reduced and eliminated until now 10,000 volts is an every-day matter, 20,000 is in some use, one plant of 40,000 is running, and apparatus, particularly transformers, has been built for pressure as high as 100,000 or even 150,000 volts,[1] and transformers have been worked at 200,000 volts.[2] But at a point far below these pressures there seems to be an impassable limit, above which overhead lines cannot be worked, and this is clearly brought out in a paper prepared with great care and thoroughness by Mr. Charles F. Scott, read before the American Institute at the last general meeting at Omaha and reprinted in part on other pages of this issue. This limit is the loss of power through air leakage, probably a convective discharge from line to line. As is clearly indicated in Fig. 6 of that paper, which is shown on page 561, this discharge begins at pressures varying from about 40,000 volts, with the wires 15 inches apart to 50,000 volts with the wires 52 inches apart, and runs up so steeply with advancing pressure that in the case of a long line it would soon become a large percentage of the total power delivered, and so reduce the efficiency of the line that the diminished line loss, due to increasing voltage, would at a certain point become balanced by the increasing leakage, above which pressure any further increase would cause a loss instead of a gain.

An increase in the distance between wires helps some, as the curves show, but much more than 4 feet is not practicable with all wires on a single pole line. The question instantly arises, What could be done with a plurality of pole lines, one for each terminal or corner of the circuit? The increased distance between wires obtained in this way would be effective until it became approximately equal to double their elevation above the ground, when, of course, the latter would become a connecting link in the path of the leakage discharges. Another factor that might enter even with the wires at a considerable distance from each other on the same pole line is leakage through the air to poles and cross arms, and in case separate pole lines were used the static discharges to the poles in wet weather might readily become a serious bar. The high self-induction of circuits looped about such a great air space, as would be that between pole lines, is no longer a difficulty, since over-excitation at the receiving end can be made to introduce the equivalent of a capacity effect, by which the power factor of the circuit may be maintained near unity, even with a considerable inductance in the line.

In the present state of the art this leakage effect may be said to set a limit to high-voltage transmission at from 50,000 to 75,000 volts, which in turn sets a limit—taking the author's own figures of three miles per thousand volts—of profitable power transmission, with average relative cost of coal and water power, at distances of 150 to 225 miles.

The assumptions of loss and investment, however, must be proportioned to the ratio of the cost of power at the shaft of the proposed source and the cost at the point of consumption of the cheapest alternative source. In cases of extreme high cost of fuel and [illegible] drop, for example three times that assumed by Mr. Scott, or 50 per cent., might be justified, in which case the distance, with the same cost of copper, [illegible] also pointed [illegible] power delivered, owing to the fact that a large proportion of the to- [illegible]

The same paper discusses another subject about which little has been generally known, and that is, the relative advantages of porcelain and glass as a material for high-tension line insulators, the author stating in part: "I can see no advantage of porcelain over glass, unless it be that of superior mechanical strength." The rise of porcelain as an insulator has been a feature of high-tension work difficult to account for. Owing, perhaps, to the fact that its surface is less hygroscopic than that of glass, and therefore it is largely used on English and European telegraph lines, where great care is taken to get favorable electrical conditions for superior transmission of messages, it was considered essential for high-voltage lines as soon as they were undertaken. As a result of this hasty conclusion, the most strenuous efforts were made by porcelain manufacturers to overcome its great failings in this class of work, notably its porosity, and to obtain a homogeneous vitrification. These results accomplished, it is now announced that glass is as good as, or better than, porcelain. Looking at the matter from a purely analytical point of view, it is obvious that the chief failing of glass in telegraph insulation would be automatically corrected in high-tension work, since as soon as the moisture on its surface became sufficient to cause serious leakage it would be immediately vaporized by the heat generated from that leakage. Complete vitrification of glass throughout its whole mass is, of course, a matter of no difficulty, although the construction of a single body of glass of the size necessary for giving a long surface distance between wire and pin may be. For example, the 40,000-volt line used in the Provo-Mercur line is fitted with a glass insulator 7 inches diameter by 5½ inches high.

Another idea suggested by the experiences described is the improvement of the insulation by care in the electrical constants of the cross arms. As pointed out by Professor Fessenden in his paper presented to the Institute on "Insulation and Conduction,"[1] the insertion between two alternating-current, high-potential terminals of a dielectric not electrically homogeneous will cause greater strains than if but one dielectric were used with a lower specific inductive capacity. The use between two line wires of two glass or porcelain insulators and a wooden cross arm is exactly such a case. The high specific inductive capacity of the glass or porcelain causes charges to collect at each alternation on the pins and tend to travel over the cross arm with each reversal of the current. Mr. Scott states: "In every case in my experience where a breakdown has occurred it has been on a cross arm which was 'wind-shaken' or 'weather-cracked,' the current following the cracks," and also in describing a line running near the Pacific Coast he states that the burning of the cross arms is almost entirely on the side toward which the winds come from the ocean bearing a mist of salt water. A higher dielectric strength, ohmic resistance and specific inductive capacity in the cross arms might be a great aid to the insulators and can, of course, only be obtained by protecting the cross arms from moisture by means of a hood or roof, or shaping them in such a way that there would be dry surfaces on their structure protected by overhanging petticoats.

The use or proposed use of oil insulators has been quite outgrown in this country. Oil reduces the surface leakage, but surface leakage under the insulator is, as a rule, a source of less trouble than the jumping of the current from the edge of the outside moist petticoat to the pin, which oil does not of course prevent.

Whether or not the limit set by these luminous brush discharges can be exceeded by the use of conductors insulated not by the air, but by solid or liquid dielectrics, the future only can tell. The comparative high cost of such conductors, however, will probably fix the distances over which transmission can be economically carried at limits as low or lower than those set by air leakage.

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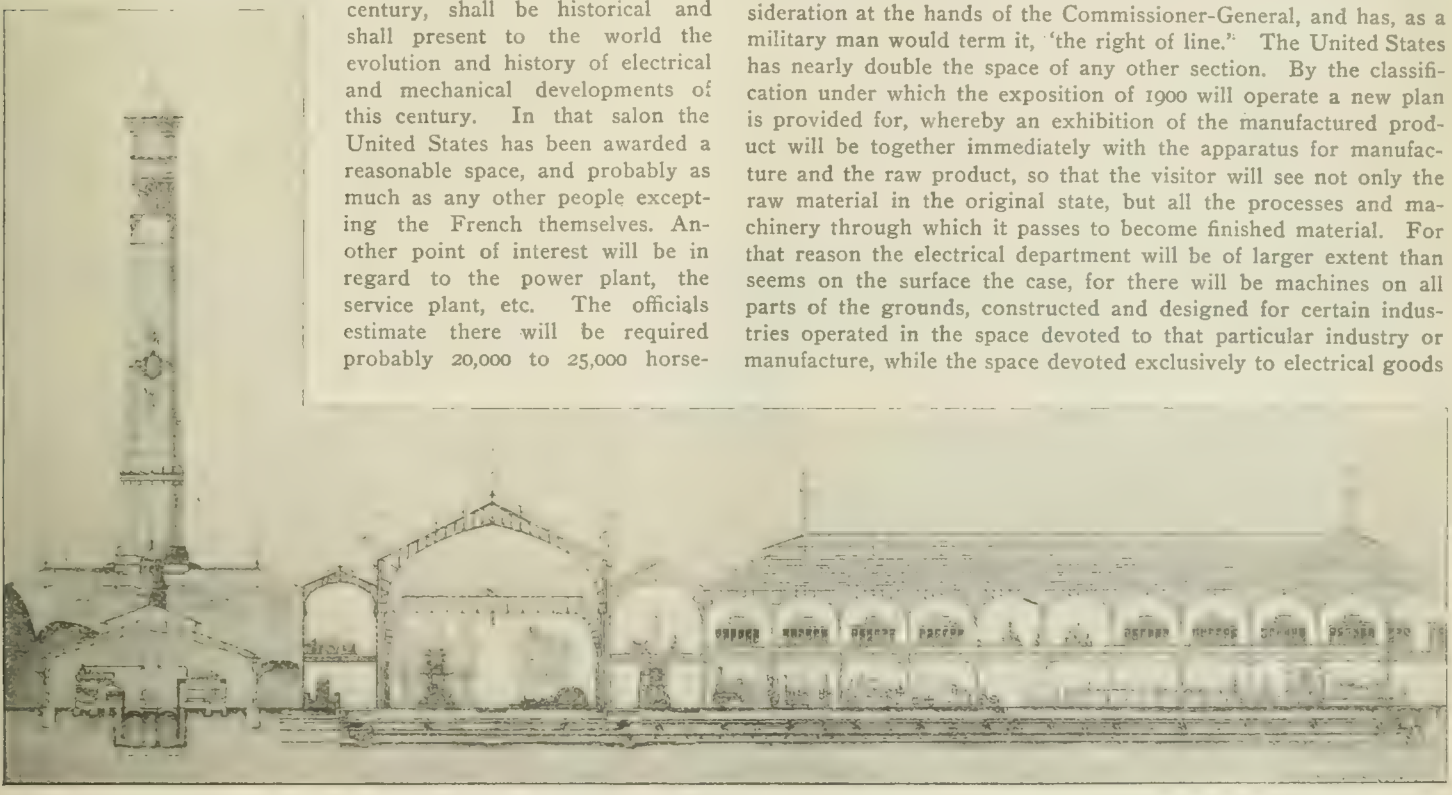
[1] See The Electrical World, [illegible]

[2] See ibid., page [illegible]

[1] See The Electrical World, April [illegible], page [illegible]

The Paris Exposition of 1900.

Mr. Francis E. Drake, director of machinery and electricity for the United States Commission of the Paris Exposition of 1900, has just returned to New York from Paris, where he has been since the middle of September, looking after affairs in connection with the United States exhibit that come under his jurisdiction. In an interview with a representative of The Electrical World Mr. Drake gave some interesting facts relating to the plans for the electrical and mechanical exhibits of the United States. The building in which these exhibits are to be displayed is not yet sufficiently advanced to show the façades, elevations, etc., but the floor plan is ready. The United States will have on the ground floor a modest space which will be used for the display of large generators, general machinery, etc. The electrical and mechanical exhibits from all countries are combined under one roof. This building will be called The Palace of Machinery and Electricity (Palais de Machinerie et Electricité). The space is divided into three sections. The ground floor is devoted to the heavy machinery; there is a space for the lighter electrical and mechanical apparatus in the gallery, and the third space, called the Salon d'Honneur, will be devoted to a retrospective exhibit which the French people desire, in this exposition closing the nineteenth century, shall be historical and shall present to the world the evolution and history of electrical and mechanical developments of this century. In that salon the United States has been awarded a reasonable space, and probably as much as any other people excepting the French themselves. Another point of interest will be in regard to the power plant, the service plant, etc. The officials estimate there will be required probably 20,000 to 25,000 horse-power, which will be devoted to lighting, motor service, transportation and other uses. This 20,000 to 25,000 horse-power will be established in two separate plants. One of the plants will be 10,000 to 12,000 horse-power, and will be located on one side of the Champs de Mars, and the other will be on the other side. The plants devoted to the French buildings will be on the side of the Avenue Bourdonnais and the other on the Avenue Suffren. The foreign section will be divided among the principal nations, Germany, Great Britain, Austria, Belgium, etc. The French will reserve half for themselves. The other portion of the plant will be on one side of the Champs de Mars and the entire Parisian section on the other side, but the two boiler plants will feed into common mains, and as far as the steam arrangements are concerned it will be the same as one battery. Provisions are made for sub-conduits to carry the water pipes, electric conductors and compressed air pipes. Steam will not be conveyed to any distance from the power plant proper, but to those exhibitors immediately adjacent to the power plant there will be given an opportunity to tap the mains coming through the main conduits. But there are few industries requiring live steam or exhaust steam, and these will be located for exhibition in the building closely adjacent to the power plant proper. Aside from that the service will not be lengthened or extended. In the court which occupies the central space in the Champs de Mars there will be a large fountain arranged in a series of cascades, for which effect they will use the condensing water of the power plant. It is rather an ingenious conception. The lighting of the buildings will not be general, but such buildings as the Electrical and Mechanical Hall or Palace, Transportation, Textile, Chemical Industries, a portion of the Agricultural Palace, the Palace of the Trocadero and the Manufactures Building will be opened at night. It may be interesting to note that electricity will not do all the illuminating at this exposition. The gardens of the Trocadero and some of the exterior features of the Trocadero will be in gas, and a very small portion of the Champs de Mars will be lighted by gas.



Sectional Elevation of Power Plant and Building Containing Steam-Driven Exhibits.

"The United States," Mr. Drake continued, "has received more individual concessions than any other nation, chiefly because of the importance of this country in the family of nations, and the fact that we have recently taken a new position. The Commissioner-General is mindful of the great interests of the electrical and mechanical manufacturers of this country, and of the fact that this industry has received the largest apportionment of space of any department. It practically stands at the head of the list. Machinery and electricity combined have more space than any other section in the American space. The department receives first consideration at the hands of the Commissioner-General, and has, as a military man would term it, 'the right of line.' The United States has nearly double the space of any other section. By the classification under which the exposition of 1900 will operate a new plan is provided for, whereby an exhibition of the manufactured product will be together immediately with the apparatus for manufacture and the raw product, so that the visitor will see not only the raw material in the original state, but all the processes and machinery through which it passes to become finished material. For that reason the electrical department will be of larger extent than seems on the surface the case, for there will be machines on all parts of the grounds, constructed and designed for certain industries operated in the space devoted to that particular industry or manufacture, while the space devoted exclusively to electrical goods will only carry typical machines, which cannot be exhibited in other parts of the grounds. That gives us still greater opportunity to display the progress and ingenuity with which the American designers have forged to the front."

Electric Motors in Bridge Construction.

According to "The Electrical Review" of London the electric motor is being quite largely used instead of the engine in the construction of a large bridge at Budapest. The pile-driver used to sink a cofferdam, the sheet piling of which is said to consist of rolled iron girders, is motor driven and is capable of driving forty of these beams to a depth of 26 feet in twenty-four hours, the steam machine driving only about three-fourths of this number. Windlasses and centrifugal pumps are also motor driven, and the enclosed or street railway type of motor appears to be unknown, since the direct coupling of the latter was considered inadvisable, owing to moisture. The belt drives, however, serve another purpose, namely, the variation of the speed ratio, the pump speed being necessarily higher as the load increases.

Balancing the Distribution of Current in Multiple-Wound Armatures.

A practical instance of the value of the system of equalizing the output of the various sections of a parallel-wound multipolar armature, designed by Mr. B. G. Lamme, and described in these columns,* has been given by the accidental errors in connecting up some large electrolytic generators. One such machine was operated with one of the shunt exciting coils reversed for two years before the mistake was discovered, the armature cross connections passing currents which gave an armature reaction sufficient to build up the needed field. An 810-kw 180-volt 4500-ampere generator was operated continuously for three weeks with two coils reversed, very little difference in the performance being noted when the mistake was corrected. A further advantage of this system not noted in the original article is that the balancing of the field not only equalizes the distribution of the current, but equalizes the magnetic pull around the armature, which, in the case of large engine-type machines, is so great that if unbalanced it is likely to wreck some part of the apparatus. Machines with cross-connected coils can be run with the armature iron practically touching the pole pieces on one side and double the normal gap on the other, with very little tendency to cling to the near poles.

Mr. Tesla's Paper Before the Electro-Therapeutic Society.

The recent publication in an electrical journal of a paper presented before the Electro-Therapeutic Society by Mr. Tesla on "High-Frequency Oscillations for Therapeutic Applications" has elicited the following letter from Mr. Tesla to the editor of the paper making the reprint, with the request that the letter be published in the columns of The Electrical World. The letter, which is self-explanatory, is as follows:

"By publishing in your columns of Nov. 17 my recent contribution to the Electro-Therapeutic Society, you have finally succeeded—after many vain attempts made during a number of years—in causing me a serious injury. It has cost me great pains to write that paper, and I have expected to see it appear among other dignified contributions of its kind, and, I confess, the wound is deep. But you will have no opportunity for inflicting a similar one, as I propose to take better care of my papers in the future. In what manner you have secured this one in advance of other electrical periodicals, who had an equal right to the same, rests with the secretary of the society to explain.

"Your editorial comment would not concern me in the least were it not my duty to take note of it. On more than one occasion you have offended me, but in my qualities both as Christian and philosopher I have always forgiven you and have only pitied you for your errors. This time, though, your offense is graver than the previous ones, for you have dared to cast a shadow on my honor.

"No doubt you must have in your possession, from the illustrious men whom you quote, tangible proofs in support of your statement you produce these, together with this letter, which, in justice to myself, I am forwarding to other electrical journals. In the absence of such proofs, which would put me in the position to seek redress elsewhere, I require that, together with the preceding, you publish instead a complete and humble apology for your insulting remark, which reflects on me as well as on those who honor me.

"On this condition I will again forgive you, but I would advise you to limit yourself in your future attacks to statements for which you are not liable to be punished by law. N. Tesla.

"New York, Nov. 18, 1898, 46 and 48 East Houston Street."

The Transmission Plant Les Clees-Yverdon.

BY J. LAFFARGUE.

Switzerland may be said to be the home of the hydraulic electric-power distribution plant, owing to the high cost of coal, the large number of water powers and the distribution of the manufacturing industries in small workshops scattered throughout the towns and country districts. A typical plant of this kind is that taking power from the River Orbe at the place known as Les Clees, and distributing it over a wide extent of territory in three general directions, as shown in the accompanying map, Fig. 1. The lines as there shown are tapped at many points, generally little country villages or chateaux, where they supply current to a few lights or to a small motor driving a shop manufacturing music boxes, watches or some other product peculiar to this odd little country. The description as given by the author named above in a recent issue of "L'Industrie Electrique" is translated below, with a few comments from an American point of view.

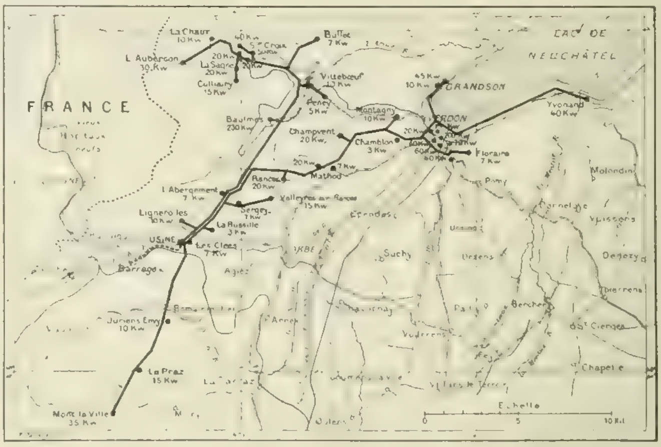


Fig. 1.—Map Showing Lines and Distribution of Loads.

The installation was put up by la Société Anonyme de l'Usine des Clees à Yverdon, which obtained a concession from the Canton de Vaud in 1894 and commenced work early in 1896, the installation having been in service regularly since the first of 1897, supplying some twenty villages and towns, as shown by the map. The source of power is the fall of the River Orbe, which is a tributary of Lake Neuchatel, a masonry dam being built at the village of

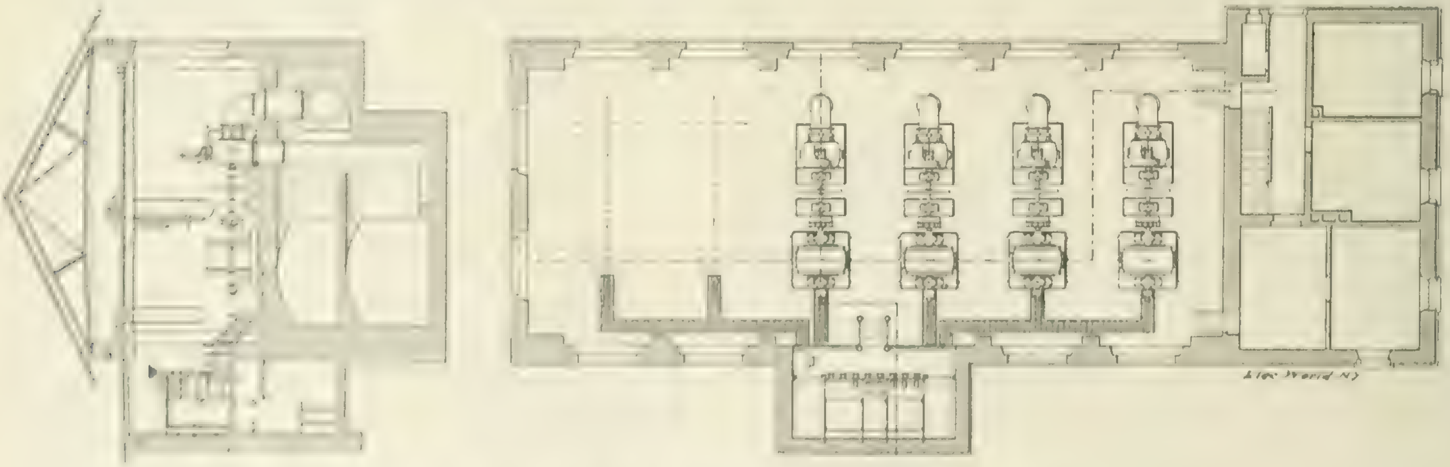


Fig. 2.—Plan and Sectional Elevation of Power House.

[illegible]

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* See The Electrical World, [illegible]

Ballaigues. This is fitted with a fish ladder for the benefit of those members of the finny tribe who wish to migrate past this point. The water is taken from here in an open canal about two miles to the penstock, which is of riveted steel plate, four feet in diameter, and gives an effective head of about 150 feet. The flow obtainable is about 350 cubic feet per second, giving an available output of 1800 horse-power at the turbine shafts.

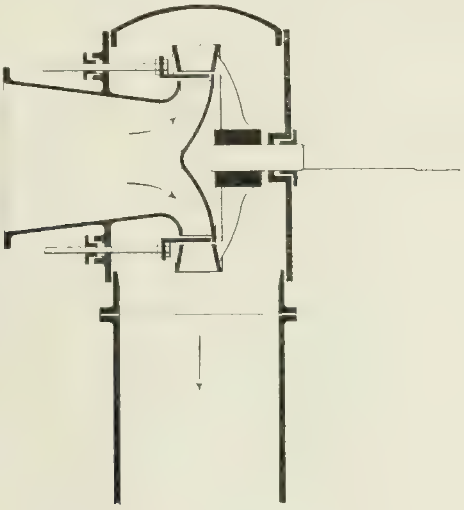

FIG. 4.—VERTICAL SECTION OF TURBINE.

The common foundation for all the machines is immediately on the right bank of the river. They stand on a pier of concrete 130 feet long, 40 feet wide and 2 feet thick. The machine room has a length of 80 feet, a width of about 33 feet and a height of 20 feet, sufficient to hold six sets of 300-hp turbines and alternators. Four groups are already installed and the fifth is under construction. The room is served by a five-ton crane. The switchboard is placed in a gallery in a special bay offset from the middle of one of the long sides of the room. This arrangement is clearly indicated in the plan and end elevation shown in Fig. 2.

The turbines, as shown in the general view, Fig. 3, are horizontal-shaft machines made by Piccard et Pictet, their rated output being 300 horse-power each at 430 r. p. m. As appears clearly in the section, Fig. 4, the intake is axial, with outward radial flow and a vertical draft tube straight down through the floor. The runner overhangs the last bearing on the shaft, and between it and the guide chutes within it is a forged ring gate for adjusting the load. This gate is operated by a mechanical governor mounted on the top of the machine.

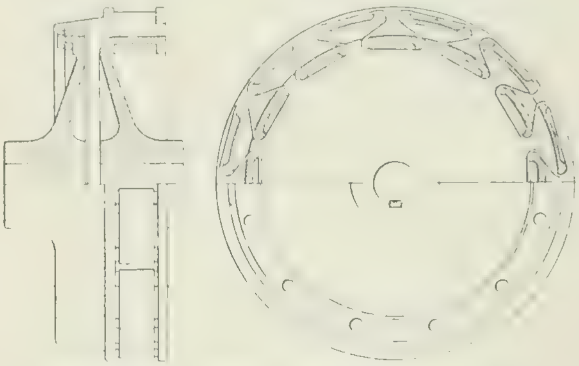

FIG. 5. HALF SECTIONS OF FLEXIBLE COUPLING.

Next to the turbine on the shaft is a fly wheel, as appears clearly in Fig. 3, and beyond the next journal is an odd type of coupling, the construction of which is clearly shown in Fig. 5. This machine, which is known in France as the Zodel coupling, consists of two overhanging concentric crowns, with projections, around which

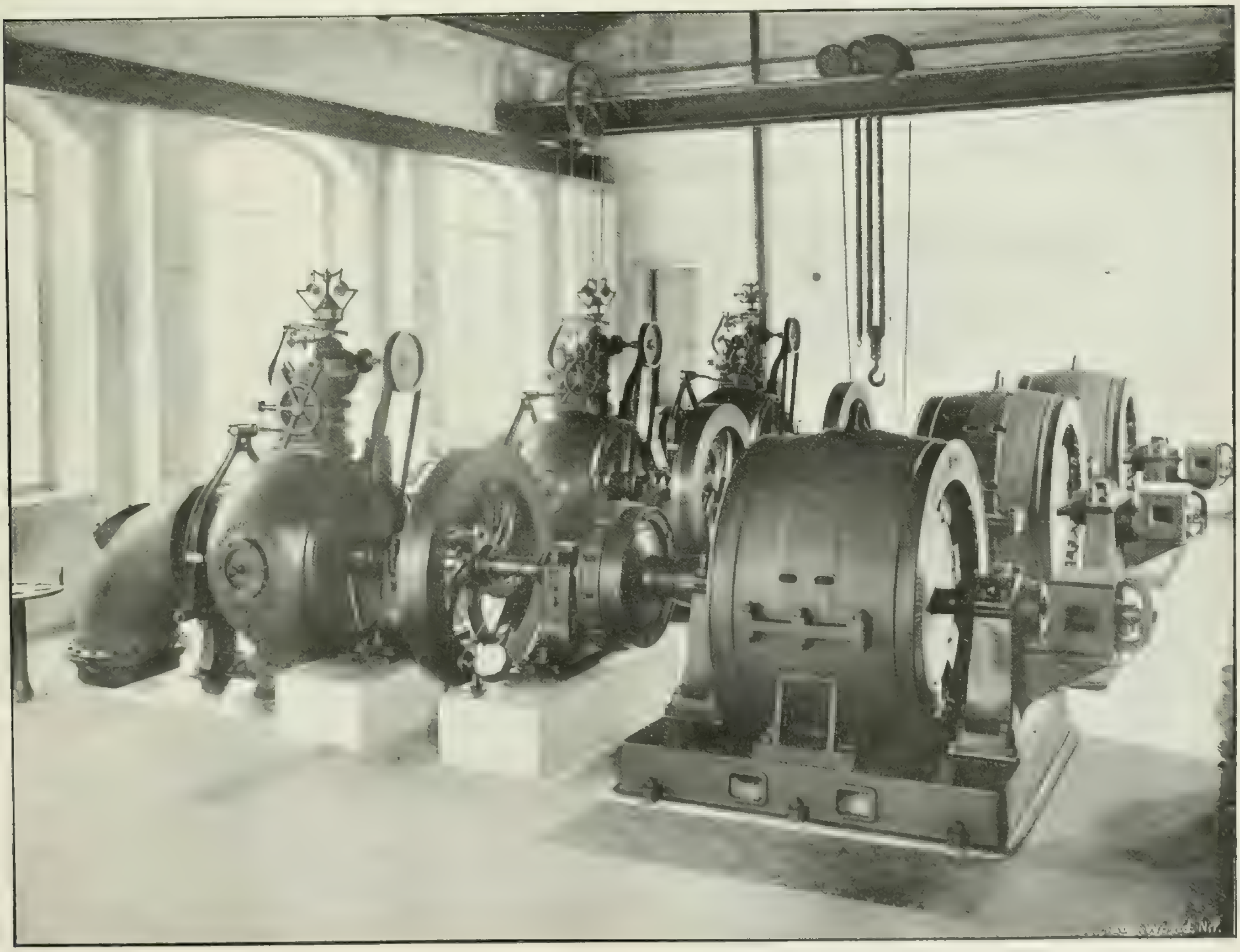

FIG. 3.—GENERAL VIEW OF TURBINES AND DYNAMOS.

is lapped a leather belt, giving flexibility, which allows a considerable variation from true alignment, and also providing electrical insulation. It will be seen that there are but two main journals, each side of the coupling, which removes the necessity for very accurate adjustment.

On each main shaft is a three-phase, 5200-volt inductor alternator, giving at normal speed a frequency of fifty cycles per second. This machine was built by la Société d'Oerlikon, and closely resembles, as may be seen by the cross-section and end elevation in Fig. 6, some American designs of inductor machines. There are two rings of laminated poles on the rotor dovetailed on bars, in turn bolted to the main casting to take up their centrifugal force, and two rings of armature laminations with six slots per pole, giving, as each ring is unipolar, one slot per pole per phase. The field exciting coil is mounted entirely outside the air gap and does not therefore come out when the rotor is removed, but requires the removal of one of the stationary armatures. The end connections of two out of every three coils are bent back exactly as in American practice. The north and south poles are axially in line with each other instead of staggered, and are magnetically connected in pairs by heavy cylindrical yokes. Each machine is fitted with a bipolar exciter coupled to the end of the shaft and supported by a bracket from the outboard pedestal.

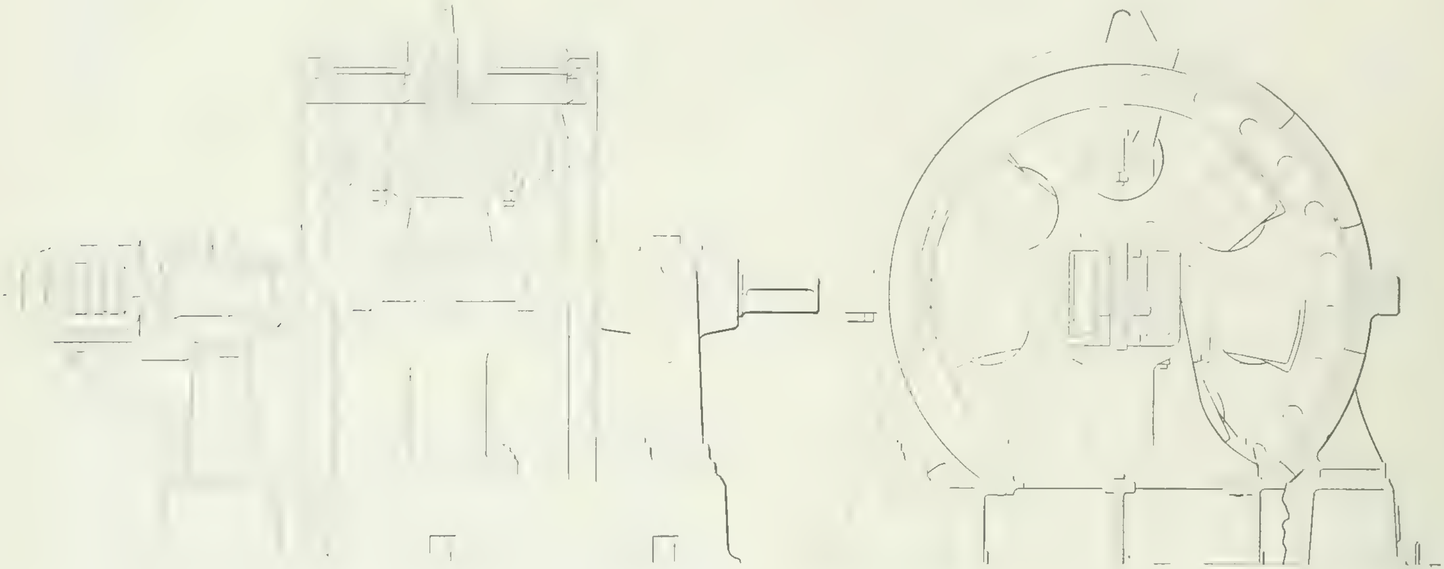

Fig. 6.—Details of Oerlikon Inductor Alternator.

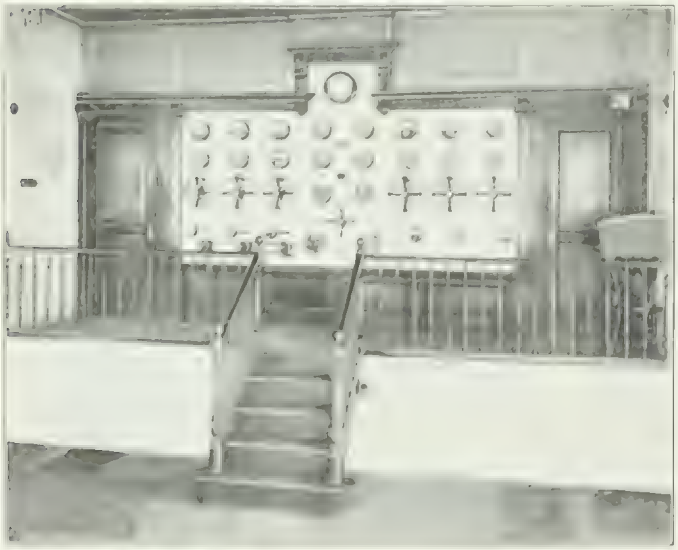

Fig. 7.—The Switchboard Gallery.

The switchboard is shown in Fig. 7. Each machine panel [illegible] and a three-part rotary main switch with a pilot-wheel in front of the board and contacts behind. All the switchboard leads and bus bars are supported on double petticoat porcelain insulators similar to those used on the lines. There are two sets of main buses for the two distribution lines, each of which is fitted with a feeder panel on one side of the board. In the middle of the board is a cross-connecting switch for multipling these two systems, and totalizing ammeters in each line, with voltmeters supplied from differential transformers, which show the actual voltage at the centres of distribution. There is also installed a relay for the automatic regulation of the pressure.

The two main lines are each made up of four copper wires, one having a diameter of 0.28 inch and the other 0.2[illegible] inch. The wires are supported on double petticoat porcelain insulators on poles placed generally 130 feet apart, although there are on the line two exceptionally long spans, one of about 975 feet and the

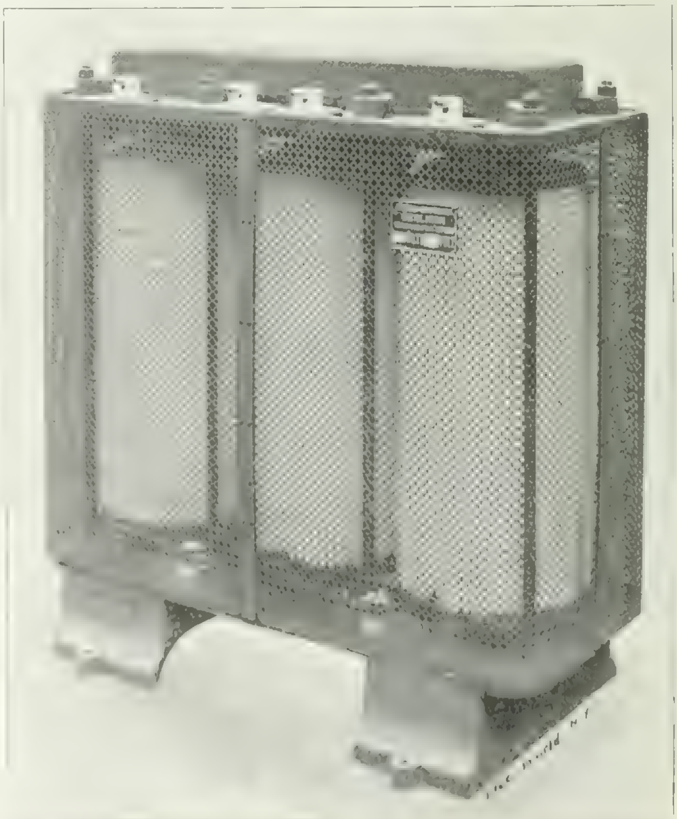

Fig. 8.—One of the Three-Phase Transformers.

other over 1000 feet in length. The total length of the primary lines is about thirty miles. One line feeds some eighteen branches and the other twelve, the map, Fig. 1, showing the amount of power demanded by each of these comparatively small loads. Each tap is taken through a switch fixed on the pole and so arranged that it can be manipulated from the ground. The transformers are as a rule placed in little masonry structures, isolated from other buildings and closed by iron doors, although some are placed in public buildings or on the consumer's premises.

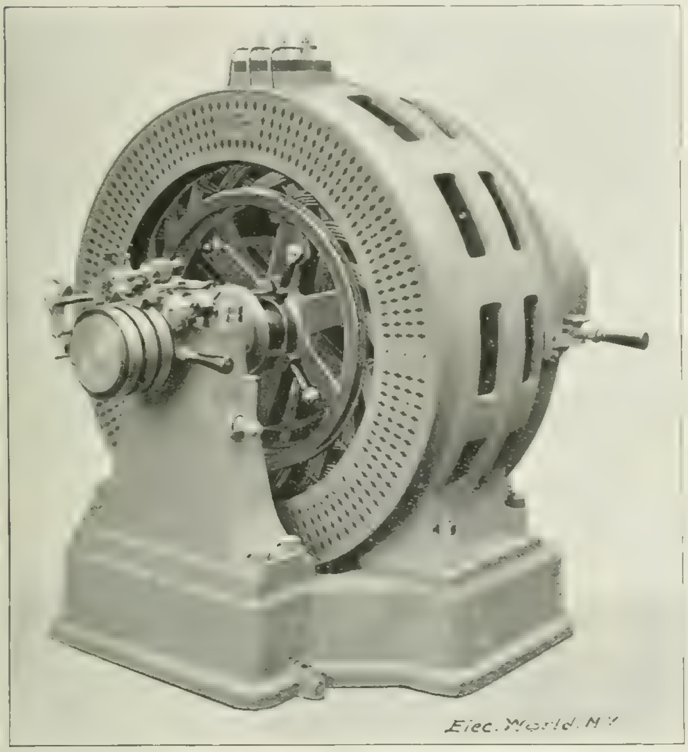

Fig. 9.—One End of the Induction Motor, Showing the Slip Rings.

The transformers themselves, as shown in Fig. 8, are of a three-phase core type, the three cores—one for each phase—being joined together at their ends by common laminæ so that they form a mutual common return for the lines of force. The cores are surrounded by insulating tubes on which are wound the primaries, covered again by insulating tubes with the secondaries outside. There are no ventilating passages or ducts, the transformer being air-cooled by external radiation and surrounded only by a wire screen. Both primary and secondary circuits are provided with four lightning arresters and with switches and fuses. The secondary circuits are run at 120 volts for incandescent lamps, and arc lamps are placed three in series across the same pressure. For the very small loads, but one phase is used, and it is stated that there is no trouble experienced with the regulation from lack of balance.

The lamp load is a comparatively small one, the greater part of the power being used in motors. Of these, an induction type clearly shown in Figs. 9 and 10 is that used for all above 2 horse-power, the smaller sizes being simple induction motors with plain squirrel-cage rotating secondaries. The larger motors, which were also made by la Société d'Oerlikon, are equipped with a special starting device consisting of a three-phase distributed secondary winding, apparently of the Eickemyer type, connected to three collector rings overhanging the bearing, as shown in Fig. 9. In order to get a better short circuit than could be obtained through these rings and brushes, there is fitted on the other end of the machine, shown in Fig. 10, a short-circuiting ring actuated by collars and a lever for internally short circuiting the three terminals of the secondary winding. The primary windings show clearly, all being bent back for the end connections. The smaller motors are run at the lighting pressure, others being fitted with special transformers, only one of 45 horse-power taking the full line pressure of 5000 volts.

The tariffs are considered very low, the rates per 16-cp lamp being scaled according to the amount of use and varying from about $3 per annum, if burned 400 hours, to $4.25 for 800 hours or more. The power for motor service is also sold on a sliding scale according to the amount used, varying per horse-power year from the equivalent of $50 for a one-horse motor to $15 for a thirty-horse motor, larger powers being subject to special contracts. The company has made an effort to obtain a day load by a special rate for small motors used between eight in the morning and four in the afternoon in the winter, or seven in the morning and six in the afternoon in summer. Motor power so used is measured by a meter with a time element and is charged for at the rate of about two cents per hp-hour for a small motor of one horse-power, the scale running down to a cent and a half for a six-horse motor.

The attendants required are two engineers and four assistants at the power station and a lineman in each general locality. The station runs continuously except between 9 A. M. and 2 P. M. on Sundays.

Short Cuts in Dynamo Calculations.

BY CECIL P. POOLE.

ARMATURES.

Five years ago the writer described in print a method then in use by himself, the object of which was economy in time in making preliminary calculations for the dimensions of dynamos and motors. Since then the method formerly used, with much satisfaction, has been modified so as to make it applicable to standard practice in designing, irrespective of personal preferences as to minor details. The "method" consists in basing the calculations for output upon the peripheral velocity, air-gap density and number of conductors, and in adopting at the outset fixed values for the peripheral velocity, air-gap density and proportion of armature covered by the pole pieces for each line of machines of a given type. The analysis follows:

If Φ represents all the lines of force that pass across all air gaps; Nw, the number of conductors on the armature; p, the number of distinct paths in the armature winding, and n the revolutions per second, the expression for e. m. f. will be

$$\Phi\, n \frac{Nw}{p} 10^{-8} = E \quad \ldots\ldots\ldots\ldots\ldots\ldots (a)$$

Now, ignoring fringing, which is practically negligible with the short air gaps commonly found, the flux Φ is equivalent to

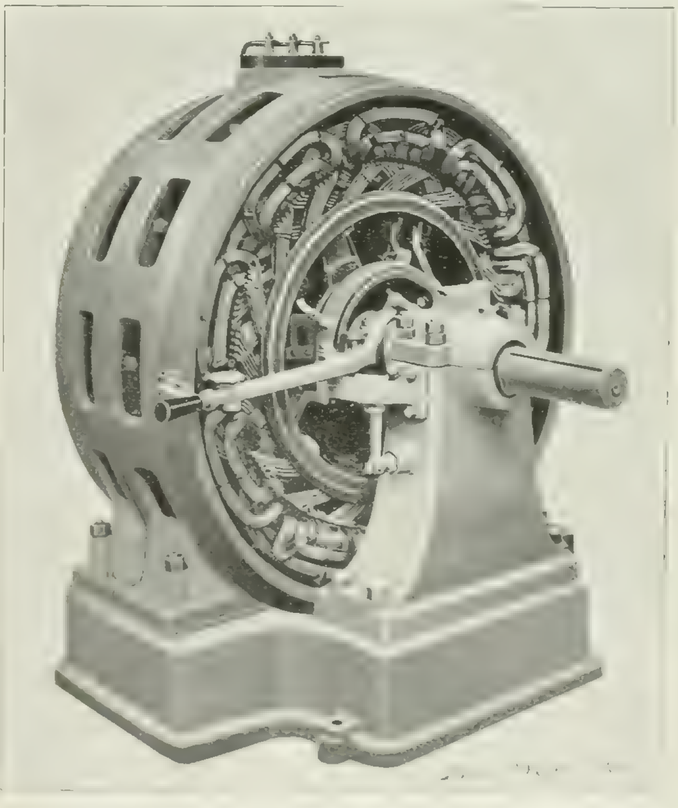

Fig. 10.—The Other End of the Motor, Showing the Internal Short-Circuiting Ring.

$$\mathrm{B}\, D\, \pi\, \alpha\, L.$$

where B is the density per square inch in the air gaps, D the diameter of the armature, L its length and α the proportion of the circumference covered by pole-faces. If dimensions be in inches and the density be reckoned in gausses then, of course, the constant 6.4516 must be included, making

$$\Phi = 6.4516\,\mathcal{B}\,D\,\pi\,\alpha\,L;$$

$$\therefore E = 6.4516\,\mathcal{B}\,D\,\pi\,\alpha\,L\,n\,\frac{Nw}{p}\,10^{-8}$$

If the peripheral velocity, expressed in feet per minute, be represented by S,

$$12\,S = D\,\pi\,n$$

and the formula above can be changed to read

$$1.24\,S\,\mathcal{B}\,\alpha\,L\,\frac{Nw}{p}\,10^{-8} = E \ldots\ldots\ldots\ldots\ldots\ldots (b)$$

For those preferring to work in lines per square inch instead of gausses the equation is

$$12\,S\,\mathrm{B}\,\alpha\,L\,\frac{Nw}{p}\,10^{-8} = E \ldots\ldots\ldots\ldots\ldots\ldots (b')$$

Now, if the values of S, $\mathcal{B}$ (or B) and α be determined for the whole line of machines, they need enter but once into the details of calculation, and may as well be taken out of the formula to be used for individual machines, separating the factors of the fundamental formula into two smaller ones, thus:

$$\frac{1.24\,S\,\mathcal{B}\,\alpha\,10^{-8}}{p} = K \ldots\ldots\ldots\ldots\ldots\ldots (c)$$

or

$$\frac{12\,S\,\mathrm{B}\,\alpha\,10^{-8}}{p} = K \ldots\ldots\ldots\ldots\ldots\ldots (c')$$

and

$$K\,Nw\,L = E \ldots\ldots\ldots\ldots\ldots\ldots (d)$$

The advantages accruing from the above modification of the fundamental formula, and dividing its factors into two formulæ, are that the most tedious calculations need be made only once for an entire line *of a given type*, reducing the calculations on each machine to a nominal amount of work, and that corrections in preliminary dimensions are made very quickly. With fixed values for S, $\mathcal{B}$ (or B) and α the magnetic flux is proportional to the diameter × length of the armature and the rate of revolution is inversely proportional to the diameter; the number of wires (of given size and number of layers) is also proportional to the diameter, so that under these conditions

$$E \propto D \times L \ldots\ldots\ldots\ldots\ldots\ldots (e)$$

and corrections in dimensions need only satisfy the equation

$$D\,L = D'\,L' \ldots\ldots\ldots\ldots\ldots\ldots (f)$$

or

$$L' = \sqrt{\frac{D\,L}{D'/L'}} \ldots\ldots\ldots\ldots\ldots\ldots (g)$$

or

$$D' = \sqrt{D\,L \times D'/L'} \ldots\ldots\ldots\ldots\ldots\ldots (h)$$

D' and L' representing corrected values for the diameter and length of the core, and D'/L' the ratio between the two.

The convenience of the method may be illustrated by an example. Suppose a line of machines is to be designed, ranging from 10 to 25 kilowatts in output and of tolerably low speed; the field magnet to be quadripolar and the armature slotted, or toothed, with as many brushes as there are magnet poles. An air-gap density of 6000 gausses is not excessive, nor is 0.6 for the value of α. The speed may be 2500 to 3000 feet a minute—say 2500. These values substituted [illegible]

[illegible]

[illegible]

strands; taking the larger wire and winding the coils "on edge" (one wire in width and several layers deep), the slots will have to be 0.175 inch wide, each, to accommodate the wire. For prelim- [illegible] tooth will have an angular measurement, on the periphery of the [illegible] slot changes Nw to 672. With eight No. 10 wires in a slot the slots must be 1 inch deep, which will reduce the angular width of a tooth to $\frac{(12.7 - 2)\,\pi}{84} - 0.175 = 0.22518$ inch at the base. The air-gap density being 6000 gausses, the average in the teeth will be about 9100 gausses, which is a fair working density for armature teeth, though it might be made considerably higher. Having changed Nw to 672 the value of L increases to 6.42 inches.

An armature of the foregoing dimensions, etc., will give 125 volts on open circuit in a separately excited field, but no account has been taken of the loss in the winding at full load. The warm resistance of the winding described will be 0.0056 ohm, within a narrow margin either way, making the drop at 90 amperes 5.04 volts, so that to get 125 volts at the brushes the armature must be lengthened to about $\frac{130}{125} \times 6.42 = 6.68$ inches (6.7 practically), increasing the open circuit e. m. f. to 130 volts, and the resistance to 0.05712 ohm, this increase being practically negligible so far as the e. m. f. produced is concerned. The C^2R loss in the armature at 90 amperes is 462.67 watts, and as the radiating surface is about 500 square inches the heating will not be excessive.

The armature just calculated is not put forward as a specimen of ideal design; all the dimensions and basic data were assumed hap-hazard in the course of writing this article, without any preliminary calculation to ascertain the result, the only object being to demonstrate the convenience of the above method of making preliminary calculations. It is obvious that if the C^2R loss here obtained be considered too great by a designer, the remedy is simply to adopt a higher peripheral velocity or air-gap density, or both, thereby reducing the value of Nw, and allowing the use of larger wire as well as fewer turns. Or the slots could be made wider and deeper to take No. 9 wire, making the teeth narrower, as there is room for a material increase in density there.

FIELD MAGNETS.

The application of the above practice is not limited to armature calculations; it may be advantageously used in ascertaining the cross-sectional area of the field magnet cores, yokes and pole pieces. Having tested the iron or steel to be used, and determined the proper density at which it is to be worked, the area of any part of a simple magnetic circuit will be approximately

$$M = \frac{D\,\pi\,\alpha\,\mathcal{B}\,v}{P\,\mathcal{B}'},$$

P being the number of poles, $\mathcal{B}'$ the density in the iron or steel and v the coefficient of leakage. As, for a given design of machine, all of the values excepting those of D and L may be fixed for all sizes within a reasonable range, the equation may be modified to read

$$M = k\,D\,L \ldots\ldots\ldots\ldots\ldots\ldots (j)$$

in which

$$k = \frac{\mathcal{B}\,\alpha\,\pi\,v}{\mathcal{B}'\,P} \ldots\ldots\ldots\ldots\ldots\ldots (k)$$

A convenient formula used by the writer in calculating shunt windings for constant potential machines is the following:

$$\frac{At\,l_m}{V} = d^2 \ldots\ldots\ldots\ldots\ldots\ldots (m)$$

in which At is the ampere turns in the winding; l_m the mean length of one turn in inches; V, the volts at the terminals of the winding, and d^2 the area of the wire in circular mils. As this equation is correct only for a rise in temperature of 50° Fahr., a heating coefficient is required to make it universally applicable. Then it becomes

$$\frac{(0.0052\,\theta + [illegible])\,At\,l_m}{V} = d^2 \ldots\ldots\ldots\ldots\ldots\ldots (n)$$

θ representing the rise in temperature in Fahrenheit degrees.

For convenience and economy in time the writer has deduced the accompanying table of constants, the use of which eliminates [illegible], leaving the expression, for use in connection with this table,

$$k'\,At\,l_m = d^2 \ldots\ldots\ldots\ldots\ldots\ldots (p)$$

the value of k' for various combinations of voltage and temperature rise being found in the body of the table.

Another formula which has been found immensely convenient for getting at the necessary coil space on the field magnet cores is subjoined:

$$\sqrt{\frac{V\,At}{[illegible]}} \cdot d = S \ldots\ldots\ldots\ldots\ldots\ldots (q)$$

where S represents the length along the core in inches, d, the diameter of the wire over the insulation in mils; δ, the depth of the winding in inches; G, the girth or perimeter of the coil in inches, and θ the rise in temperature, Fahrenheit. The result cannot be absolutely accurate, because the "imbedding" of the wires of each layer between those of the layer below, which varies with each size of wire, renders it difficult to obtain, on paper, the exact value of δ. The error being from $\sqrt{.02}$ to $\sqrt{.06}$ it is not important, and the formula saves a good deal of time. Moreover, if the coefficient of shrinkage due to "imbedding" be ascertained experimentally for each size of wire, δ can be given a precise value.

TABLE GIVING VALUES OF K' IN EQUATION (P).

Temp. rise.		Volts.			
Fah.	C.	110	115	120	125
	10	.00854	.00817	.00783	.00752
20		.00858	.0082	.00786	.00755
25		.00368	.0083	.00796	.00764
	15	.00872	.00834	.00799	.007675
30		.00878	.0084	.00805	.0073
35		.00848	.00849	.00814	.00782
	20	.0089	.00852	.00817	.00784
40		.00898	.00859	.00823	.0079
45	25	.00908	.008687	.00832	.00799
50		.00918	.00878	.00841	.00808
	30	.00926	.00886	.00849	.00815
60		.00938	.00898	.0086	.00826
	35	.00945	.00903	.00866	.00832
70		.00958	.00916	.00878	.00843
	40	.00962	.0092	.00882	.00848
81	45	.00978	.00935	.00897	.0086
90	50	.00998	.00954	.00915	.00878
		Other Voltages.			
$k' = \frac{1}{2}$ the table values when V is		220	230	240	250
$k' = \frac{1}{4}$ the table values when V is		440	460	480	500
$k' = \frac{1}{5}$ the table values when V is		550	575	600	

High-Voltage Power Transmission.*

BY CHAS. F. SCOTT.

Several years ago an investigation of the conditions and requirements incident to the use of high voltages was undertaken by the Engineering Department of the Westinghouse Electric and Manufacturing Company. In this experimental investigation the size of the apparatus and the conditions of the tests were as far as practicable such as would prevail in actual work.

The transformer, the *sine qua non* of high-voltage working, received first consideration. A design suitable for large sizes was worked out and tested; then high-voltage windings were made. Attention was next directed to the line insulator.

New phenomena were liable to be presented at higher voltages and it was necessary to determine what they were, also how to meet the requirements which they impose. New forms and sizes of insulators were designed, made and tested to determine the losses which would occur and the limit at which they would break down.

The luminosity and the hissing sound emitted by the connecting wires of high voltage suggested a loss which might be an appreciable addition to that over the surface of the insulators. It was found that a very considerable loss of energy took place between the wires —a loss which at high voltages was much in excess of that across the surface of the insulators.

Mr. L. L. Nunn visited Pittsburg at this time and became much interested in this work. He was a pioneer in power transmission, having put in the first large alternating-current transmission plant in this country, namely, that at Telluride, Col., which was designed by the writer and described by him at the general meeting of this institute in 1892. It was proposed that this work be taken up conjointly by the Westinghouse company and Mr. Nunn, and prosecuted on a much enlarged scale, by operating the original motor over a high-voltage line. In a report to the vice-president and general manager of the electric company, dated April 2, 1895, the writer said: "The transformers would be arranged to give a line pressure of 10,000, which is to be increased by suitable steps to possibly 50,000 volts * * * I regard this as an excellent opportunity to make a thorough and extremely important and valuable test of high-tension working under difficult practical conditions, which our company should take up and carry out as fully as possible." Raising and lowering transformers were made and sent to Telluride, and power for the 100-hp synchronous motor was transmitted at voltages far exceeding any which had been previously used anywhere. Exceptional facilities were afforded for observing the practical operation of high-tension working under severe climatic conditions, and for making measurements. The results of the work were so assuring that the Telluride Power Transmission Company has lately installed a plant which is in commercial operation at 40,000 volts and is now making an increase in the plant. This work has been continued on experimental circuits at East Pittsburg, and some measurements have been made at Niagara.

The work which has just been briefly described was an investigation into an unknown field. It has been progressively and systematically carried out and it has determined results which were unforeseen, and which are of both theoretical interest and practical importance.

This present paper describes the more interesting and important parts of this work and gives the methods by which measurements have been made and the results which have been reached. A number of points of interest and importance are given with regard to long-distance transmission plants now in operation.

HIGH-TENSION TRANSFORMERS.

In 1891 the Westinghouse company furnished transformers for the 10,000-volt transmission to San Bernardino and Pomona. Twenty transformers were used in a set, each giving a pressure of 500 volts and the twenty in series 10,000 volts. This arrangement made the insulation within the individual coils a matter of comparative ease. The insulation between the coils of the high-tension circuit and other parts of the transformer was secured by allowing a space, which was filled with oil.

The first arrangement of transformers for giving from 30,000 to 50,000 volts was made by using a number of transformers, each giving 10,000 or 15,000 volts. The low-tension circuits of the several transformers received current from an insulating transformer in which there were a number of separate coils, each one supplying a separate raising transformer. An arrangement of this kind was used for obtaining the high voltages in the exhibit of the Westinghouse company at the World's Fair. A large transformer was designed in January, 1894. The output of 200 kilowatts was many times greater than that of any transformers which had been made by the Westinghouse company. The transformer was oil-insulated and was cooled by water flowing through a pipe immersed in the oil. This transformer was pronounced a success, and the type was adopted and has been followed ever since as a standard, except that the water-cooling is employed only on the largest size.

The transformer was then rewound for 40,000 volts, and a somewhat reduced output. It was operated at this voltage for a short time, when it was found that through an oversight the insulation between layers was insufficient. In October the high-tension coils were rewound for 60,000 volts, and the transformer is still in use after many months of varied service and a considerable period of inactivity.

The making of a single large transformer for a very high voltage naturally involved new difficulties. Above 10,000 or 20,000 volts there was an unexplored and uncertain field in the matter of insulation. Materials which were commonly used at ordinary voltages might have very different characteristics under the new conditions. Tests were made on materials before the first high-voltage transformers were made, and it has been continued. The large high-tension transformer as made to-day was not designed in a week or a month, but it has been an evolution based upon experimental tests and experience in continued operation.[1]

HIGH-TENSION INSULATORS.

After a high-voltage transformer was constructed, the insulator naturally presented itself as a fundamental factor in transmission. The requisites of an insulator for high-voltage work are, that it shall have a dielectric strength sufficient to prevent the current passing directly through the material, that its dimensions shall be large enough to prevent the passage of current over the outside of the insulator to its support, and that the resistance, both of the material and its surface, shall be sufficiently high to prevent undue loss of energy. In addition to these fundamental electrical requirements are those of a mechanical nature involving strength and convenience. These properties must of course be permanent and not liable to deterioration while in service.

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*A paper presented before the American Institute of Electrical Engineers, Omaha, June, 1898.

[1] See THE ELECTRICAL WORLD, March 5, 1898, page 300.

Up to this time very little attention had been given to the manufacture and design of high-tension insulators. There were available for our laboratory tests the glass insulators which we had designed for the 10,000-volt transmission line at San Bernardino and Pomona, Cal.

A much larger glass insulator was made having the so-called "helmet" form, which was probably the beginning of a type which is now quite common. The large glass insulator presented mechanical difficulties in manufacture, and recourse was had to porcelain. An insulator was designed to be under-hung, the top of the insulator being supported in an inverted cup which was to be bolted to the under side of the cross-arm. From the bottom of the insulator a pin extended which was anchored in a hole in the insulator and held the wire several inches below the porcelain. The object was to place the wire below the cross-arm so that the snow which might pile up on the cross-arm would not come near the insulator. The wire, moreover, instead of being supported upon the top of the insulator, where it is in connection with an extended wet surface, would be supported from the part of the insulator which is most protected and the dryest.

An interesting evolution then began to take place in the manufacture of porcelain. There were eight or ten steps in this history, in which insulators which were presumed by the manufacturer to be satisfactory were broken down on high-voltage test. Porcelain which presented a beautiful smooth glazed surface was often found to contain internal cracks or cavities which were soon traversed by the current. In other cases bits of pebbles or other impurities were found. In still other cases the porcelain was not homogeneous

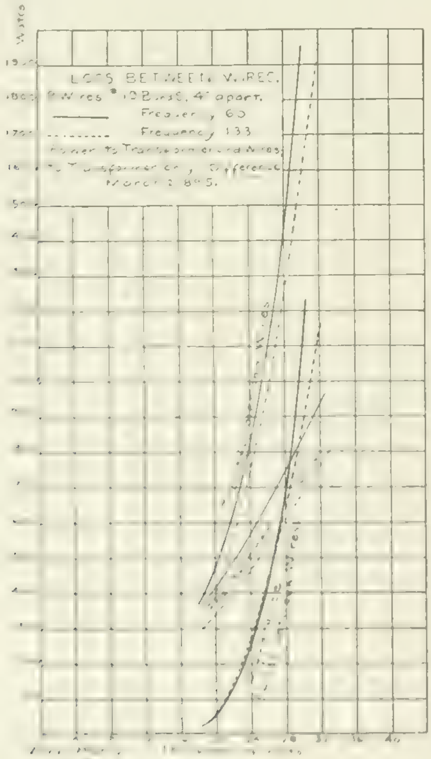


FIG. 1.

[illegible] porous and absorbed a [illegible] of sugar would do. The effect of this work is seen in the improved quality of material now [illegible] benefited by this experience. [illegible] of the unpleasant experiences with porcelain insulators might have been prevented if similar preliminary tests had been made instead of employing the [illegible]

The [illegible], however, did not [illegible] sulation. Moreover, smaller insulators of the ordinary form were [illegible]

[illegible]

insulators. Twenty-four insulators were mounted on wooden pins. A wire was run along the tops of the insulators and a second wire connected the pins. The increase produced in the reading of a wattmeter in the primary of the raising transformer when the wires were connected to the high-voltage terminals was taken as the loss

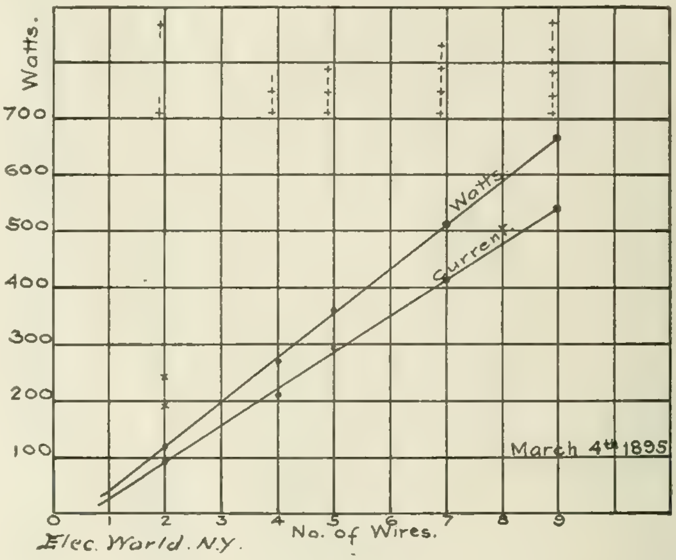


FIG. 2.

on the insulators. The loss at 25,000 volts was about two watts per insulator. This voltage between pin and wire corresponds to 50,000 volts between transmission wires.

LOSSES BETWEEN WIRES.

The loss over the surface of insulators was quite small, in fact almost insignificant compared with the amount of power which would ordinarily be transmitted. The various displays of energy about high-tension wires led us to investigate and determine whether this loss was one of importance. In order to measure the loss between wires, eliminating what occurs on the insulators, it was desirable to have a considerable length of wire, to support it without insulators, and preferably to arrange the wires in such a form as to give a considerable loss. Nine wires each 60 feet long were stretched 4 inches apart in a horizontal plane and were held in place by strings several feet in length at each end. The wires were No. 19 B. & S. gauge, 0.036 inch in diameter. They could be connected in various ways, and any pair or pairs of wires could be omitted as desired.

The power supplied to the raising transformer was measured by a wattmeter placed in the primary low-tension circuit. When the load was placed on the transformer, the wattmeter reading increased, and the amount of increase was taken as the power delivered to the load. This method involves certain errors which will be pointed out further on, but on the whole it gives an approximate and fairly correct indication of the power, and is sufficient to show clearly the general form of the loss curves and a number of interesting characteristics.

The first measurements of this loss are recorded February 26, 1895. The first, third, fifth, seventh and ninth wires were connected in multiple to one terminal, and the other wires were connected to

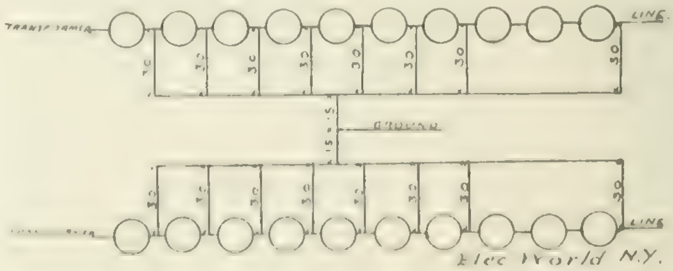


FIG. 3.

the second terminal of the raising transformer; successively increasing voltages were applied.

The wires began to give a hissing or crackling sound and in the dark began to appear luminous at a little below 20,000 volts. As the voltage was increased the sound became more and more intense, the wires vibrated and became more and more luminous, until at the higher voltages they were surrounded by a coating of soft blue light many times the diameter of the wire. Often there were bright points along the wire, probably corresponding to bits of dust or rough places resembling points on the wire. The large room soon became strongly charged with ozone.

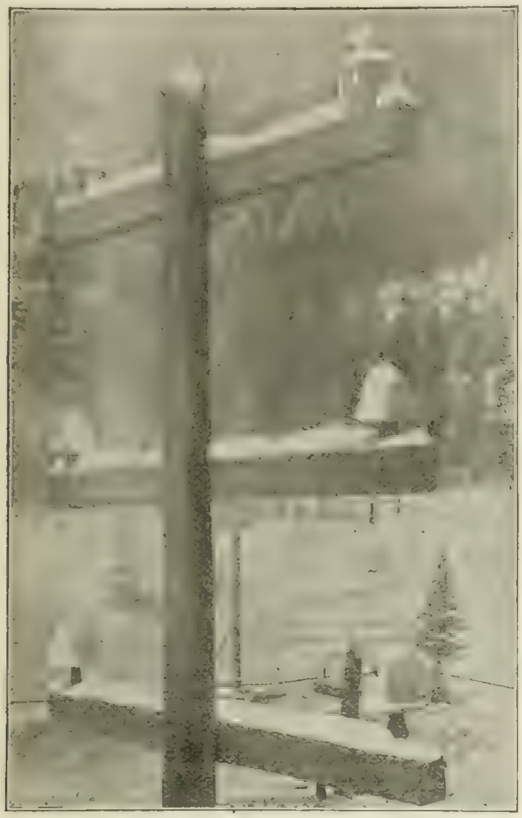


Fig. 4.—50,000 Volts on Large Glass Insulators (Upper Cross-arm) and on Porcelain Insulators (Lower Cross-arm).

Results of measurements on all wires, alternate wires being connected together to one terminal, and the intermediate wires to the other terminal of the raising transformer, are given in the accompanying cut, Fig. 1. Three curves are given for a frequency of 60 periods per second, or 7200 alternations per minute. Two of these curves give the wattmeter readings for the different voltages, one for the transformer alone, and the other for the transformer and high-tension wires; the third curve gives the difference between the two, and therefore represents approximately the loss on the high-tension wires. Corresponding curves are given of tests made at a frequency of 133. The loss in the transformer is less at the higher frequency, but the loss on the high-tension wires is almost the same for both frequencies. These losses are very small below 18,000 volts, but increase rapidly up to 30,000 volts.

As the two sets of tests were made with dynamos having different characteristics they may not accurately represent the relative effects of the frequencies. The difference due to causes other than the frequency are, however, probably small, so that these tests are correct in showing the general relation between the loss and the pressure, and that the loss depends little if at all upon the frequency.

Tests were made with different numbers of wires. In one case the measurements were made with the arrangement described above, in which five wires were connected together and the four intermediate wires were connected to the second terminal of the raising transformer. Two wires at one end were then left off. Two of these were next omitted, leaving three connected to one terminal and two to the other. One of these was left off, leaving the first and third wires connected together, and the second and fourth also. The first and ninth wires were then connected together, also the second and eighth. As the first and second wires were well separated from the eighth and ninth, the mutual effect between them is negligible, so that the loss in this case may be considered as double that which would be obtained from the first and second wires alone. The results of this measurement are plotted in Fig. 2. The points for both loss and current fall on a straight line and indicate that each additional wire causes a definite increase.

Measurements made upon wires at greater distances show that the action is considerably less as the wires are separated. The loss is approximately the same at 28,000 volts when the wires are 4 inches apart that it is at 36,000 volts when they are 16 inches apart. The loss for a distance of 8 inches is intermediate.

Other measurements were made, but nothing of further importance was developed. It is interesting to note that within a few days of the first measurements the general characteristics of this loss were determined, namely, that the loss between wires increases rapidly after a critical voltage is reached, that the loss is practically independent of the frequency, that it is much less as the distance between wires is increased. When a loss of 1200 watts was obtained on a total length of 540 feet of wire at only 30,000 volts, the important bearing of this phenomenon upon transmission became very evident. The tests were stopped as preparations were begun for the continuation of the work at Telluride.

TRANSFORMERS AT TELLURIDE.

The original Telluride plants operated at 3000 volts. Both the generator and the synchronous motor were wound for this pressure. Two transformers were furnished for the high-voltage tests, one for raising the generator voltage for transmission and the other for lowering the voltage for the motor. The windings were connected with a number of terminals by which the high-tension voltage could be varied over a wide range up to 60,000 volts.

Coils of similar shape were placed side by side in what is known as the "parallel" form of construction. Each coil had many layers of wire and but few turns per layer, thus securing a small difference of pressure between consecutive layers. The high-tension winding was divided into four similar coils, each designed to give a maximum of 15,000 volts. The individual coils could be differently connected, either in series or in multiple. The low-tension coils were five in number and were provided with loops, by which the number of effective turns could be varied. Three low-tension coils were placed betwen two pairs of high-tension coils and the two remaining low-tension coils were placed on the two ends. Between the low-tension and high-tension coils metallic shields were placed, which were connected to the ground for protecting the low-tension circuit from danger in case of accidental contact with the high-tension circuit, and also for screening the low-tension circuit from electrostatic induction from the high-tension windings. The transformer was immersed in a case containing oil. The iron and the case of the transformer, as well as the shields between the coils, were connected to the ground.

There was also an auxiliary transformer whose primary was connected across the generator terminals, while its secondary was placed in series with the circuit to the raising transformer, thus either raising or lowering the generator e. m. f. as desired. The secondary had a number of steps so that the voltage could be varied at will.

THE TRANSMISSION LINE.

The line extends from the power station near Ames, which is a few miles from Telluride, Col., to the Gold King mill. The line passes over an exceedingly rugged country and has a total length of nearly 2¼ miles (11,720 feet). There are sixty-two poles, each carrying three cross-arms, the upper being about 26 feet from the ground. Each cross-arm carries two wires supported by insulators which are designated as follows: Large glass, small glass, porcelain. (See Figs. 4 and 5). The large glass insulator is the same as that used on the circuit in the San Bernardino and Pomona plant. The total height is 5 inches and the maximum diameter 5½ inches. The bottom of the insulator stands 1¼ inches above the cross-arm. The porcelain insulator is 4 1-16 inches high and 5⅞ inches in diam-

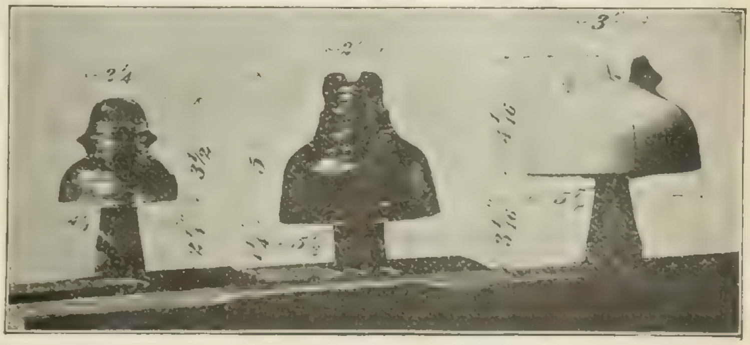


Fig. 5.—Insulators Used in High-Tension Tests at Telluride.

eter. The bottom is 3 1-16 inches above the cross-arm. The small glass insulator is 3½ inches in height, 4¼ inches in diameter and stands 2¼ inches above the cross-arm. This insulator is triple petticoat; the other two insulators are double petticoat. The circuits were strung with galvanized iron wire 0.165 inches in diameter, which is No. 8 B. W. G., and about No. 6 B. & S. gauge. Later the circuit on porcelain insulators was changed to No. 6 B. & S. copper wire 0.162 inch in diameter. The measured resistance of one of the iron wire circuits was 66 25 ohms at —7° C.

THE LIGHTNING PROTECTION.

The lightning protection was laid out by Mr. A. J. Wurts, who previous to this time had spent some months at Telluride, determining the requirements for protecting the 3000-volt circuit. The protection consists of choke-coils and spark-gaps of non-arcing metal.

In each line ten choke-coils were placed. Unit arresters, each consisting of seven non-arcing metal cylinders and having six spark-gaps, were connected as is shown in Fig. 3.

RUNNING TESTS AT TELLURIDE.

The first tests were qualitative rather than quantitative. It was uncertain what phenomena might accompany the operation of a long line at high voltage, and the pressure which could be used on the insulators was a matter to be determined. The first thing was to find what would work; measurements could be made afterward. A high voltage was placed on the transmission line, sometimes transmitting no power and at other times operating the 100-hp synchronous motor. In December, 1895, the motor was operated at 25,000 to 33,000 volts for several days. In January, 1896, 45,000 volts was used continuously for over a week, and beginning with the latter part of March a continuous run of thirty-seven days was made at 50,000 volts. "Some very severe conditions of weather were encountered during this time, very high gales of wind prevailed, the air was filled with clouds of dust; part of the time the snow which fell was quite damp and during the last few days of the run there was some rain. At this voltage the wires were plainly visible at night and the characteristic hissing of high-tension currents could be heard several hundred feet. No lightning arresters had been installed up to this time and the cause of the shut-down was damage to the raising transformer, caused by lightning. Lightning arresters were installed. The lightning season commenced about June 1. During the latter part of June lightning discharges over the arresters were very frequent. At this time we were limited to a running voltage of about 34,000 volts, as there were not enough arresters to permit of increasing the voltage. No trouble whatever was had with the lightning protection. Discharges were frequently seen crossing the arresters and during two or three days in the early part of the season discharges occurred at intervals of a few seconds for several hours. Enough arresters were afterward obtained to run at 45,000 volts, but the lightning discharges were much less frequent."

Some measurements upon the line were made by determining the power given to the raising transformers when the lines were connected and when they were disconnected. These measurements showed that the loss due to the line is small below 45,000 volts, but increases rapidly when about 50,000 volts is exceeded, and reached [illegible] at [illegible] volts. The results up to 72,000 volts are given in curve 2, Fig. 9. Curve 1 in this figure is the loss on the [illegible] curves.

[illegible] five times as great as any which had been in general commercial use. [illegible]

[illegible]

[illegible] none too plenty in the heart of the Rocky Mountains for making measurements which would tax the resources of almost any laboratory. The apparatus used introduced a disturbing influence in the circuit, which, however, could be measured and eliminated. On the other hand, a wattmeter for measuring power on a high-tension circuit must accommodate a very high voltage and a very small current. As the charging current to an open line is usually very large in proportion to the loss current, the error of the instrument is very sensitive to slight variations of phase in the shunt current. (A description of the instruments and the methods used is given in an extract from the report of Mr. Mershon at the end of the author's paper.) The result of the measurements and the conclusions are given partly by extracts from Mr. Mershon's report, and partly in abstract.

RESULTS OF MEASUREMENTS.

"The results of measurements taken are embodied in curves.

"In every case the measurements were taken upon an open-circuited line—in no case upon a line which was transmitting power. The line losses obtained are therefore a combination of those occurring between the line wires and the very small $I^2 R$ loss in the wire itself due to the charging current of the line.

"Measurements taken with the Weston wattmeter include the loss in the high-tension coil of the power transformer due to the currents applied to the line. This loss is in general small and in the following curves corrections have not been made for it. Curves taken with the Thomson wattmeter require no such correction.

"There is an additional correction which may be made in the case of those curves whose voltages were obtained from the raising transformer. This correction arises from the fact that the action of the capacity current taken by the line, in connection with the series reactance of the transformer supplying it, is such as to make the voltage impressed upon the line somewhat greater than that obtained by the ratio of the transformer winding. The measurements taken to determine the amount of the error in voltage show it to be small.

"There were two generators used. One was that regularly running and supplying power to the power circuits of the Telluride Power Transmission Company. It is a 600-kw, 22-pole, quarter-phase machine, delivering 500 volts at a frequency of 60, or 7200 alternations per minute. Its armature is of the slotted type and is wound with copper bars. In the notes this generator is designated as 'Slotted Armature.'

"The other generator is one whose field is that of the 100-kw toothed armature machine, originally sent out as a part of the first Gold King transmission plant. It has twelve poles and as originally run operated at 3000 volts and 10,000 alternations. There are two armatures for this machine—a surface-wound armature, designated as 'Smooth Armature,' and a toothed armature, designated as 'Toothed Armature.'"

A set of measurements was made for comparing the loss on the three circuits supplied respectively with large glass, small glass and porcelain insulators. The curves are very nearly identical and correspond very closely with the right-hand curve in Fig. 6. "There was a heavy wet snow on the ground and the cross-arms at the generating station and more or less snow all along the line, that at the further end being dryer than at the generating station. There was more or less snow falling during the measurements, and this accounts for a wide variation of the points taken at the high voltages, as falling snow renders the wattmeter reading very unsteady, the unsteadiness being such as one might expect if from time to time there was a discharge between the wires. This unsteadiness does not seem to be as great in the case of falling rain as in the case of falling snow."

A series of measurements was made to determine the connection between the loss and the distance between wires. "As at that time it had not been fully demonstrated that the loss was not affected by weather conditions except there was precipitation, changes in distance between wires were made upon one circuit, while the distance between wires on another circuit was maintained always the same, and the latter was used as a reference circuit when a change in loss was observed."

The several curves have been plotted together, due correction being made for the slight difference in the loss in the reference circuit which probably resulted from slight differences in the precipitation when the curves were taken. The distance between the wires in the several tests was 15, 22, 35 and 52 inches respectively. The results are shown in Fig. 6. It will be noted that the loss is much greater when the wires are close together and that the curve begins to ascend at a lower voltage.

The loss curves in Fig. 7 were taken on one of the circuits, first with the Weston wattmeter and then with the Thomson wattmeter. The Weston wattmeter was not in circuit when the measurements with the Thomson wattmeter were taken. As an additional check, the readings were taken on each of the wattmeters of the loss occurring in the shunt resistance; of the Thomson wattmeter the results were in practical agreement with each other and with those obtained by calculation. The discrepancy in the results obtained on the two instruments when measuring line loss will be referred to later.

A set of comparative readings was taken on one of the circuits and on a dummy circuit, identical with the main circuit, as regards kind and number of insulators and the size of wire, but only 60 instead of 11,720 feet in length. The results show that the loss on the two circuits is practically identical up to about 50,000 volts, which is the part of the curve below the bend. The losses agree closely with those shown in Fig. 6. At higher voltages the loss on the dummy circuit increased slightly, indicating that the loss was of the same nature as that at a lower voltage. The agreement of the loss on the two lines at low voltage (*i. e.*, below the bend in the loss curve) indicates that this loss was over the insulators. The great increase in loss on the long line at high voltage indicates that the loss was due, not to the insulator, but to the line.

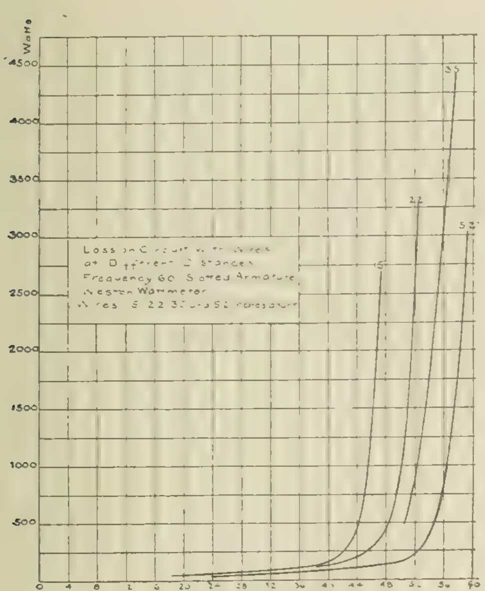


Fig. 6

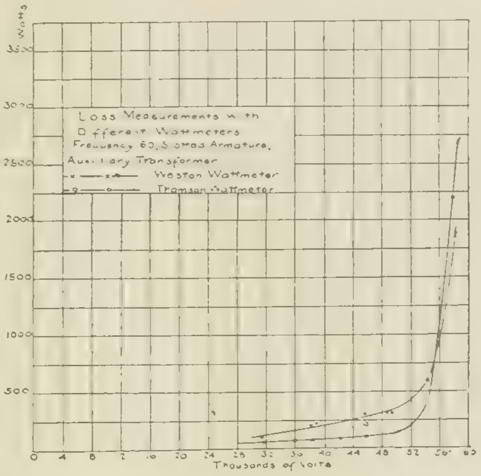


Fig. 7.

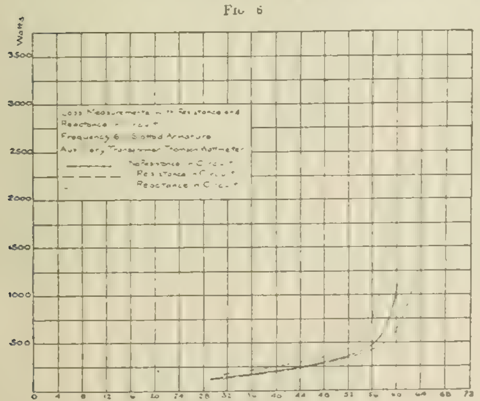


Fig. 8

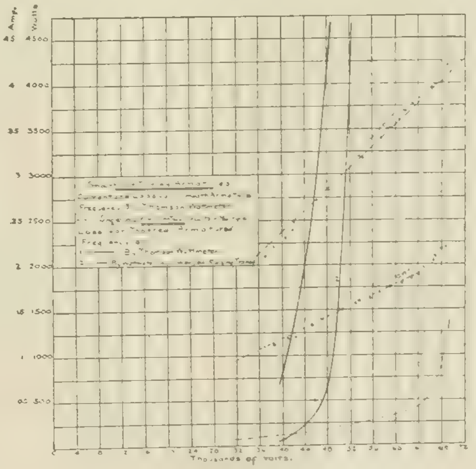


Fig. 9

Measurements were made with resistance between the generator and the raising transformer, then with reactance and then with neither resistance nor reactance. The results are shown in Fig. 8, and indicate a different condition, depending upon the character of the circuit supplying the current. It was presumed that this difference arose from a modification of wave form of the e. m. f. applied to the line.

Measurements were made upon the wave form and the corresponding losses when different generators were used and different circuits were connected. In one test an armature giving nearly a sine wave was used which delivered current at 30 cycles. Measurements were made upon one circuit only, and then upon two circuits in multiple. The current and the loss are both given in Fig. 9.

(To be continued.)

Electrical Fakirs and the Lay Press.

A popular conception of the science of electricity is that a dark and awful mystery enshrouds it, and that those who practice it are wizards endowed with unearthly powers. It has consequently been a fruitful field for fakirs, a sort of happy hunting ground for those who "live by their wits." The sins of falsehood committed in its name have been legion and continue to be propagated, especially by newspapers which should know better, at a fearful rate. It appears that the art of exploiting sensational falsehoods has of late grown to the proportions of a regular business, and that actually a number of "agencies" for the manufacture and sale of lurid literature for the Sunday newspapers are in existence.

The method used is for the sagacious employee of one of these bureaus of prevarication to invent and imagine the tale and sketch it in the rough, leaving out names and places. Then his predatory instincts come into play and he sallies forth to find an accomplice who will "stand for" the principal character. This personage is a degree worse than the writer of the story, because the latter often has the excuse of a living which must be made, while the former is only anxious to play the part of the jackdaw in the fable. Too frequently the accomplice who "stands for" the "fake" is an alleged electrician, the most of such stories as find publicity being about marvelous advances in the electrical line.

There have been some recent yarns duly set forth with pictures and other attractive embellishments that are strongly suggestive of the methods of the news agency. It is deeply to be regretted that the competition of newspapers as to which can publish the most startling sensation and the gullibility of the public have resulted in the common appearance of such matters. The silliness of some of the journalistic "fakes" is almost beyond belief. Schemes to photograph thought (with reproductions of the photographs), to drive all the machinery in New York from the power of the Coney Island surf, etc., are beginning to pall upon the sated taste of the public. Before long we may hear of a revival of the labors of Dean Swift's philosophers, who were engaged many years ago in making sunbeams from cucumbers.

The Brush Multi-Circuit Arc Machine.

Patents No. 613,880, 613,881 and 613,882, issued November 8, 1898, to Mr. C. M. Green and assigned to the General Electric Company, cover the principles and details of the multi-circuit arrangement of the Brush constant-current arc machines. This arrangement, which is now well known to central-station men, consists of a division of the external load into two or more parts, these parts being separately connected in between the several sections of the commutator. The arrangement is such that all parts of the load and of the machine windings are in series, the circuit being first through one section of the armature windings, then out and through one section of the load, back and through the next section of the armature windings, then through the next section of the load, etc., according to the number of circuits, and finally back to the starting point. Thus, in a 160-light, four-circuit machine, for example, the potential rises about 2000 volts on one section of the machine, falls again to its original value in one section of the load and rises again, so that the maximum difference of potential between any two points of the circuit is only 2000 volts, instead of the 8000 that would be obtained without this arrangement. This gives a great reduction of the breaking-down stress on the insulation under ordinary circumstances, but gives practically the full voltage of the machine across any accidental opening in the circuit.

DIGEST OF CURRENT ELECTRICAL LITERATURE AMERICAN AND FOREIGN

By Carl Hering.

Dynamos, Motors and Transformers.

ELECTRIC GENERATORS. Parshall and Hobart. Lond. "Engineering," Nov. 4.—In this continuation of their serial (see "Digest") they continue the discussion of commutation in direct-current dynamos. They point out the importance of the inductance of the short-circuited coil in the design of the machine; the constants concerning this inductance are best determined by actual measurements; in practice a good average expression is that one ampere turn will give a field of 20 C. G. S. lines per inch of length of armature coil; it is convenient to assume this as a basis for working out a design, and after the design is completed the figures are corrected according to the dimensions of the final design. Several tests are described, the results of which have a direct bearing on the value of the constants, and by a study of these results the most desirable proportions of the armature slot can be determined, which will bring the inductance down to, or even below, this figure; they refer to the coils in which the current is being commutated, and the tests described show how to measure this inductance; five such tests, with the tables of results, are described. They give as the practical definition of inductance the following: "A coil has an inductance of one henry when it is situated in a medium of such permeability, and is so dimensioned that a current of 1 ampere sets up a magnetic flux of such a magnitude that the product of the number of lines linked with the coil by the number of turns in the coil is equal to 100,000,000." The inductance is furthermore proportional to the square of the number of turns in the coil.

CONTINUOUS-CURRENT DYNAMOS AND MOTORS. Guilbert. "L'Eclairage Elec.," Nov. 5.—Brief, illustrated descriptions taken from patent specifications.

PREDETERMINATION OF ROTARY PHASE MOTOR DIAGRAMS. Rothert. "Elek. Zeit.," Nov. 3.—An elaboration of this theory and a deduction from it of a simple method for calculating the complete diagram.

ROTARY FIELD MOTORS. Hanappe. "L'Eclairage Elec.," Oct. 29.—Another installment of his long mathematical article. He discusses the elementary graphical theory of non-synchronous polyphase motors in which magnetic dispersion and Foucault current and hysteresis losses are not considered.

Lights and Lighting.

ELECTRIC LIGHTING APPLIED TO ARCHITECTURE. Ekin. "El'ty," Nov. 16.—A reprint of the paper read before an architectural association in which he discusses internal lighting and the manner in which the current should be conveyed to the lights. He limits himself to the incandescent lights. Every room to be lighted should be examined from three different points of view, the purpose for which it is to be used, the decorations, furniture and general surroundings, and the cost of the proposed lighting.

LUMINOUS FOUNTAIN. Lohman. "Jour. of El'ty," Oct. —A detailed, illustrated description of the electrical fountains in the Schilling gardens in Oakland, Cal., which he, in part, designed. The fountain is only 14 feet in diameter.

Power.

ELECTRICITY ON WAR SHIPS. Lond. "Elec. Rev.," Nov. 4.—Extracts from the U. S. "Army and Navy Register," containing [illegible] on board the Brooklyn, showing that it was eminently satisfactory in the recent action off Santiago.

ELECTRIC CAPSTANS.—Lond. "Engineering," Nov. 4.—The [illegible] used by the Northern Railway of France.

ELECTRICALLY OPERATED DRAWBRIDGE. [illegible] "Stevens Indicator," reprinted in "El'ty," Nov. 16.—A reprint of a [illegible] It has been in successful operation for the past five months.

[illegible] by it.

[illegible]

miles, and the current is carried by six copper wires; (what the system is is not stated). The pipe line is 6700 feet in length.

Traction.

HEAVY RAILROAD WORK IN ITALY.—"Elec. Tech.," Oct. 15; abstracted briefly from "Elettricita."—A note stating that on the road from Milan to Monza only accumulator cars will be used, whereas on the road Lecco-Sondrio the high-tension, three-phase current system will be used, the current being generated by water power. According to the "Elek. Zeit.," the work on the line from Milan to Monza is to begin at once.

HEILMANN LOCOMOTIVE.—"Cosmos," Oct. 29.—A note stating that the locomotive is not in service, but that the official reports continue to pronounce the experiment a success. The experiments showed that the vibrations were reduced to almost nothing. It is announced that the locomotive will again be put into service.

ELECTRIC RAILROADS IN HUNGARY.—"Zeit. fuer Elek.," Oct. 23.—Brief extracts from statistics for the end of the year 1897. The total length of street railways was 187.5 km, of which 103.8 were electrical and consisted of eight railways.

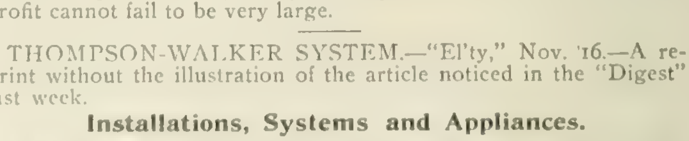
SURFACE-CONTACT SYSTEM. Anderson. Lond. "Elec." and "Elec. Eng.," and without illustrations in Lond. "Elec. Rev.," Nov. 4.—A brief, illustrated description of this system, one of the chief features of which is that the surface contact plugs are not fixed, but have a 4-inch vertical motion; when no car is over them they are flush with the pavement; when a car passes they are automatically raised 4 inches, so as to come in contact with the collector bar, and simultaneously with this motion they are made alive. The cost of the boxes, according to the inventor, is $6000 per mile. The apparatus is essentially a mechanical one, as the studs are raised and lowered mechanically by the car itself through the medium of wires connecting the boxes. The description is fuller in the "Elec. Rev." and "Elec. Eng.," and the illustrations are better in the latter.

ELECTRIC CANAL HAULAGE. Galliot. Lond. "Elec.," Nov. 4.—A short description of the working of his system at Pouilly, in France, which was referred to unfavorably in the recent paper by Allen. Twenty-six kw have been in operation since the beginning of this year; the system consists of tricycles running on the towpaths and fitted with electric motors, the current being obtained from overhead wires; there are two generating stations of 200 horse-power each. Notwithstanding the apparent low efficiency of a tricycle on a common tow-path, the power available on the tow rope averages 60 per cent. of that at the brushes of the motor. The motors are 6 horse-power, which is necessary for 300-ton barges at a speed of 1.5 miles per hour. The assumption of Allen that 2 horse-power could haul 100 tons at 2.5 miles per hour does not agree with Galliot's experience, in which a speed of only 1.5 miles an hour was reached under these conditions. As it has been successful, the lines are to be extended over 84 km, 30 of which will soon be completed. The charge is 0.106 cents per ton mile, empty barges being hauled gratis; although not cheaper than horse traction, the speed and regularity are superior; it is claimed that the profit cannot fail to be very large.

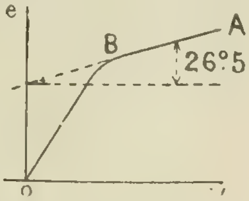
THOMPSON-WALKER SYSTEM.—"El'ty," Nov. 16.—A reprint without the illustration of the article noticed in the "Digest" last week.

Installations, Systems and Appliances.

REGULATION OF VOLTAGE IN A THREE-WIRE SYSTEM. Del Proposto. "L'Eclairage Elec.," Nov. 5.—Descriptions, accompanied by brief theories, of various methods of automatic regulation of the voltage, for very rapid changes in the currents in the two branches. Such a regulator should maintain the voltage between the outers constant, and should divide it equally between the two branches; any system requiring the movement of switches would be too slow; in the methods which he described it is done by the excitation of the machines. One arrangement is shown in the first figure, in which it will be seen that each of the two



dynamos has its own shunt and series windings, and besides this each has an auxiliary field coil through which the current in the neutral wire flows. The shunt winding produces the difference of potential on open circuit, the series or compound winding compensates for the loss of the armature in its own winding -that due to the reaction in the dynamo and the loss in the outside wires; the supplementary winding adds its action to these two to that machine which delivers more current, and deducts it from the excitation of the machine giving less current; this winding should raise or lower the voltage of the machine by an amount equal to the product of the neutral wire current by the sum of the resistances of the neutral wire and twice the resistance of each coil; that is, it should compensate for the loss in the whole neutral wire circuit, including the coils. The second solution is shown in the second figure, and will explain itself; the supplementary coils, in this case, oppose their action to the effect of the other two windings. This method is not as good as the first, as the total amount of excitation is considerably greater. For determining the excitation of each machine in the first case proceed as follows: Calculate the total ampere turns (1) for the normal current and the required voltage at the extremities of the total resistance, including the one outer, the neutral, the series coil and one auxiliary coil; then the ampere turns (2) for the normal current, and the same difference of potential at the ends of the resistance of one outer and the series coil; and finally the ampere turns (3) for the voltage on open circuit; then the ampere turns (1)—(2) should be generated by the supplementary series coil, the ampere turns (1)—(2)—(3) by the series winding, and the rest by the shunt winding. Such machines can serve only for the feeder for which they have been calculated, and no other machines can be connected in parallel to the same feeder. With auxiliary terminals, however, the series excitation can be divided into two parts, all of it being used when only one set of machines is in use, while part of it is cut out when two groups are used in parallel; a similar means can be adopted when a pair of machines is used with feeders of different resistances; they will operate right when the current in the two sets of feeders is divided proportionately to their cross-section, which in general is not the case; in every case, however, the arrangement is better than the usual one. He then discusses similar arrangements for equalizers, which are used when the neutral wire does not go back to the original dynamos, but only to the local equalizer, and consist of two dynamos coupled to the same shaft, one acting as a motor and the other as a dynamo, according to the neutral wire current. In its simple form it cannot equalize the voltages perfectly; moreover, the brushes must always be at the neutral point, because the machines act sometimes as a motor and sometimes as a dynamo; the equalization will be less perfect as the neutral current and the armature resistance are greater. The e. m. f. of the one acting as dynamo should be increased and that of the one acting as a motor should be diminished; this can be accomplished by exchanging the excitations of the two machines—that is, exciting the shunt winding of each from the armature of the other; a practically perfect regulation can thus be obtained by proper proportioning. Let $A\ B\ O$ in the adjoining figure be the curve showing the relation between the e. m. f. induced e, and the difference of potential V applied to the armatures; then the conditions are that the portion $A\ B$ of the curve makes an angle of 26.5°, the tangent of which is 0.5; this condition can be satisfied by proper choice of the sections and materials used, the resistance of the magnetic circuit remaining within the ordinary limits. (Siemens and Halske, who patented the next two methods described, claim that this one will not accomplish the object.) In the next two methods described the two shunt windings are in series between the outers; two supplementary coils are added similarly to the two methods above illustrated for the original dynamos; there are no series coils in series with the outers. He shows how these windings should be proportioned. The first of these three methods is the simplest, and gives the best results, but requires careful proportioning with respect to the magnetic curve, which is not the case with the two latter, the last one of which is preferable to the other. In all three two totally separate machines (except that the armatures are mechanically coupled) are required. He then discusses at some length the effect of the speeds of the armatures in the equalizers, both analytically and graphically. The variation is less than for two motors connected in series to a constant difference of potential; neither the maximum nor the minimum speed will be at no load.



STOPPAGE AT BRIGHTON.—Lond. "Elec.," Nov. 4.—Referring to the stoppage at that station noticed in the "Digest" last week, Tapper states that the substitution of maximum cut-outs for minimum cut-outs would not overcome the difficulty, for if the armature was short-circuited the results would be precisely the same. Undoubtedly, the correct explanation is that the combined effect of decreased speed and armature reaction reduced the dynamo fields to zero; this is a perfectly well-known result on the short-circuiting of a shunt dynamo. The action of the minimum cut-outs was the result, and not the cause, of the cessation of current. A serious danger would be introduced by omitting the minimum cut-outs; if a bad short-circuit occurs somewhere in the network the engineer is in an extremely awkward predicament and cannot re-start. He concludes that the use of non-return cut-outs and separate excitation are the only possible remedies, are absolutely essential, and afford complete security. Philip suggests that the cause may have been a break in the shunt circuit of the damaged dynamo.

PRICE OF ELECTRICAL ENERGY IN NEW YORK.—Lond. "Elec. Rev.," Nov. 4.—An editorial discussion of the recent reduction in price of the Edison Company in New York, criticising the system and showing that the charges are high. It is admitted that in tramway enterprise England is behind America, but in the distribution of cheap electricity the English have nothing to learn from New York.

BATTERY BOOSTER.—Lond. "Elec. Eng.," Nov. 4.—Several answers to the question whether a 40-volt shunt-wound dynamo is the best booster to use for raising the voltage of a 100-volt circuit for charging batteries; also whether it is not likely that the booster may reverse.

CONTROLLING APPARATUS IN CENTRAL STATIONS. Dunning. Lond. "Elec. Eng.," Nov. 4; reprinted in "El'ty," N. Y., Nov. 16.—A short article giving practical hints concerning switchboards and other controlling apparatus.

NURNBERG. Scholtas. "Elek. Zeit.," Nov. 3.—The beginning of a very long, well-illustrated description of this station, in which the simple alternating current is used. The station contains four direct-connected dynamos of 500 horse-power each and one of 1000.

ARSENAL PLANT.—Lond. "Elec. Rev.," Nov. 4.—A brief, illustrated description of the plant at the Woolwich arsenal. It consists of a single direct-connected, continuous-current dynamo, which is said to be one of the largest in the United Kingdom; it has a nominal output of 375 kw at 330 volts, and a speed of 120; the total weight of the dynamo is 40 tons.

DRIVING EXCITERS.—"Jour. of El'ty," Oct.—An editorial discussing the best means of driving the exciters in a water-power plant. If driven from the alternator its speed will fall when that of the alternator falls, and this is not preventable; if driven direct by a small water-wheel there is a liability of the wheel-nozzle becoming choked, but this is preventable. The inference is to use the latter method.

POSSIBILITIES WITH ELECTRIC LIGHTING PLANTS. Poole. "Jour. of El'ty," Oct.—A reprint of a paper read before a Western gas association, and intended for managers of gas plants who are "saddled with an electric light plant" which is not paying; he endeavors to show how such plants may be made profitable.

Wires, Wiring and Conduits.

RULES AND REGULATIONS.—"L'Eclairage Elec.," Oct. 29, and "L'Elec.," Nov. 5.—A reprint of the official instructions accompanying the law concerning electrical conductors in France. Under high-tension installations are included those using continuous currents of more than 600 volts or alternating currents of more than 120 effective volts as a maximum; low-tension installations are those using currents below these voltages.

ELECTROLIERS.—Lond. "Elec. Rev.," Nov. 4.—Illustrations of some new artistic fittings.

Electro-Physics and Magnetism.

EFFECT OF SOFT IRON ON HIGH-FREQUENCY CURRENTS. Pellat. "Comptes Rendus," 126, p. 731; abstracted in "Science Abstracts," Oct.—A certain negative experiment might appear to show that iron is not magnetized in the magnetic field alternating with high frequency, but another experiment shows that the iron is magnetized and that its magnetization may have a considerable influence on certain phenomena. His experiments show that the presence of even a small quantity of iron in the axes of a coil prohibits the use of a certain classical formula for obtaining the value of the oscillating current.

DISTRIBUTION OF MAGNETIC INDUCTION IN STRAIGHT IRON RODS. Gill. "Phil. Mag.," Nov.—A study of such distribution was necessary in a new method which he devised for measuring magnetic hysteresis, the principle of which method is that the mechanical work is measured when a specimen of iron is passed through a magnetic field, a method which does not require specimens of any particular dimensions or shape. Under these conditions the induction varies greatly from the centre to the end. In this method it is necessary to know the amplitude of the cycle, referred to as b, through which the whole specimen would have to be taken to give the same loss as that measured; if the distribution of the inductance, when the specimen is in the centre of the field, is known, the value of b can be calculated by an equation which he gives. To determine this distribution requires some time, and is tedious, and he therefore devised a method of determining its value in a simple and direct way; this is the subject of the present paper. From the results he found that the ratio of b to B maximum is constant as long as the centre of the specimen is not saturated (B maximum being the induction at the centre); also that this ratio varies only by a small amount for specimens of different relative dimensions, and is constant for all specimens whose length is less than 30 times the section; when this ratio is known the value of b can be determined by simply measuring the induction at the centre of the specimen; the value of this ratio when the length is less than thirty times the section is 0.768. This method can be applied over the whole range of induction used in practical work. The method of observation used in determining this is described and the results are given in detail. Fleming, in a paper on the measuring of hysteresis loss in straight iron strips (see "Digest," July 3 and Oct. 2, 1897), determined the value of *b* and found that at a point of the specimen whose distance from the centre is a certain fraction of the half length the induction is always equal to *b*; the author finds this to be true as long as the centre is not saturated; also when the length of the specimen is less than thirty times the section; Fleming found this distance to be 0.56 of the half length, while the present author found 0.564; but the error in the value of *b* may be much greater if obtained by measuring the induction at this point as suggested by Fleming, as a small error in placing the coil would give a large error in the result; but if the induction at the centre is measured, a small error in placing the coil would give practically no error in the result.

ENERGY OF A MAGNETIC FIELD. Pellat. "L'Eclairage Elec.," Oct. 20.—An Academy paper deducing some formulas based on the quantity of heat absorbed or given out in order to maintain the temperature constant during the charge.

POWER TRANSMISSION THROUGH AIR. Trowbridge. "Sc. Am.," Nov. 19.—After a brief description of Tesla's new method of transmitting power through the air without wires, he refers to his own recent experiments with high voltages. He has increased the voltage obtainable with his apparatus to 3,000,000. Up to 1,500,000 volts the length of the discharge in air appears to be closely proportional to the e. m. f., but when this is exceeded the proportionality no longer holds, for with 3,000,000 volts the spark is only 7 feet, while it should be about 10 feet. The reason for this is that from both terminals there is a luminous brush discharge, and the resistance of the air diminishes under the action of such high voltages. A few experiments are described; in view of these he is led to believe that ordinary air under high voltages acts like a fairly good conductor, and he can conceive of such high voltages that the initial resistance might not be more than the resistance of metals. In employing such high voltages as Tesla suggests the great loss could only be obviated by shifting his entire generating apparatus far above the surface of the earth.

Electro-Chemistry and Batteries.

DEPOSITING METALS DIRECT FROM THE ORE. Hoepfner. "Elek. Zeit.," Nov. 3.—A reprint in full of his paper which was read at the meeting of the Union of German Electricians. It refers chiefly to his process as applied to copper and briefly to other metals also. His process is now in use in Germany, and has shown that it is a success; one installation, which is to be completed this fall, will have a daily output of 1000 kg of copper per day. The ores are first ground fine, then leached in a hot solution of copper chloride, which is said to dissolve the copper, silver, lead and nickel, while the solution is changed to cuprous chloride; it is then filtered, freed from arsenic, antimony, bismuth and iron by means of lime, and then freed of its silver; the solution flows in two parts through a vessel containing a diaphragm, an anode of carbon and a cathode of copper; in the cathode chamber the copper is deposited from the solution, while in the anode chamber the chloride set free combines with the solution, forming cupric chloride, which is then used again for dissolving more of the ore; the process is therefore completely cyclic without any consumption or loss of the liquid. Tests have shown that from an ore containing 3.37 per cent. of copper 91 per cent. is extracted in four hours, while only 3 per cent. of the iron is dissolved; in a longer time 98.5 per cent. of the copper was dissolved, while only 4 per cent. of the iron went into solution. The lead and nickel contained in the cathode chamber after the copper has been deposited are then also separated out, the former in spongy form and the latter in a solid deposit, absolutely free from copper, although containing a little cobalt. He then compares his process with the copper sulphate process of Siemens and Halske; the latter does not separate out the silver, and is therefore valueless for many ores; his process yields per ampere twice as much copper as the sulphate process, because he deposits the copper from a cuprous solution; it requires a voltage of only 0.8, and has a current efficiency of 90 per cent., so that 1 horse-power per day will deposit 44 kg of copper, as compared with 15 kg in the sulphate process; moreover, the silver, lead and [illegible] the case of the sulphate process; [illegible] can be [illegible] it can be separated out [illegible] valuable by-product. There [illegible] their purpose and do not deteriorate. If the electrolytic processes, half a kilogram of [illegible]

ter results, as ores containing only 6 to 8 per cent. of zinc can be worked; the presence of lead does absolutely no harm; the zinc which is deposited is almost chemically pure; other valuable metals, such as gold, silver and copper, are also obtained; the value of the by-product—chloride of calcium—covers the greater part of the cost of the process; the preparation of the solution is not as simple as its electrolysis; he intends to modify his process so that the chlorine can be used over again, as in the copper process; the voltage is only 1.0 to 1.2, while when both free chlorine and zinc are produced it requires 3 to 4 volts; for one kg of coal about three-quarters to 1 kg of zinc can be obtained, while in the distillation process from 5 to 6 kilometres of coal are required. In conclusion he refers briefly to the possibilities of obtaining electrical energy by an electrochemical process; he suggests inverting his process, so that the metals are dissolved, yielding a current, the oxide of the metal being then reduced again by means of coal; he thinks he has already found a method of doing this.

ELECTRIC DEPOSITION OF COPPER. Brown. Lond. "Engineering," Nov. 4.—A note stating that the description of the Dumoulin process (see "Digest," Nov. 12) was wrong in so far as it refers to the use of animal matter for making the deposit smooth. It was found in practice in the use of the Elmore process that the agate burnishers were not the cause of the foliation, but on the contrary were found to give better results than any other burnishers.

GALVANIC DEPOSITS ON NON-CONDUCTORS. Knothe. "Elek. Anz., Oct. 20.—A description of the best process for coating objects that are non-conductors. It is hopeless to try and form a metallic coating by chemical means, and the only satisfactory methods are to use graphite or a coating obtained by a solution of silver. The graphite method is briefly described, but is considered inferior to the silver solution method. For the latter a solution of nitrate of silver in alcohol is used, the body being dipped into it or coated with it; it is then placed in the vapor of phosphor or sulphide of hydrogen, which converts the coating into a conductor; the sulphur method is preferred because the coating adheres better and the process may be repeated if not successful at first, while that is not the case when phosphorus is used. The silver solution should be made neutral with ammonia, as it will then adhere better to greasy surfaces and hastens the sulphiding process. With such a coating the first deposit is formed a little more rapidly than with graphite. The object should have one or more copper conductors attached to it to start the deposit; these starting points are best placed in the deeper portions of the object. The object should first be treated so that all pores are filled and that it becomes waterproof; this is done with wax, tallow or a mixture of the two and collodium; wood is best boiled in linseed oil. The silver solution is made of 2 parts by weight of silver nitrate, 4 parts water, 5 parts ammonia of 0.9 sp. gr. and 6 parts of absolute alcohol; when the ammonia is added a brown precipitate is first formed, but is re-dissolved. After being coated with this it should be completely dried and freely exposed to the air for some time; it is then subjected to the action of the hydrogen sulphide; this process may be repeated as often as is necessary. The current for depositing the copper should be only 0.5 to 1 ampere per sq. decimetre of surface and at 0.75 to a maximum of 1.5 volt. The copper solution should consist of 3 to 4 parts of water to 1 part of the sulphate and 2 to 8 per cent. of sulphuric acid. The hydrogen sulphide is obtained by pouring dilute sulphuric acid on iron sulphide. A metallic deposit on glass, porcelain, etc., is best obtained by coating it first with gold paint and then firing, after which the deposit can be made. Or the objects may be covered with a coating of wax or resin, which is then coated with a silver solution as above described. Celluloid may be coated in the same way. Collodium or celluloid may also be coated with a solution of phosphorus in ether-alcohol added to a solution of concentrated silver nitrate; the object is then painted with the creamy precipitate which is formed. To try to use copper salts in place of the silver salts would not give good results.

ALKALI MANUFACTURE.—Lond. "Elec. Eng.," Nov. 4.—A brief description of the Hargreaves-Bird process, other descriptions of which have already been referred to. The anode chamber, containing a strong salt solution and carbon electrodes, is separated by partitions of asbestos cloth from the cathode chambers, a sheet of copper wire gauze being pressed into the outside of the partitions. The novel point of the method is that although these partitions are quite impervious to salt solutions under ordinary circumstances, yet when an electrical current passes from the carbon to the wire gauze, metallic sodium passes through the partition and is converted into caustic soda by means of steam. Fourteen electrical horse-power could decompose 15 cwt. of salt per week; this amounts to about 117 watt minutes per gram of salt decomposed; the e. m. f. is 2.2 volts; theoretically the energy necessary to decompose one gram of salt is 61 watt minutes.

WHITE LEAD.—"Elec. Rev.," Nov. 16.—An anonymous communication calling attention to an electrical process which is in operation in Brooklyn producing from 5 to 6 pounds of white lead per hour or 2 pounds per electrical hp hour. A solution of ammonium nitrate and bicarbonate is used; the process is continuous and the cost depends only on the cost of the electrical energy; the product is said to have a covering capacity equal to that of the best quality.

GOLD FROM SEA WATER.—"Eng. and Min. Jour.," Nov. [illegible].—An illustrated description of the "accumulator" used by Jernegan with which he professes to have extracted the gold from sea water; it is given as a matter of curiosity, as it has no scientific interest. It consists simply of a vessel into which the sea water is forced near the bottom; there is a suspended platinum anode, while the cathode is mercury at the bottom of the vessel, and in this the gold is said to be absorbed. The experiments are being continued by the president of the company.

Units, Measurements and Instruments.

MEASURING EARTH PLATE RESISTANCE FOR TELEPHONE CIRCUITS. Nowotny. "Zeit. fuer Elek.," Oct. 23.—After discussing the methods in general, he describes one of them in detail and gives a number of comparative results. The measurement of the resistance to earth is important, whether it is used for single-wire circuits or only for lightning arresters; it is therefore important to measure numerous earth resistances in a large telephone station, including the earths at the numerous subscribers' ends, and a simple method is therefore desirable. If there are two other earth connections which can be used conveniently, then the well-known method can be used in which all three of the earth resistances are determined; if there is only one such additional earth connection the Wiechert method gives good results; but often there is no such additional earth connection, and one would have to be made, which is tedious and expensive; this can be obviated by using the earth connection at the central station, together with the line wire, as the second earth, in measuring the resistance of the earth plate at the subscribers' end. For the measurements he prefers to use the bridge method with interrupted currents and a telephone; when the line wire to the station is very long he prefers using another earth connection nearer at hand. In this Wiechert method the two earth plates, connected in series, are made the two arms of a Wheatstone bridge, one of them, however, having also in series with it a known resistance; the other two arms are adjustable resistances, such, for instance, as a slide wire resistance; one of the poles of the telephone which is used in the place of the galvanometer is connected with the sliding contact, while the other is connected to earth through any convenient earth contact whose resistance does not enter into the calculation. This enables the ratio of the two earth resistances to be determined; they are then measured in series, which gives their sum, and from these two determinations each of the earth resistances can be calculated. He found that better results are obtained when the battery and the telephone are transposed, one end of the battery being connected to the so-called earth contact. As a check, the two earth-plate connections may be reversed and the bridge measurements repeated. The tabulated results of his tests show a sufficient agreement for all practical purposes.

ALKALIMETRIC METHOD OF MEASURING SPARK DISCHARGES. Cardani. "Nuovo Cimento," 7, p. 105; noticed briefly in "Science Abstracts," Oct.—With a certain solution, through which a number of sparks has been made to pass, he measures the amount of soda liberated by each spark, from which the electrical quantity discharged by the spark may be calculated. The amount of soda set free is determined by adding to the solution another, which will bring it back to the original color, the amount of this second solution being a measure of the quantity of soda.

MAGNETIC FLUXES IN METERS AND ELECTRICAL INSTRUMENTS. Campbell. Lond. "Elec.," "Elec. Rev.," and "Elec. Eng.," Nov. 4.—A brief abstract of a Physical Society paper in which he describes how he measured the magnetic fluxes and fields in certain instruments in order to determine the order of magnitude of the flux density and the total flux. The methods are described in detail, and important deductions are made (although not in the abstract), one of them being the influence of the earth's field.

TESTING SHEET IRON. Roehr. "Elek. Zeit.," Oct. 27.—He gives the results of some measurements made with the Koepsel apparatus by both the step-by-step method with continuous current and the direct method with alternating current and a wattmeter. He shows that that apparatus, when properly used, gives very correct and reliable results; the hysteresis loops agreed very well; tables of results are given. He states that the Steinmetz coefficient can be used only in connection with the hysteresis loss, and claims that too much importance is given to it because, according to the Reichsanstalt, it may vary from 30 to 40 per cent. It is much more important in forming an opinion of sheet iron to have the characteristic hysteresis loop and to determine the loss directly from it. He found that a plate taken from the edge of a large sheet gave better results than one taken from the middle. The amount of carbon contained is a very good indication of the loss, and not, as is often supposed, the amount of manganin; a high percentage of carbon diminishes the loss quite appreciably. It has been possible to reduce the loss from 10,000 to 6000 ergs per cb cm through the aid of proper investigations. A table compares the results obtained with the alternating-current and the continuous-current methods; the second method has advantages over the first, as it gives the curve of the loop and the amount of coercive force and resonance, but a serious objection is the accurate determination of the cross-section of the sample, which latter is more easily done by the second method.

PHOTOMETER.—Lond. "Elec." and "Elec. Rev.," Nov. 4.—A brief, illustrated description of a new form of Preece-Trotter photometer made by Nalder. It is as accurate as the old patterns, but its weight and bulk are reduced to a half, while the cost is considerably less than that of the original. An amyl-acetate lamp is used in place of the incandescent lamp and accumulator. The apparatus consists of a very short horizontal tube mounted on a tripod; the screen is on the upper side of one end, and is illuminated on one side by the lamp by reflection from a movable screen, the inclination of which can be changed so as to vary the light falling on the fixed screen; the inclination is read off by means of a pointer and scale, the reading giving the illumination directly in candle-feet.

STANDARD HIGH RESISTANCES. Fawcett. "Phil. Mag.," Nov.—A reprint of his short Brit. Assn. paper describing a high resistance, which is both cheap and reliable. It consists of a thin metallic film deposited in vacuum from a metallic cathode; by making the cathode of a grid of wires the deposit on a parallel plate of glass will be quite even; if the wires are of two different metals the deposit seems to be an alloy of these; in his experiments gold-platinum films were used exclusively. These films should be boiled for several hours under reduced pressure in a non-conducting, chemically inactive oil; the film is then hermetically sealed in its oil bath and the vacuum maintained; after this treatment the resistance undergoes no further measurable change. The temperature coefficient decreases as the thickness of the filament decreases, and it may therefore be possible that it may be made negative, and therefore also zero. The filament thus obtained is scratched with a needle with parallel lines extending from either side to near the other so as to form a zig-zag strip, the scratching being continued until the resistance has the required value. It has the following useful properties: Constancy of resistance, small temperature coefficient, negligible capacity, negligible self-induction, and ease of adjustment to definite value. A megohm was subjected to 105 volts for five days without experiencing any detectable alteration.

TEN CANDLE-POWER STANDARD. Harcourt. Lond. "Engineering," Oct. 28.—A brief notice of his Brit. Assn. paper in which he described his new 10-candle pentane standard lamp. A similar one of 16 candle-power can be constructed on the same principle.

INFLUENCE MACHINE. Pidgeon. Lond. "Elec.," "Elec. Rev." and "Elec. Eng.," Nov. 4.—An abstract of a Physical Society paper. "The machine consists of a pair of glass discs, rotating in opposite directions upon a spindle. They are partially covered on one face with narrow radial sectors of tinfoil, each provided with a small brass knob. This face of the disc, including its sectors, is then coated with insulating wax, leaving only the knobs projecting through the wax. Two earthing brushes pass through two insulated fixed inductors and support them. The inductors are kept charged by exploring points connected to each, and placed so as to collect electricity from the revolving discs. By means of brushes the sectors on each of the discs are successively earthed at the moment they pass the fixed inductors, i. e., at the moment that their capacity is a maximum; and they are made to deliver up their charge to the main collecting brushes at the moment when they are electrically farthest from the inductors, i. e., when their capacity is a minimum. Hence, if there is no loss of electricity in the process the potential at the collecting brushes is proportionately high. Each sector of a particular disc, as it moves away from its inductor with rising potential, induces a corresponding potential on the sectors opposed to it on the second disc; this action is cumulative. The thick coating of wax restricts leakage to the small area of the contact knobs, so that surface effects of dirt and moisture are minimized." In the discussion J. H. Thomson called attention to the advantages in mechanical construction; he also found that about 80 per cent. of the power used to drive it was wasted in mechanical friction and of the remaining 20 per cent. a great deal was lost by leakage. The Lond. "Elec. Rev." says that one of the merits of this machine is its absolute immunity from the evils arising from surface moisture and dust; this mixture of paraffin wax and resin adopted does not commend itself, as the wax itself absorbs moisture and the resinous mixture retains the electrical charges.

Telegraphy, Telephony and Signals.

THE TELEPHONE IN GREAT BRITAIN.—Lond. "Elec.," Nov. 4.—Extracts from the official report of the parliamentary committee: it is chiefly of local interest.

HERTZIAN TELEGRAPHY.—"L'Eclairage Elec.," Oct. 8 and 15.—An illustrated abstract of the article of Ducretet noticed in the "Digest" Oct. 8.

ELECTRICAL ALARM. Ebel. "El'ty," Nov. 16.—A reprint of the article noticed in the "Digest" last week.

PERSIA.—"El'ty" and "Elec. Rev.," Nov. 16.—A reprint of the short article noticed in the "Digest" last week.

Miscellaneous.

PRESIDENTIAL ADDRESS. Preece. "Elec. Eng.," Lond. "Elec." and "Elec. Rev.," Nov. 4.—The beginning of a reprint in full in the first and a very full abstract in the latter two journals, of his presidential address before the Institution of Civil Engineers. The first part, chiefly of local interest, refers to the Government examinations and to technical education in Great Britain. He refers to the generous and enlightened policy of banks in Germany, which give their financial support to new industries, whereas in England this is done by syndicates with terribly overloaded capital. In discussing telegraphy in Great Britain he gives the following mileage of wire: General post office, 435,000; railway companies, 105,000; United Colonies, 387,066; submarine cables, 183,400. Total, 1,111,366. This refers to the present time. He refers to the successful use of a serving of brass tape in sea water cables to protect them from the "limnoria terebrans," a crustacean which bores through the gutta percha; he calls attention to the declining supply of gutta percha and to its questionable purity; the supply fails to meet the demand. He refers favorably to paper insulation; the lead-covered paper cables, which are used largely in streets of English cities, are very satisfactory; he is now laying one of seventy-six wires between London and Birmingham. He refers to the competition of the telephone, stating that some such instrument as the electric typewriter or the telautograph is needed. Regarding wireless telegraphy he remarks that sensational experiments for booming a financial enterprise are not processes that commend themselves to that institution. In referring to telephony he states that speech is now practically possible between any two post offices in the United Kingdom, and theoretically possible with every capital in Europe; the progress in the use of the telephone in Great Britain has been checked by financial complications, it being in the hands of a company promoter, and has remained the shuttlecock of the stock exchange; telephony is an imperial business like the post and the telegraph, and it ought to be in the hands of the state. Some figures are given showing that the Government did well in purchasing the telegraphs; he shows that the present magnificent system has been built virtually out of the revenue; the tariff is very cheap and press dispatches are transmitted below cost price. The total number of telephones in use (presumably in the United Kingdom) is 152,019. He discusses the application of the telegraph to railway management and gives some tables showing the extent of its use in that country. In discussing the subject of electric light he gives a table showing the position of the industry in that country and the United States at the present time; some of these figures for the United Kingdom and the United States respectively are as follows: Number of central stations, municipalities, 72 and 338; companies, 63 and 2251; kw capacity, municipalities, 44,219 and 41,193; companies, 24,344 and 578,051. He urges local authorities to combine the electric lighting and railway power stations, claiming that it will reduce the cost of the current for both. The subject of electric lighting on board ship is discussed; a table gives the electrical energy used on a first-class battleship; another gives some information concerning the British Navy. The reprint is to be continued.

The Dow Engine.

[illegible] Mr. Joseph Dow October 1, 1898, before the Engineers' Club of Philadelphia and reprinted in the Proceedings, describes most completely the novel and interesting details of the engine of his design [illegible]

After taking up historically the efforts of Mr. George H. Corliss, with whom Mr. Dow was associated, the reasons for the remarkable success of the Corliss improvements are detailed in the paper somewhat as follows: One of the most serious losses in steam-engine work is initial condensation and re-evaporation during exhaust. This can be to a certain extent eliminated by multiple expansion, which reduces the limits of the cycle of temperature changes through which the cylinder walls must pass, and also by reducing not only the volume of the clearance, but particularly the surface area of the clearance space. The valves should be mounted as close to the cylinder limit of the port as possible. They should not require too much movement to effect the opening and closing of the ports, and they must be actuated by the least possible exertion of power. These favorable conditions, with others, are possessed by the Corliss system, and have caused its success. In this system, however, they are combined with the detachable or "tripping" valve gear, which limits the speed to about 100 or 120 r. p. m., a rate too low for economical direct coupling to electrical generators, unless the lattter are of very large outputs. The advantages of gravity balance of the reciprocating parts obtained by means of two cylinders side by side, with cranks set 180 degrees apart, are noted, after which [illegible]

This engine is a double vertical compound, the present construction using steam of 125 to 130 pounds boiler pressure, and intended to run at about 150 r. p. m. The cylinders are placed as closely together as possible, side by side, permitting only room enough between them to provide for the valves, with their passages, and non-conducting spaces to prevent destructive loss of heat, which is further secured through the whole being surrounded by a space filled [illegible]

All the valves and steam passages have their positions between the cylinders, not only to avoid any possible loss of heat from them, but to facilitate the [illegible] with the use of a simple operation of the valves. The final exhaust passage is, however, completely separated not only from its cylinder but from the steam [illegible] end merely continuations of the ports—directly into the second, the up stroke [illegible]

[illegible] the base and foundation to be compact, which is important when space is costly, [illegible] in use; yet [illegible] high-pressure [illegible]

other by means of the pistons being cast hollow, that the smaller one may be filled with sufficient lead to make its weight equal to that of the larger. The high-pressure valves (see Fig. 2) are cylindric in shape and so constructed that the induction steam passes entirely through them from end to end. The steam chamber is placed directly against the high-pressure cylinder, and at top and bottom is connected with the valves by means of passages in the casting, which lead completely around both their ends, from which, through ample openings, steam freely enters; but to the outside of the body of the valves no steam can obtain access from this chamber, being prevented by packing rings, which have their bearings upon seats at either end of the main portion of the valve. In this manner pressure, acting upon the valve, is entirely regulated from its own interior through means of the steam port at one side, and at the opposite side the balance port, arranged with steam-tight packing strips, and with sufficient area to secure a firm seat against both cylinder and exhaust ports, while passages outside the bushing into which the valve fits communicating with the cylinder ports complete the balance against the changing pressure within the cylinder. The valve receives always the same degree of movement, regardless of the point of cut-off, and, consequently, no ridges can form in the seat where a smooth, perfect contact is maintained, improving with wear, while but little force is required for actuation. Exhaust is effected by this valve through a depression in its side formed to complete the passage which connects the cylinders at the proper time.

The valves in second cylinder need no cut-off, its steam expansion being a continuation of that begun in the first; therefore, their construction and action are very simple. They open the connecting passage just before the high-pressure valve releases the steam, and close it with enough time before expansion is completed to leave the steam within it of higher pressure than the terminal of second cylinder; the passage is opened again when compression has brought the pressure in this cylinder back to the same degree, and the completed compression is reached with a pressure about equal to the terminal of first cylinder; this contributes to smoothness of action. These valves also control the exhaust and compression of their own cylinder. Both sets of valves, notwithstanding their own peculiarities, preserve the setting, seating, and movement peculiar to the Corliss system; but, as one valve controls both inlet and outlet, the necessary "dead spaces" at the ports are reduced one-half.

The single wrist-plate, shown in Fig. 3, controlling the main movements of thes valves, yields its well-known advantage of quickening the action just when most needed, while giving almost perfect rest to the valve during the ingress and egress of steam. The cut-off movement is taken from the "cross-head," that it may be simple in connection and accomplished at identical positions of the piston for both directions of its movement with its own angular advance. This movement is communicated to a vertical lever which has a slot through its upper limits, in which is carried a sliding block, having connection with the governor, from the centre of which links are attached leading off at either side to rocker arms, which also carry connecting rods leading on one side to the upper, and on the other side to the lower, valve gear. Cut-off is always completed at an identical position of these rockers, and they are so arranged that, if the block is down in the slot, the cut-off will come much sooner than if it be up, the range following such part of the whole stroke as may be desired, from no admission of steam at all to a coincidence with the closing effected by the main gearing at about seven-eighths stroke.

The connecting mechanism from the cut-off lever to the valve gear is so constructed that the governor can only move the valve mechanism between the proper limits of no admission and admission of seven-eighths of the stroke, any motion of the governor beyond these limits being taken up by toggle joints in the connecting mechanism, and not transmitted through to the cut-off plate. The immediate valve gear is set upon a "bonnet" as with the Corliss engine. It comprises a crank keyed to the valve stem, and connected through a toggle joint with another crank oscillated by the wrist plate. The middle pin of the toggle joint carries a roller which rides in the groove in the cut-off plate, which in turn oscillates, owing to its connection, as described above, in time with the main cross-head, the range of its motion being determined by the governor. This groove is so proportioned as to give the valve a quick cut-off determined solely by the governor and the cross-head position, all the other events of the valve being dependent solely on the movement of the wrist plate; thus a positive-action valve is obtained with all the advantages of the Corliss detachable. The advantages of the whole design may be summed up as follows:

In compounding, the second cylinder receives its steam directly from the first through short passages no longer than the ports of the cylinders, and closely guarded against radiation of heat, the expansion of steam, stroke for stroke, being simply a continuation of that begun in the first, without the interposition of a receiver or excessive connecting passages, thereby recovering initial condensation by direct re-evaporation into the next cylinder; also, saving much in intermediate condensation, convection and radiation, while avoiding the necessity for reheating in an attempt to overcome these difficulties.

The steam chest is between the cylinders, so combined with the first cylinder and its steam passages, so guarded from the exhaust passages, and the whole within so efficient a covering insulating from loss of heat that the smallest degree of loss in energy is suffered from this cause.

The valves—one of which takes the place of two, as with the original Corliss construction—being in themselves continuations of the steam chamber, hold the steam always close against the cylinder ports, while they are balanced for easy action not only against their contained pressure but also against the varying force within the initial cylinder, thus requiring but little power to [illegible]

[illegible] between the closing of the [illegible] greatly [illegible] largely owing [illegible] one port for induction and [illegible]

[illegible] for both gravity and the energy delivered by the pistons, secures smoothness of action and saving in friction.

Great compactness is readily attained, particularly with the vertical construction [illegible] much weight, of occupying [illegible] in proportion to the power developed.

[illegible] positive in action, and, while

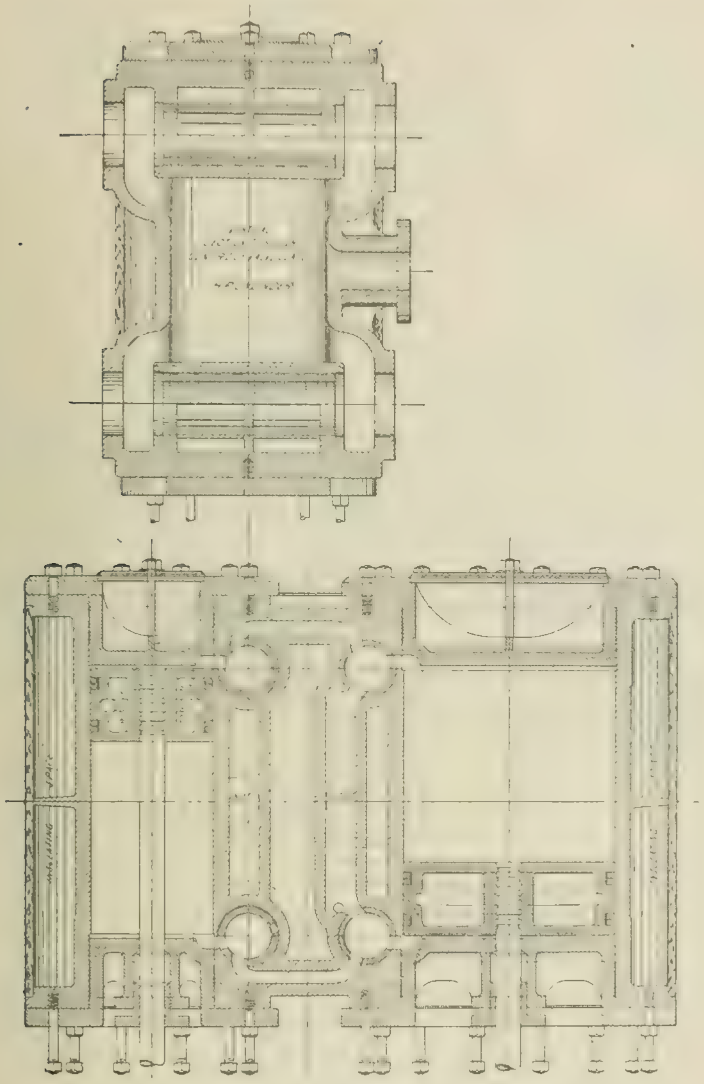


Fig. 1.—Section Through Cylinders and Valve Gear.

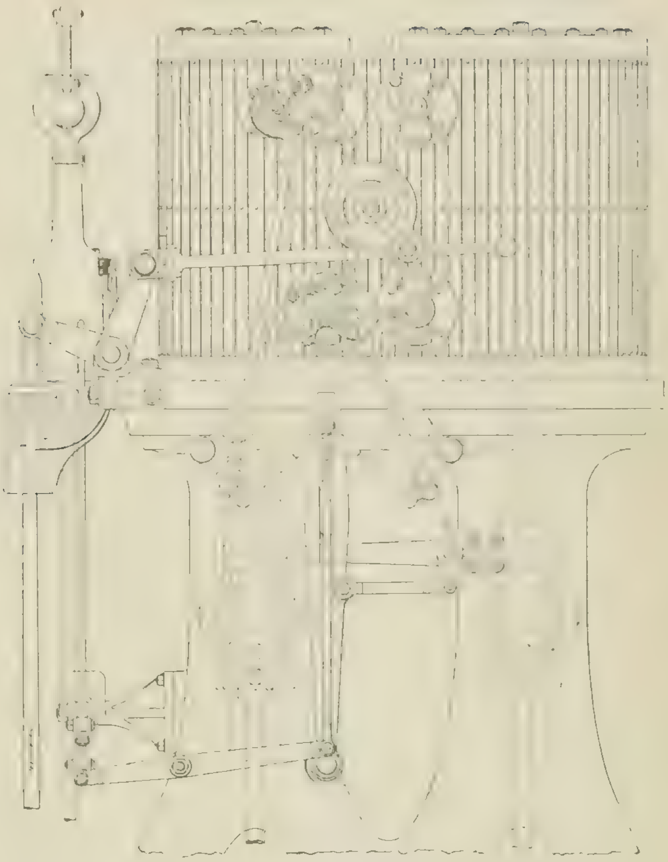


Fig. 3.—Side Elevation Showing Valve Mechanism.

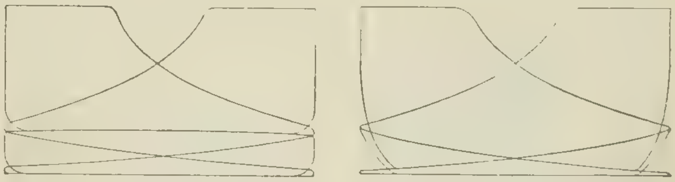


Fig. 4.—Cards with and without an Intermediate Receiver.

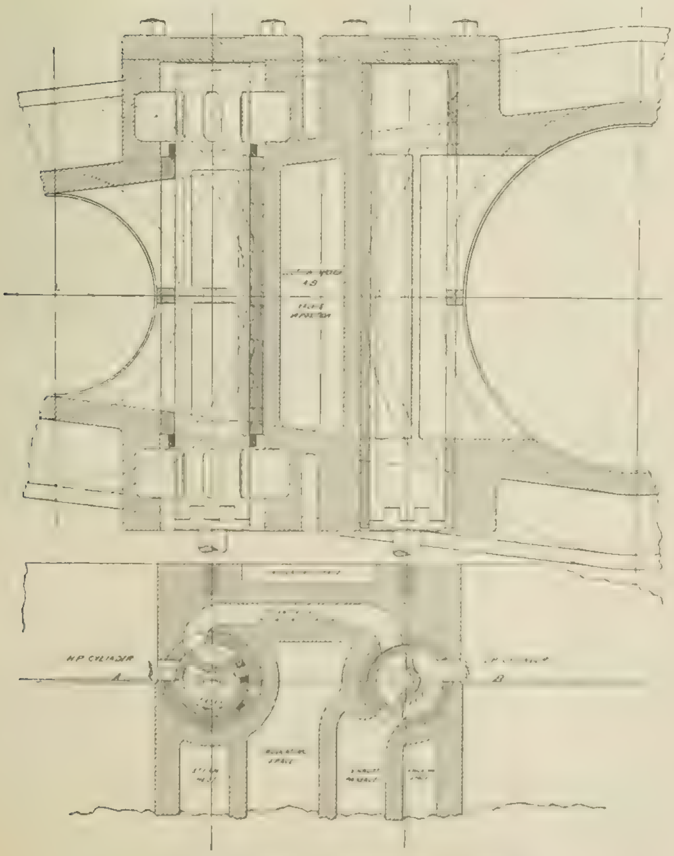


Fig. 2.—Detail Sections of Valves.

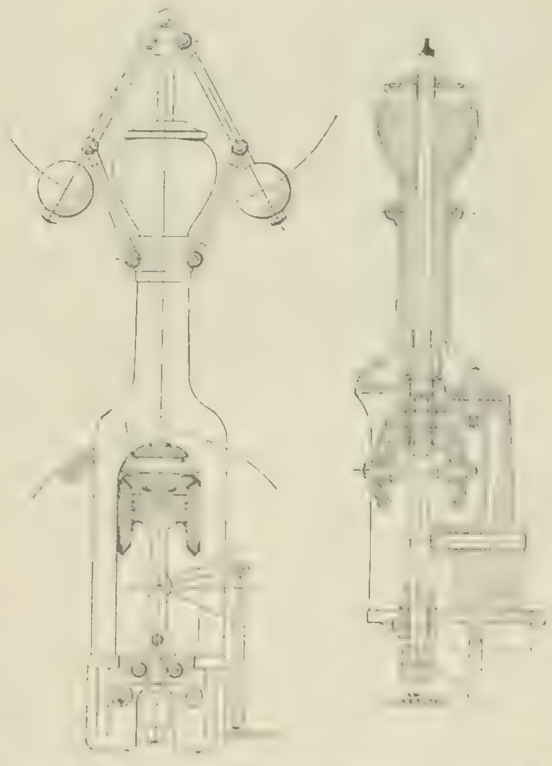


Fig. 5.—Elevation and Section of Chronometric Governor.

retaining all advantages of the Corliss gear, they avoid the disadvantage of the "drop" and "dash-pot."

A cut-off is provided, always smooth in action and positive in proportion to the velocity of the engine.

These advantages help greatly to do away with the necessity for low speed, which has so much held back the progress of the Corliss system, and a velocity can readily be attained sufficient to meet all needs.

A cut-off can be effected with equal readiness from a point before the beginning of the stroke up to seven-eighths of its travel, where it merges perfectly into the closing of the valve as effected by wrist-plate action alone, with a full opening of the induction port at once, to be held until the point of cut-off, regardless of its place in the stroke, while leaving, as is essential with the Corliss system, all the other events of the valve entirely undisturbed by its change. With the original Corliss engine a cut-off can be effected only within less than the first half of the stroke, while the "drop and dash-pot" arrangement obliges the valve to be kept in motion, with the steam port slowly opening until the cut-off is made.

The engine effects the cut-off with an equal distance from either end of the piston travel for all points at which it may take place, it being perfectly corrected for angular advance of the connecting rod and consequent position of the piston. This is also true of the wrist-plate connection, which is corrected for angular advance of the eccentric rod.

The valve-gear is not only very compact and simple, but always positive in its action, while one wrist-plate for both cylinders directly controls lead of the initial steam, lead of exhaust and closing of exhaust for compression, the only event separated from its action being the cut-off, which is entirely independent.

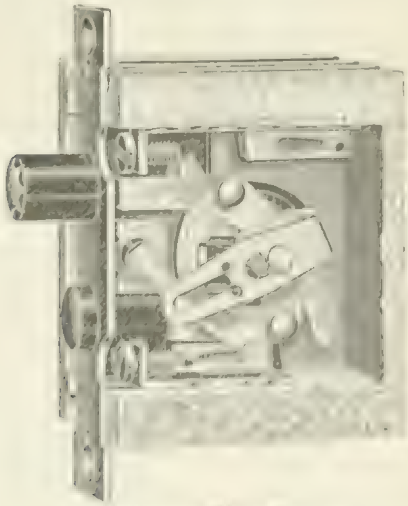
The engine is governed by the Dow chromometric governor, which is shown in Fig. 5. This differs radically in principle from the ordinary fly-ball governor, although resembling it somewhat in appearance. The position of the valves is not dependent on the position of the fly balls, which act not as centrifugal weights, but as a rotating pendulum, tending to maintain an isochronous speed. This pendulum is driven by an elaborate differential bevel-gear train, the difference in speed between the shaft of the engine and the rotating pendulum being taken up in a sector-shaped gear actuating the valve cut-off mechanism. Thus, so long as the work done on the pistons is not exactly balanced by the load and there is a tendency toward acceleration or retardation of the speed, this acceleration or retardation itself continues to move the valve mechanism toward a shorter or longer cut-off position, respectively, until the two speeds are exactly equal. The governor is naturally remarkably sensitive and yet free from all tendency to hunting.

A Serviceable Push Switch.

The push switch represented in the accompanying illustration is designed particularly for use in private houses, public buildings, hotels, etc., and is recommended by the manufacturer (the Hart & Hegeman Manufacturing Company, 52 High Street, Hartford, Conn.) for the ease with which it can be operated, its durability, the ease with which it can be installed, and its ample carrying capacity. Mechanically, this switch is strong, the case being one piece of porcelain, and electrically it is designed to stand heavy service.

This switch is made in the single-pole, double-pole and three-way types. A 10-ampere switch was recently tested on circuits carrying 15 and 20 amperes at 115 and 230 volts, the circuits being opened and closed 3200 times altogether. The switch worked freely, and no undue heating or arcing was observable. [illegible] order, hardly any of the effects [illegible]

The contacts are of the "knife-switch" type, and the switch plates are well



[illegible]

[illegible]

Some New Telephone Apparatus.

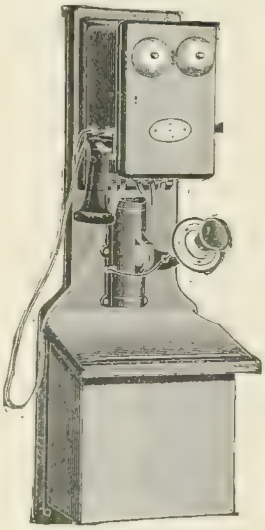
[illegible]

illustrated sheet of the telephone apparatus manufactured by the Hipwell Company shows a line of long-distance telephone instruments, extension bells, magnetos, transmitters, receivers, fuse and lightning arresters.

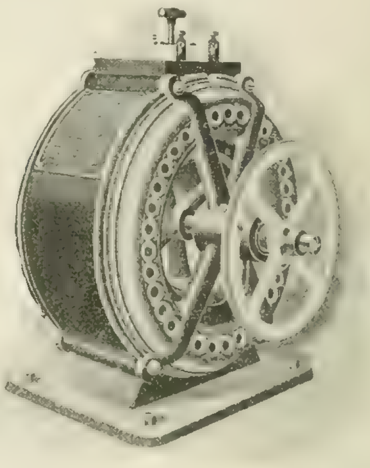
The illustration shown below gives a view of a complete subscribers' long-distance outfit. The receiver is of the bipolar type, and is said to be unaffected by temperature changes. Its magnets are made of the best tungsten steel, the pole pieces being nickel-plated to avoid rusting.

A Slow-Speed Laboratory Motor.

The machine illustrated herewith has been designed especially to meet the demand for an alternating-current motor for laboratory work, such as the driving of static machines, dental apparatus, small pumps, etc. It is intended to fill a gap in the alternating-current motor line, and develops three or four times the power of the ordinary 16-inch fan motor. It is made in four sizes, two of which are designed for 16,000 alternations, running at speeds of 1200 and 1000 r. p. m., and two for 7200 alternations at speeds of 540 and 450. The slow speed, it is stated, gives the machine quite a strong torque at the pulley, and makes it much more convenient to adapt to direct belting or to gearing, without the intervention of countershafts.



Long Distance Set.

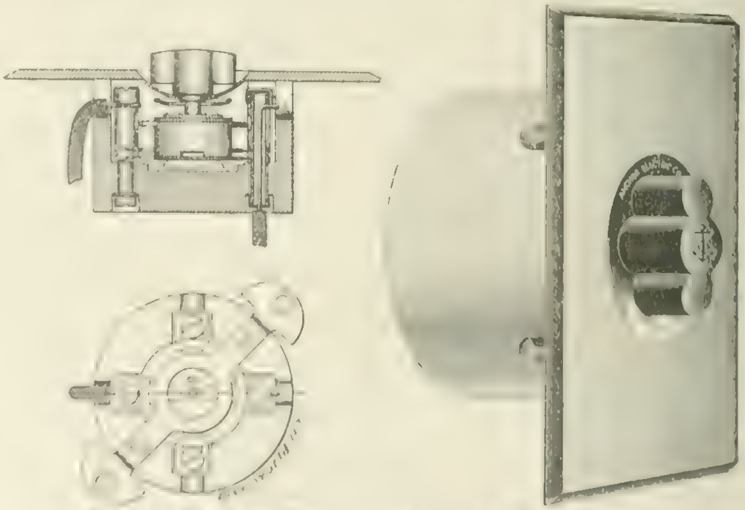


Slow Speed Alternating-Current Motor.

These machines are manufactured by the Emerson Electric Manufacturing Company, 714-718 St. Charles Street, St. Louis, Mo.

Improved Flush Switches.

In the accompanying illustration is shown a flush switch which has the non-current carrying parts of the movement built up of nickel steel, thoroughly insulated from the moving contacts and encased in a heavy porcelain cup fastened to a strap and yoke, by which it is screwed to the wall. This device is manufactured by the Anchor Electric Company, Boston, Mass. Other fea-



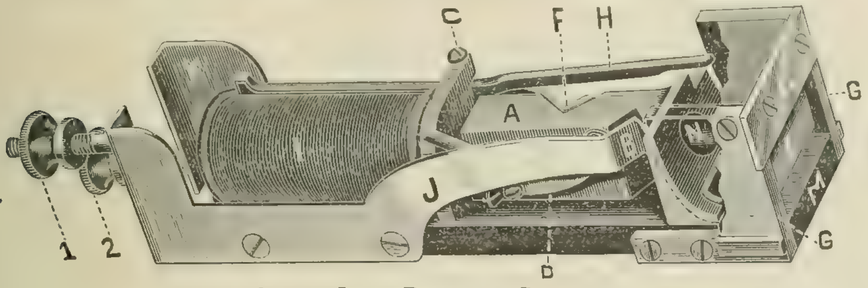
Section, Plan and Perspective Views of Flush Switch.

[illegible]

tremely tough and non-absorptive, and is modelled so as to occupy the smallest space, at the same time possessing the maximum strength. The binding posts are so arranged as to enable connections to be made easily from the front, when in deep sockets, leaving no slack wire and requiring but a fraction of the time usually needed in wiring up flush switches. The action is said to be so quick that the switch will operate successfully on a circuit of double the designed potential and double the load if necessary. Flexible spring handles are used, and the anchor stamped on the handle is claimed to be a safeguard against intentional or careless substitution.

Spring Jack, Drop and Coil for Telephone Express Switchboard.

The accompanying illustration gives a perspective view of the jack drop and magnet coil used in the Western "Express" switchboard, manufactured by the Western Telephone Construction Company, of Chicago. It is claimed that this spring jack and drop is the most simple and ingeniously arranged of any heretofore used to perform the same purpose. The drop is mechanically restored with the plug as it enters the jack to make a connection with a subscriber, and is said to be, with the one used on the company's No. 1 boards, the only self-restoring switchboard drop that is positively free from infringement of patents. Referring to the cut the armature shown at *H* is arranged with an adjustable spring, which prevents the sticking of the armature to the magnet head or pole, and never fails to release the drop or shutter when the subscriber calls. The night-bell connection is made by the upper edge of the drop making contact with two springs directly over the drop, which are connected with the night-bell circuit.



SPRING JACK, DROP AND COIL.

In construction the spring jack consists of a solid brass casting, *A*, bored out for the plug, as shown at *N*. *J* and *K* are the line-wire conductors, and form the tip-spring connection with the plug at *F* and sleeve-spring connection with the plug at *B*. The drop shown at *E* is insulated and hinged to side pieces, *G*, *G*, which are connected with the night-bell circuit. The cut-out spring shown at *D* is disconnected from the sleeve spring *J* when the plug is inserted in the jack, thus cutting out the coil. Thumb nuts 1 and 2 secure the jack in position and connect with the line terminals. The magnet *I* is mounted on the hard-rubber base *M*, and can be easily removed. The armature swings on the pivot in front of the magnet head, and is secured by the pivot screw *C*. Only two springs are used in connection with the drop and jack. The side pieces *G* *G* are provided with lugs which fit into grooves in the vertical strips in front of the board, which hold the jack in position and relieve it from all strain as well as from the effects of contraction and expansion. The construction of the jack is so simple that the liability to get out of order has been reduced to a minimum, and it is said to be free from danger of short circuits.

MAGNETO FOR INSTRUCTION AND EXPERIMENTS.

A Small Magneto.

The Knapp Electric & Novelty Company, 47 Warren Street, New York City, is manufacturing a little magneto which is designed for instruction and experimental work. It is simple in design and well finished. Each outfit includes hand electrodes, sponge electrodes for application to afflicted parts, etc.

This little machine corresponds with all the other products of the Knapp Company in quality of workmanship and material in its manufacture, and is excellently adapted for the use of young experimenters.

The Wright Discount Meter.

An efficient instrument for the determination of the discounts of the Wright demand charging system is now put on the market by the Wright Discount Meter Company, 1012-1013 Monadnock Block, Chicago, of which Mr. Martin J. Insull is manager.

The Wright demand system has been much discussed in electric lighting conventions and in the technical press, and has already been adopted by several of the largest Edison companies, notably those in Chicago, Boston and Cleveland, although the discount meter has not as yet been actively pushed on this market.

The appearance of the meter is shown in the accompanying illustrations, of which Fig. 1 is a diagrammatic view. Fig. 2 shows the meter with the front hinged door closed for sealing, and Fig. 3 shows the door open and the working parts of the meter tipped out toward the restoring position. The meter consists essentially of a U-tube *L* filled with a colored liquid, a bulb, *H B*, containing air at one end and a graduated indicating tube, *I T*. Surrounding the bulb *H B* is a conductor in series with the load and so arranged that it heats the air within, which action forces the colored liquid over the siphon, whence it drops into the tube *I T*, from which it cannot be restored except by the inspector at the end of a predetermined interval. The greater the maximum load occurring at any time the greater is the heat developed in the bulb *H B*, and the greater is the amount of liquid spilled over into the indicating tube. This at the end of any period, then, thus gives an indication of the maximum load which has occurred during that period. Very brief loads, such as short circuits, etc., do not affect the instrument, which has a time lag such that if the maximum load last five minutes the meter will register 80 per cent.; if ten minutes, 95 per cent., and full 100 per cent. if the load is continued over half an hour. The restoration is effected by tipping the working parts outward, as shown in Fig. 3, until the liquid in the indicating tube runs up into the air bulb *A B*, Fig. 1, when on tipping it back the liquid runs down into the tube *L*, and the meter is ready again to indicate the maximum during the next predetermined period, generally a month or quarter. It is connected up simply in series with the ordinary integrating watt or ampere-hour meter, and indicates directly the number of kilowatt hours or ampere hours which should be charged for at the full rate, the balance of the kilowatt hour or ampere hour indication being charged for at a discount dependent on the wishes of the central station management. Thus, the greater the brief load of a given installation and the greater the reserve capacity of engines, dynamos, lines, etc., which the central station must maintain to carry these brief loads, but which increase the fixed charges of the system, the greater is the proportion of the consumer's load, which is paid for at the full rate.

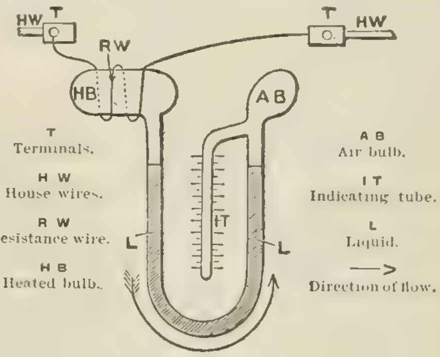


FIG. 1.

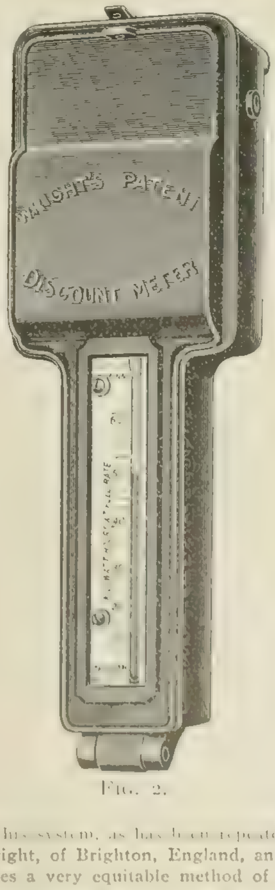


FIG. 2.

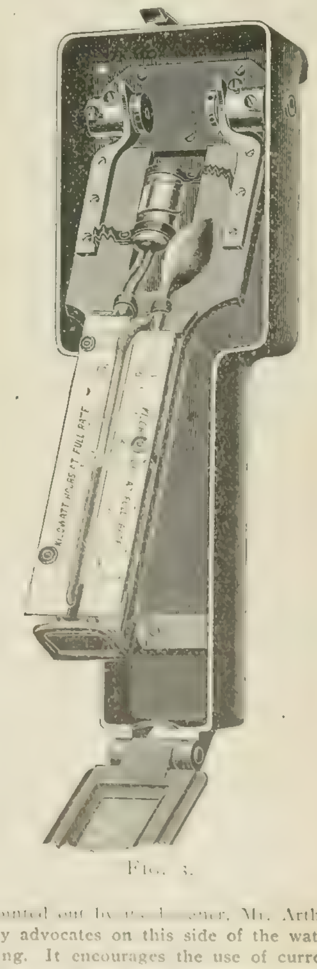


FIG. 3.

This system, as has been repeatedly pointed out by its designer, Mr. Arthur Wright, of Brighton, England, and many advocates on this side of the water, gives a very equitable method of charging. It encourages the use of current by the central station's best customers, namely those who use current on a steady load, and charges those who use the current comparatively infrequently, and are, therefore, less desirable, the higher rates. The instrument is a most simple one, with no delicate working mechanical parts, and gives in service far less trouble than even the best of integrating power meters.

Financial Intelligence.

THE ANNUAL REPORT of the Third Avenue Railroad Company, New York, for the year ended October 31, shows the following results as compared with the previous year: Gross earnings $2,359,779, a decrease of $211,043; operating expenses $1,280,465, decrease $164,180; net earnings $1,079,334, decrease $46,860. After adding other incomes and deducting charges and dividends, the total remaining surplus is $210,405, a decrease of $47,926.

Special Correspondence.

NEW YORK NOTES.

THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS held its 129th meeting at 12 West Thirty-first Street on Wednesday evening last. Mr. Fred W. Carter, of London, England, read a paper on "The Design of Transformers."

MR. CHARLES H. KIRKLAND will represent in the metropolitan district the Bibber-White Company, of Boston, Mass., manufacturer and jobber of electrical merchandise. Mr. Kirkland, who is well known to the electrical fraternity in and around New York, will open offices at No. 129 Greenwich Street.

THE ANNUAL MEETING of the Telegraphers' Mutual Benefit Association was held in the Western Union Telegraph Building on the afternoon of November 16. The reports submitted by the president and secretary show the association to be in a prosperous condition. The officers of the last year were re-elected to serve during the ensuing year.

MR. H. J. MEDBERY, president and general manager of the Warren-Medbery Company, Sandy Hill, N. Y., has just returned home after a brief business trip to the metropolis. The New York office of the Warren-Medbery Company, by the way, has been removed from the sixth floor to room 101, eighth floor of the Taylor Building, 39 Cortlandt Street.

CONSUMMATION OF THE BROOKLYN ELECTRIC LIGHT DEAL.—The property and plant of the Edison Electric Illuminating Company, of Brooklyn, were on November 14 transferred to the Kings County Electric Light & Power Company, in accordance with the recent deal between the two concerns. The consolidation, it is stated, will result in some radical changes in the management and incidentally in the saving of $200,000 or more per annum in the operating expenses. It is stated that the Kings County Company will lower prices as rapidly as is feasible, with the idea of reaching the point of successful competition with gas.

A MEETING of the creditors of H. B. Coho & Co. was held November 18 at 143 Liberty Street, this city. About 75 per cent. of the creditors were present or represented. The liabilities were stated to be $60,000, and assets estimated at $40,000. A committee of five creditors was appointed to wind up the business, collect the outstanding accounts and divide the proceeds pro rata among the creditors. The committee consists of representatives of the Eddy Electric Manufacturing Company, the Oswego Boiler Works, the Marietta Manufacturing Company, the City Bank of Hartford and the Harrisburg Foundry & Machine Works. The business was started in 1884 by Mr. Herbert B. Coho, and the "Co." was George C. Hoffman.

[illegible] OF THE NEW YORK ELECTRICAL SOCIETY.—At the meeting of the New York Electrical Society on November 17 twenty-five new members were elected. Among them were the following named gentlemen: Augustus Treadwell, Jr., Electric Storage Battery Company, New York City; [illegible], New York; Fred R. Wainwright, Chesley Electric Company, Newark, N. J.; Thomas J. Fay, Elec- [illegible], editor THE ELECTRICAL WORLD, New York; Charles E. Dustin, Excelsior Electric Company, Brooklyn; Henry B. Cutter, Philadelphia; Charles T. Child, electrical editor "Engineering Magazine," New York; Dr. Louis Duncan, [illegible] Company, Hoboken, N. J., and V. C. Gilpin, Cutter Electrical & Manufacturing [illegible].

[illegible]

[illegible]

"Improvements in Steam Boilers," by W. B. Le Van; "Valve Gear of the Willans Engine," by John A. F. Svenson; "Variation of Belt Tensions with Power Transmitted," by W. S. Aldrich; "Calorific Power of Weathered Coal," by R. S. Hale; "Specific Heat of Superheated Steam," by R. C. Carpenter, Considerable attention will be paid to entertainments, etc. During the afternoons visits will be made to various points of engineering interest. On the afternoon of November 30 a visit will be made to the Duane Street station of the Edison Electric Illuminating Company. On the afternoon of December 1 an excursion will be made to the plant of the John Stephenson Company, Limited, at Elizabethport, N. J., which represents the most advanced practice in electrically driven tools. Other points of interest which will be visited will be the Stevens Institute, Columbia University, the power houses of the United Electric Light & Power Company and the Broadway cable line, and the eastern power house of the Brooklyn City Railway Company. At 9 o'clock on the evening of November 30 a reception and conversazione will be held at Sherry's, Forty-fourth Street and Fifth Avenue.

BUFFALO AND NIAGARA FALLS NOTES.

THE INCLINED RAILWAY that leads from Prospect Park, Niagara Falls, to the bottom of the gorge will be operated by electric power next year, instead of steam.

IT IS SAID that if the Canadian authorities oblige the power company to develop power on that side of the falls, and there is no call for it there it will be cabled across to this side. As this form of energy has been declared to be "raw material" it can be brought to the United States free of duty.

IT IS REPORTED that the Niagara Power Company has never received so many inquiries in regard to power as are coming in now. More orders for generators are to be placed at once. The State Reservation at Niagara, which has the right to use a certain amount of power from the power company, is now preparing to take the current.

THE CANADIAN GOVERNMENT is in doubt over the petition of the Niagara Falls Power Company for the exclusive right to develop power from the falls. It is thought that the plea of the company, that it is paying an annual rental of $25,000 for this privilege, will more than anything else finally secure the renewal of this exclusive privilege.

A CARPET FACTORY, to be run by power from the Niagara tunnel plant, is to be built at Echota, a short distance above the power house. The contracts are signed, but the details are not yet made public. There is also a move to establish a manufactory of electrical machinery at Niagara Falls. It will be a branch of one of the large companies.

THE EARNINGS of the Buffalo & Niagara Falls and Buffalo & Lockport trolley lines for the quarter ending September 30 are small, considering that the period covers the heavy summer travel season. The net earnings of the Niagara Falls line are $38,712.50, and net income $11,808.38. Of the Lockport line the net earnings are $7,428.21 and net income $1,898.17. The capital of the former is $1,000,000 and of the latter $1,250,000.

THE INCREASE IN THE LOAD ON THE NIAGARA-BUFFALO TRANSMISSION LINE.—On Friday, November 11, the power given to the transmission line leading from the Niagara Falls power plant to Buffalo was cut off from the rest of the plant feeding the local service and put on a special generator in order to give a higher voltage, the load having become such that the line drop necessitated this change.

A TROLLEY LINE is to be built from Buffalo to Rochester. It was at first reported that the line would parallel the New York Central's main line, but this is now denied, and it is said that the new road will originate at Niagara Falls. From this it is not difficult to infer that the Buffalo & Lockport road will be made the western end of the line, as it already covers a quarter of the distance. The projectors of the enterprise are very reticent over the matter.

THE STARTING OF THE BUFFALO GENERAL ELECTRIC COMPANY'S TRANSFORMER STATION.—The machinery of the new transformer station of the Buffalo General Electric Company was turned over for the first time on Saturday afternoon, November 19. But one of the small sets of this station had had current through it previous to this time. Both exciter sets and all six of the motor-driven arc light twin sets were brought up to speed, and with the sole exception of one of the exciters started off successfully, turned over in the right direction, and exhibited not the slightest sign of any mistake in the running of the large number of wires required in a motor driven plant of this kind.

CHICAGO NOTES.

MR. E. L. [illegible], general manager of the Akron Electrical Manufacturing Company, Akron, Ohio, visited Chicago during the week on the business of his company. He arranged with Messrs. Meysenburg & Badt to represent the Akron Electrical Manufacturing Company in the Western territory.

AN ORDER [illegible] of the Metropolitan Elevated Railroad at an [illegible] has been entered by Judge Showalter in the United States Circuit Court. Twenty days are allowed for the redemption of the bonds [illegible] the sale will take place in January. On [illegible] on the first mortgage for [illegible], dated August, 1892, the complainants being Adrian Iselin, Jr., and George G. [illegible]. Mr. Dickinson McAllister was appointed receiver.

"PRACTICAL NOTES ON ELECTRICAL MEASUREMENTS" was the title of a paper read by W. B. Hale before the Chicago Electrical Association on the evening of October 21 last. Mr. Hale pointed out the difference between ammeters and voltmeters, the former, he said, being a low-resistance voltmeter and a voltmeter being a high-resistance ammeter. He referred at length to the practical use of these instruments, and described the general method of measurement of resistances, both low and high, and battery testing, and concluded his paper with a description of the practical units of electrical measurement. The paper was very elementary in character, and was interesting no doubt to all those who had the pleasure of being present at the meeting.

ST. LOUIS NOTES.

BURIAL OF CITY WIRES.—The superintendent of fire-alarm and police telegraph has taken the first steps toward the burial of the city wires. He has turned over to the City Register for publication two advertisements relating to contracts, one for supplying the cables and connections, and the other for putting them into the conduits.

THE KINLOCH TELEPHONE COMPANY has announced that about 450 of its instruments in the downtown district are in working order. No books have as yet been furnished, and none of the officers will vouchsafe the time when the entire system will be in full operation. What service is now being given is during the day only and not at night.

THE OPENING of the long-distance telephone line between Kansas City and St. Louis was attended on the night of November 15 by Governor Stephens, who sat at one end of the line, at Tenth and Olive Streets, and delivered a brief congratulatory address to 300 members of the Commercial Club in Kansas City. The line is rapidly extending westward.

THE PLANT for lighting Webster Groves, a suburb of St. Louis, by electricity has been completed, and on November 14 128 new 16-cp incandescent lights were turned on for the first time. The lights are distributed over the city at places designated by the committee on public improvements. Old Orchard, Tuxedo and Webster Park are included in the lighted district. The Suburban Electric Light & Power Company is furnishing the power.

LINDELL CONSOLIDATION.—President Whitaker, of the Lindell Railway Company, is working hard on the plans for consolidating the several lines of the system granted by the Municipal Assembly. He hopes to have the details of the plan arranged by January 1, but is by no means positive he can complete the work by that time. Mr. Whitaker will not divulge any of the proposed details, but outside parties state that the capital stock of the consolidated lines will be $10,000,000. The new system embraces the several branches of the old Lindell Company, the Olive Street cable road and the Manchester and Laclede electric lines. There will be a total of 55 miles of tracks, with twenty transfer points.

A TELEPHONE TEST CASE.—On November 15 a foreman of construction for the Bell Telephone Company was arrested at the instance of the superintendent of the fire-alarm telegraph service. He was charged with interfering with the city's wires. He was tried and fined, but his case was appealed. The action of the authorities places the Bell Telephone Company in a peculiar position. If it proceeds to comply with the city ordinance, requiring the burial of its wires, its action would result in an absolute paralysis of the city's fire-alarm telegraph system. Should it fail to carry out the requirements of that same ordinance it would subject itself to a string of daily penalties that no corporation would care to burden itself with. The underground conduit ordinance requires the burial before January 1, 1899, of all overhead wires, except the trolley wires of the street railway companies.

CITY LIGHTING.—The committee on city lighting of the Board of Public Improvements will prepare another bill to present to the City Council providing for the contract for lighting the city during and after the year 1900. Fourteen bills prepared by the Board of Public Improvements have already been rejected by the Council. The instructions offered in the resolution presented to the Council at a meeting last week, instead of being a help in the preparation of a bill, tend to further complicate the situation. The committee finds that one of the bills embodying features suggested by the resolution was approved and became a law. Bids were advertised for, but the lighting companies refused to bid, giving as an excuse that the ordinance was invalid. The defeat of the Julian law will allow the board to prepare a bill allowing the city to do private lighting in the event of the city conducting its own lighting plant. Under the Julian law this would not have been permitted.

PACIFIC COAST NOTES.

CHEHALIS, WASH., will soon have an independent telephone system in operation.

THE CITY COUNCIL of The Dalles, Ore., recently passed, over the mayor's veto, an ordinance which authorized the lighting of the streets by electricity. The local lighting company will have to install additional generators in order to furnish the required service.

THE EXTENSIVE electro-plating plant of the Southern Pacific Railroad Company was destroyed in the fire which burned several buildings at the Sacramento shops, where 2200 men are employed. A very complete alternating electric-power system is in operation at the shops. The burned buildings will be rebuilt as soon as possible.

THE ASTORIA STREET RAILWAY COMPANY, Astoria, Ore., recently gave an option on its rolling stock and other property to F. D. Kuettner, of the Astoria & Columbia River Railway Company. The persons interested have petitioned for a street-car franchise to run seventy-five years, and also to supply electricity and steam for a variety of purposes.

THE PEOPLE'S MUTUAL TELEPHONE COMPANY, San Francisco, has been again granted a year's extension of time in which to comply with the conditions of its franchises. President Crittenden promised that the system would be in operation within six months, although very little work has yet been done. He stated, also, that he had let contracts for supplies aggregating in value $176,500.

THE BLUE LAKES WATER COMPANY is pushing the construction of its pole line to Stockton, Cal., the transmission distance being 38 miles. The company expects to be ready to transmit its surplus of current generated at Blue Lakes City to Stockton by January 1 next. The voltage on the line will be 38,000, and there are no great engineering difficulties to be overcome. Pure aluminum wire will be used for transmission purposes. Stanley two-phase generators are in use.

CANADIAN NOTES.

THE ROAD COMMITTEE of the city of Montreal will ask the City Council to take steps to have all electric wires, except trolley wires, placed underground.

THE ARTHABASKAVILLE RAILWAY COMPANY, of Arthabaskaville, in the province of Quebec, is asking for incorporation to construct a steam or electric railway from Dudswell to Maddington Falls.

THE TOWN of Barrie, Ont., is negotiating with the Barrie Electric Light Company for the purchase of its electric plant. The sum of $35,000 has been placed in the hands of the Town Council to purchase a municipal plant, and the question is whether the existing plant will be taken over or an entirely new one installed.

MR. GEORGE E. SLEEMAN, of Ottawa, has a car fender on exhibition which he claims is superior to many in use at present. The fender is as wide as an ordinary car and has a cushion of strips of wood attached to an iron frame. In front of the frame is a strip of wood which acts as a guard, and when touched it causes the fender to fall to the rails where it cannot help picking up anything it runs against. It is easily attached and detached. The fender has been successfully used in Guelph, Ont.

A PROPOSITION has been made to the city of Toronto, on behalf of the Anglo-American Electric & Supply Company, for the supply of electrical energy to the city. In a letter to the Council the statement is made that the company proposes to put in a 10,000-hp plant at a cost of about $1,000,000. Tenders were also opened last week for the supply of an electric plant for civic and commercial lighting and power for the city. The tenders were found to be incomplete, and as a result the city engineer has recommended that none of them be accepted, it being impossible, owing to the small number of tenders received, to arrive at even an approximate estimate of the cost of the plant.

ENGLISH NOTES.

A NEW INFLUENCE MACHINE.—At a meeting of the Physical Society on October 28 a new type of influence machine was described by Mr. W. R. Pidgeon. As in the Wimshurst, the machine consists of a pair of glass discs rotating in opposite directions on a spindle. They are partially covered on one face with narrow radial sectors of tin-foil, each provided with a small brass knob. This face of the disc, including its sectors, is coated with insulating wax in such a way that only the knobs project through the wax. Two earthing brushes pass through the insulating fixed inductors and support them, these inductors being kept charged by exploring points connected to each and placed so as to collect electricity from the revolving discs. By means of brushes the sectors on each of the discs are successively earthed at the moment they pass the fixed inductors, i. e., when their capacity is a maximum, and they are made to deliver up their charge to the main collective brushes when they are electrically farthest from the inductors, i. e., when their capacity is a minimum. The thick coating of wax restricts leakage to the small area of the connecting rods, so that the effects of dirt and moisture, so troublesome in the usual types of influence machines, are considerably reduced.

OPENING OF THE FOLKESTONE ELECTRICITY SUPPLY WORKS.—The Folkestone electricity supply works were formally opened on November 2 by the mayor of the town. The station is but a small one, its present capacity being only about 300 kilowatts, but it embodies some of the best features of English electrical engineering practice. The area of supply is very compact, but unfortunately it was found impossible to acquire a site for the central station in the centre of the town, so that the station which has been built lies about a mile from the centre of the supply area. It has, however, the advantage of being close to a railway station, and has a private siding from which coal is delivered straight into the bunkers. The boilers are of the well-known Davy-Paxman "Economic" type, 14 feet long by 8 feet diameter, each being capable of evaporating 6000 pounds of water per hour by working at a pressure of 150 pounds. The steam pipes are arranged on the usual ring main system, and are of 6-inch steel, with copper bends, with 5-inch steel connections to the boiler and 2½-inch and 3½-inch copper connections to the engines. Geipel steam traps are used at the ends of the ring to drain the pipes. Three Peache single-acting three-crank type of engine are directly coupled to Parker dynamos. The latter are of the bipolar type, two having an output of 160 amperes and the third 380 amperes, all designed to work at from 420 to 460 volts. The distribution is on the three-wire system at 420 volts across the outers, and balancing is insured by a battery connected across the mains, and a booster set. Another battery is to be installed in the town at a later date. The mains are of the Callender Construction Company's type, insulated with impregnated jute, lead covered and armored, and laid directly in the ground. There are a number of arcs on the network, including street lighting in some parts of the town. These lamps are all connected eight in series across the 420-volt mains.

INSTITUTION OF CIVIL ENGINEERS.—Mr. W. H. Preece, the newly elected president of the Institution of Civil Engineers, delivered his inaugural address on November 1. The position of president of this institution is one of the very highest honors, and Mr. Preece is to be congratulated on being the first electrical engineer who has been appointed to fill it. Naturally the major portion of Mr. Preece's address was devoted to the subjects of telegraphy and telephony. Among other interesting figures he cited the following are specially worthy of note, representing the extent of the present system of telegraphs owned by this country:

	Miles of Wire.
General Post Office and its licensees	435,000
Railway companies	105,000
India and colonies	387,966
Submarine cables	183,400
	1,111,366

Referring to the scarcity of gutta-percha the speaker noted the fact that lead-covered paper cables were now coming very much into use. A 76-wire cable insulated with paper is, as I have mentioned in a previous letter, being made between London and Birmingham for telegraphic purposes. The cable companies are, acording to Mr. Preece, also contemplating leading their long cables from Cornwall to London, so as to be free from weather troubles, and it is quite possible that paper will be the dielectric used to surround the conductors. Referring to wireless telegraphy Mr. Preece stated that visions of dispensing with wires altogether had been fostered by the popularity of Marconi's system. But wireless telegraphy was as old as telegraphy itself, and a practical system of his own was now in actual use by the Post Office and War departments. "Sensational experiments for 'booming' a new financial enterprise, were not," he said, "processes which commended themselves to this institution. We want practical work and engineering progress." Coming to telephony the president reminded his audience that it was now possible to speak between many important towns in England and France, and that it was theoretically possible to talk with every capital in Europe. The Post Office Department is now considering the submersion of special telephone cables to Belgium, Holland and Germany. The following expression of opinion as to the ownership of the telephone system, coming from the chief engineer of the Post Office, has particular significance at the present moment: "The progress of the use of the telephone in Great Britain has been checked by financial complications. It fell into the hands of the company promoter. It has remained the shuttlecock of the Stock Exchange. It is the function of the Postmaster-General to work for the public every system of intercommunication of thought which affects the interests of the whole nation. Telephony is an imperial business, like the post and telegraph. It ought to be in the hands of the state. The public and the press have frequently kicked violently against the present regime. Committees of Parliament have sat and deliberated upon the question. The report of the last committee is now under consideration. 'Quidquid delirant reges, plectuntur Achivi.' Two causes exist to impede this desirable absorption, the fear of being 'done' by watered and inflated capital, and the assumed bad bargain made in absorbing the telegraphs in 1869. The former is a mere bugbear. The public does not want to purchase stock. It wants to acquire a plant and business which can be easily and fairly valued. The latter is a gross fallacy." Up to the end of 1808 the number of telephones in use by the National Telephone Company was 133,498. Those in use by the General Post Office number only 9588; and railway companies owning 8933 instruments brought the total to 152,019. An interesting table was also given showing the extent to which the various systems of electric signaling were used on the railways of the United Kingdom.

FRENCH NOTES.

A SERIES of trials in practical transportation by large automobiles was begun on October 6 at Versailles, under the name of "The Competition for Heavy [illegible] [illegible] cavalry of steam, electricity and [illegible], accompanied by much noise, up and down [illegible] Versailles and round about the neighboring country. This makes the second year that this competitive trial has been run [illegible] represented by eighteen vehicles, two of which were of foreign make. The preceding year there were but fifteen vehicles, and all were French.

ELECTRIC TRAMWAYS.—An electric street railway is being built at Amiens. Separate gangs of workmen are pushing forward both the track and [illegible] in [illegible] Boulogne, Roubaix, Tourcoing, Châlons, Havre and Rouen, all towns in the [illegible]

[illegible]

THE [illegible]

erection of any buildings or the acquisition of all accessories or furniture needed. 5. The participation of this company, either directly or indirectly, whether in France or in foreign countries, in transportation enterprises, and in all commercial, industrial or financial operations which may be in any way connected with them, either through the creation of new companies or the enlargement of or amalgamation with existing ones. The provisional offices of the company are at No. 38 Rue de Laborde, Paris.

General News.

NEW INCORPORATIONS.

THE CARO LIGHT & POWER COMPANY, Caro, Mich., has been incorporated with a capital stock of $25,000.

THE ROCKY FORD ELECTRIC LIGHT COMPANY has been incorporated at Pueblo, Col., with a capital stock of $15,000.

THE UNITED TRACTION COMPANY, Chicago, Ill., has been formed by A. B. Wilson, A. E. Meanor and L. J. Bohan, with a capital stock of $500,000.

THE CAMDEN, DUNKIRK & ALBANY ELECTRIC TRACTION COMPANY, of Dunkirk, Ind., has been incorporated with a capital stock of $10,000.

THE CINCINNATI, LAWRENCEBURG & AURORA ELECTRIC STREET RAILWAY COMPANY, Aurora, Ind., has been incorporated with a capital stock of $10,000.

THE HARPER'S FERRY ELECTRIC LIGHT & POWER COMPANY is the title of a new concern incorporated at Harper's Ferry, W. Va., with a capital stock of $15,000.

THE MUTUAL ELECTRIC COMPANY has been incorporated at Waco, Tex., by W. W. Seley, S. W. Sladen, I. A. Goldstein and L. Migel. The capital stock of the company is $10,000.

THE GREGORY ELECTRIC COMPANY, Chicago, Ill., has been incorporated with a capital stock of $100,000. The incorporators are Charles E. Gregory, George A. Fargher and George Wadsworth.

THE EL PORTE ZUELO LIGHT & POWER COMPANY has been incorporated in Chicago, Ill., with a capital stock of $500,000. The incorporators are C. D. Crandall, William H. Carpenter and W. R. Patterson.

THE MITCHELL-PARSON ELECTRIC COMPANY, Portland, Me., has been incorporated with a capital stock of $150,000. The incorporators are George A. Copeland, Revere, Mass., and William E. Pearson, Winthrop, Mass.

THE NORTHERN MINNESOTA TELEPHONE COMPANY, Park Rapids, Minn., has been incorporated with a capital stock of $10,000. Among the incorporators are Charles Moody, F. A. Vanderpool, of Park Rapids, and others.

THE SANDS ELECTRIC COMPANY, Cleveland, Ohio, has been incorporated with a capital stock of $10,000, to manufacture all kinds of electrical appliances. Among those interested are L. Sands, E. Velhagen and F. B. Sheels.

THE ABBOTT ELECTRIC & MANUFACTURING COMPANY, Cleveland, Ohio, has been formed for the purpose of manufacturing electrical and mechanical devices. The incorporators are H. H. Hammond, H. I. Wickes, William A. Marbach, S. Abbott and C. B. Abbott. Capital stock, $15,000.

THE TELEGRAPH AND TELEPHONE.

EAST PROVIDENCE, R. I.—The East Providence Telephone Company has been incorporated with a capital stock of $25,000.

WINCHESTER, KY.—The East Tennessee Telephone Company has been granted a franchise to maintain a telephone system in this place.

MONTGOMERY, ALA.—A franchise to establish and maintain a telephone system in this place has been granted to W. F. Vandiver, F. M. Billings and [illegible]

MONTPELIER, VT.—The Montpelier Telephone Company has been incorporated with a capital stock of [illegible]. It proposes to build and maintain lines [illegible] in Windham and [illegible] counties.

STAMFORD, CONN.—The telephone line from Walton to Masonville, De[illegible], [illegible] Trout Creek and points between has been taken down. [illegible] the line does not pay.

ATLANTA, GA.—Mr. F. [illegible], of Atlanta, has been appointed temporary receiver [illegible] for the Augusta Telephone & Electric [illegible]. The petition was filed by Marion Erwin, attorney for Thomas & [illegible] York.

KANSAS CITY, MO.—The Missouri & Kansas Telephone Company has [illegible] Board of Public Works for permission to construct conduits for its [illegible] streets of the city. Action on the petition will be taken at [illegible] of the board.

WASHINGTON, D. C.—A final settlement has been effected between the [illegible] and the Western Union Telegraph Company on money [illegible] by Postmaster-General Wanamaker. [illegible] have been paid.

CLOQUET, MINN.—The [illegible] Telephone Company, which has obtained [illegible] long-distance telephone line [illegible] line between Cloquet and [illegible] to Duluth via Carlton.

[illegible] Telephone Company has the Seward [illegible] with the York and David City [illegible] from the junction to town to be in connection with Seward and points south. The line north to Bellwood and Columbus will be completed in a few days.

BUFFALO, N. Y.—Threatened litigation has caused the Empire State Telephone Company to abandon its project of building lines in sections of Monroe and Ontario counties. Farmers combined to ask the company to pay big sums for the privilege of setting poles. Now that the project has been declared off there is a howl from the ones who caused the trouble.

DES MOINES, IA.—A meeting of the Iowa Telephone Association was held recently in Des Moines for the purpose of agreeing upon tolls and the proper division thereof between the different independent lines in the association. Among the different lines represented at the meeting were the Mutual Company, of Des Moines, by J. W. Hill; the Southwestern Telephone Company and Clearfield & Mt. Ayr Company, by D. M. Smith; the Perry Telephone Company, by G. M. Brady; the Jefferson Telephone Company and the Boone-Marshalltown Company, by C. E. Wells, and the Central Telephone line by W. Brandt. The companies now in the association have lines reaching 184 towns in this State. They have just opened connections with Dayton. Harcourt and Gowrie with metallic circuit lines. Among the different improvements being made by the independent companies is a line by the Central Telephone Company, of which J. W. Hill, of Des Moines, is president. The company will complete the construction of a line to the southwest, reaching Oskaloosa and Ottumwa before December 1. In Fort Dodge a new metallic circuit line is being constructed with which all independent lines will have connections. In addition to this improvement there will be built from Fort Dodge to Sioux City a metallic circuit line in connection with the independent lines. The Boone-Marshalltown line, connecting Boone, Marshalltown and Des Moines, was recently completed. The old grounded line has been abolished and the metallic circuit substituted.

Electric Light and Power.

EMMETSBURG, IA.—The citizens of this place have voted to establish an electric light plant.

DECATUR, ALA.—Mr. R. D. Smith is interested in the organization of a company here to build an electric light plant.

CARTHAGE, MO.—An election will be held to vote on the proposition to issue $25,000 bonds for the purpose of constructing an electric light plant.

SARCOXIE, MO.—It is proposed to establish an electric light plant in this place, and the Sarcoxie Electric Company has been organized for the purpose.

WYNNE, ARK.—There is talk of establishing an electric light plant in this place. Mr. W. M. Kennedy is in a position to give further information on the subject.

BOSTON, MASS.—The Massachusetts Electric Freight Company has applied to the Legislature for a charter. It asks for authority to make contracts with street railway lines to carry freight.

MILLEDGEVILLE, GA.—There is some talk of building a municipal electric light plant in this place, with a capacity of 50 arc and 1000 incandescent lights. Mayor H. H. Horne can give further information on the subject.

SEABRIGHT, N. J.—The Seabright Electric Light Company will rebuild its plant which was destroyed by fire several years ago. The company has bought a lot, adjoining the Shrewsbury River, and will begin the erection of a building.

SAVANNAH, GA.—The Edison Electric Illuminating Company, which was recently organized here by New York and Savannah gentlemen, is applying to the City Council for a franchise to operate an electric lighting plant. The company has a capital of $100,000.

SENECA FALLS, N. Y.—The Seneca Electric Light & Power Company, embracing the plants at this place and Waterloo, has been placed in the hands of a receiver. This action was brought about by the Old Colony Trust Company, of Boston, as trustee of the company's bonds. H. H. Crowell, of Syracuse, has been appointed receiver.

GRAND RAPIDS, MICH.—The Newaygo Transmission Company has been organized by local capitalists, with $15,000 capital, to develop the water power at Newaygo, 30 miles north of here, and to transmit electric power to this city. The company has been given a franchise to erect poles and string wires in this city. A. C. Sekell and Charles F. Pike are the chief promoters of the enterprise.

NEW YORK CITY.—Recent changes in the directorate and management of the Block Lighting & Power Company gave rise a few days ago to a rumor that the concern, which holds a perpetual franchise for the manufacture and sale of electricity for lighting and power purposes, had been sold to the Metropolitan Street Railway Company. This rumor, however, was denied by Edward P. Doyle, ex-president of the Block Company.

FORT WORTH, TEX.—The report of the Fort Worth City Electric Light Works for the year ended March 21, 1898, shows that the cost of each 30-cp incandescent lamp per year, with interest, was $8.06, without interest, $5.27; cost of each 1200-cp arc lamp per year, with interest, $64.48; without interest, $42.10. There are 402 30-cp incandescent lamps and 68 arc lamps in use in the city. The report states that the small boy burdens the department with an expense on account of breakage of lamps, for which there is no feasible remedy.

TRENTON, N. J.—On November 15 Mr. Thomas C. Barr, of Orange, and Col. A. R. Kuser, of Trenton, purchased the stock and franchises of the Trenton Electric Light & Power Company, paying therefor, it is stated, $416,000. It is understood that the consolidation of the electric light company with the Trenton Street Railway Company and the Delaware River Improvement Company will be effected. The latter concern owns a water-power franchise at Merrisville, Pa., just across the river from Trenton, and proposes to dam the Delaware River for the purpose of obtaining water power for the operation of the electric light and street railway plants. It is stated also that one of the projects in view is the building of an electric railway to Philadelphia.

The Electric Railway.

EVANSVILLE, IND.—Dayton capitalists have petitioned for a franchise to build an electric railway from Evansville to Rockport, Tell City and Cannelton.

ELLICOTT CITY, MD.—The new electric railroad between Baltimore and Ellicott City is nearing completion, one track having been finished almost to the terminus here.

WHEELING, W. VA.—The Wheeling Street Railway Company is considering the question of increasing its capital stock, and may decide upon issuing bonds to make improvements in its system.

NEWPORT NEWS, VA.—The Peninsula Railway Company, composed of W. A. Post, Frank Lee and A. L. Parker and others, has applied to the Council for a franchise for the construction of a new street railway in this city.

DES MOINES, IA.—The Des Moines Edison Electric Light Company has increased its capital stock from $130,000 to $450,000. A new building is being constructed at the water-power plant at Centre Street, which will be equipped with water wheels.

LIMA, N. Y.—The employees of the Lima & Honeoye Falls Railroad are on strike, and the road is tied up. The trouble has been pending for some time. The cause, it is claimed, is the inability of the employees to get what is owing them.

HAVANA, CUBA.—The sale of the Ferro-carril Urbanos system is announced to an English stock company for $1,600,000. The system covers 25 miles of road. The entire line will be rebuilt and the motive power will be changed to electricity.

PORT CHESTER, N. Y.—The Port Chester Street Railway Company has made applications for the extension of its road from the present terminus, in Rye village, to Mamaroneck, to connect with the Mamaroneck, White Plains & Tarrytown Railroad.

CHICAGO, ILL.—The report of the receiver of the Calumet Electric Railway covering the period from May 1, 1897, to August 31, 1898, shows total receipts of $503,475; disbursements $492,038; receipts from operations, $281,786; cost of operation and expenses, $279,409.

DALLAS, TEX.—The Dallas Rapid Transit Electric Street Railway property, approximating 11 miles of track, a power house, rolling stock and other assets, were recently sold at trustees' sale. The purchaser was a man named Thayer from Boston, and the property went to him at $35,000.

BOSTON, MASS.—The directors of the Newport & Fall River Street Railway Company have declared a semi-annual dividend of 3 per cent., payable on January 1 next. This is the first dividend declared by the company. The road has been in operation since June 9 and up to November 1 its net earnings amounted to $20,897.

JACKSON, MISS.—There was general rejoicing in Jackson when the work of tearing up the old horse-car tracks was begun and the public realized that actual work on an electric line begins at once. General Garnes and other Tennessee capitalists are behind the enterprise, and will spend more than $100,000 on the car line and lighting system.

LEXINGTON, KY.—A company is being formed in this city to build an electric railway between Lexington and Richmond, Ky., a distance of 22 miles. The principal promoters are W. J. Loughridge, vice-president of the Electric Street Railroad Company, and Dr. Bennett, president of the National Exchange Bank. The road will cost $125,000. It will cross the Kentucky River at Clay's Ferry.

LYNCHBURG, VA.—The Lynchburg & Rivermont Street Railway Company will extend its present line from the city post office to the city park, a distance of about 1⅜ miles. Girder rails will be used on the paved streets and T rails on the unpaved streets. Track and overhead material will be required and perhaps two additional cars will be purchased. It is the intention to have the line ready for business early next year.

HOUGHTON, MICH.—The Village Council has granted a street railway franchise to William H. Taylor, of New York City, on condition that he secure franchises from other towns in this vicinity so as to complete a belt line connecting various places in the county. The proposed line will be 20 miles in length, and the only obstacle in the way of its building is said to be the objection of the Calumet & Hecla Company to allow the electric railway to cross its property.

OWOSSO, MICH.—Eastern capitalists and local owners of the road and power plant of the Owosso & Corunna Traction Company are planning to extend their electric lines running west of Detroit to Pontiac and Sylvan road. Grand Rapids and Chicago capitalists are also endeavoring to secure the property to construct lines through to Grand Rapids and Lansing. This will make Owosso the centre of all the electric roads in this part of the State. The capital interested is $400,000.

GALVESTON, TEX.—The United States Mortgage & Trust Company, of New York, has filed in the United States Circuit Court a suit against the Galveston City Railroad Company and the Guaranty Trust Company, of New York. The plea is for the foreclosure of the second mortgage, $75,000, made second only to the first mortgage, and the amount due, ascertained and determined, that in default of the payment of this sum within the time limited by the court it may decree that the railroad company and the city and all persons claiming an interest in the property be barred.

BROOKLYN, N. Y.—Public meetings are being held in this city remonstrating against the use by the Nassau Railroad Company of summer cars fitted up for winter use. These cars are provided with side doors, and in order to collect fares it is necessary for the conductor to open the door, thus letting in cold air and causing draughts, which the passengers protest against very strongly. The Brooklyn Heights Company is making capital out of the popular dissatisfaction against the Nassau Company's cars, and is calling attention to its own new and handsomely fitted up cars.

HAGERSTOWN, MD.—Plans for the electric railway over the Blue Ridge Mountains, in which Pennsylvania and Maryland capitalists are interested, are being perfected. The directors of the Blue Ridge Electric Railway Company have selected a committee to decide upon the route. It is stated that the plan most likely to be adopted will connect Penmar and Blue Mountain House, and then swing over to Blue Ridge Summit, Monterey, Buena Vista and back to Penmar. From the latter point the line will extend to Waynesboro, Pa., and other points in the Cumberland Valley, and may also be extended to Gettysburg.

BALTIMORE, MD.—A syndicate of Baltimoreans, of which Messrs. Middendorf, Oliver & Co. are the representatives, with a capital stock of $300,000, has purchased bonds of the Atlanta Railway Company to the same amount. It is the purpose of the syndicate to control the road, developing it into one of the most efficient and best paying street railways in the city. The road has secured 10 miles of additional franchise, under which will be built a line to Grant Park, the city water works and West End. The total trackage of the road when complete will be 26 miles. The bonds of the new company amount to $500,000. The capital stock is $1,000,000.

KANSAS CITY, MO.—A franchise has been granted to the Jackson County Electric Railway Company to build a double-track line from the city limits to Dodson and Swope Park, a distance of between 5 and 6 miles. The incorporators of the company are F. W. Sears, B. F. Burd, W. H. Brown, Dr. C. McDonald and Henry Smith. It is stated that the company is identical with the Missouri Electric Railway Company, which was incorporated about a month ago by the same gentlemen, and which will operate the city end of the line. The city company's capital stock is $500,000 and the county company's stock $100,000. A power house will be erected at Bush Creek and Prospect Avenue at a cost of about $40,000.

NEW BRITAIN, CONN.—According to the returns of the Central Railway & Electric Company for the nine months ending June, 30, 1898, the gross earnings were $116,192.88; operating expenses, $79,210.65; net earnings, $36,982.23; no dividends were paid. Miles run, 338,403; passengers carried, 1,434,105; number of employees, 83. The returns of the Bristol & Plainville Tramway Company show gross earnings of $44,383; operating expenses, $33,005.80; net earnings, $11,377.81; dividends, $3000; miles run, 145,629; passengers carried, 543,032; number of employees, 30. The returns of the Hartford Street Railway Company show gross earnings, $438,069.12; operating expenses, $303,095.95; net earnings, $134,973.20; dividends, $21,000; interest, $77,938.72; taxes paid, $24,177.93; miles run, 2,228,935; passengers carried, 8,886,229; number of employees, [illegible].

SYRACUSE, N. Y.—About three months ago there was a forty-eight-hour tie-up of the lines of the Rapid Transit Street Railway Company, of this city. A compromise was effected by the State Board of Mediation and Arbitration, but dissatisfaction on the part of the men was evidently not entirely removed. On November 17 a general strike of the conductors and motormen was ordered by the president of the union. It is stated that the object of the present trouble is to secure a recognition of the union, which was one of the points yielded by the men at the time of the settlement of the last trouble. The employees, however, claim that the present difficulty is brought about through the unwarranted discharge of employees. There are 230 members of the union, and the lines involved comprise practically all the street railways inside the city. Very few of the employees obeyed the order to strike, and the service was not interrupted to any great extent, new men being put in the strikers' [illegible].

ROCKLAND, MASS.—A plan for the amalgamation of all the street-car lines in southeastern Massachusetts is under way. The leaders in the project are Pepper and Register, owners of the Hingham street railway line. The acquisition of the Brockton, Bridgewater & Whitman Street Railway is only a link in the chain which will ultimately lead up to the control of the entire system of street railways in this section by the combination. In pursuance of a policy of expansion, which has been quietly developed, the promoters of the project have acquired a controlling interest in the Rockland and Arlington street railways. The syndicate has now control of a system of street railways from Nantasket Beach to Bridgewater, and the question of its control of the Hanover Street Railway is only a question of a short time.

Directory of Scientific Societies, Associations, Etc., and Meetings of the Same.

THE NEW YORK ELECTRICAL SOCIETY.—President, Gano S. Dunn; secretary, George H. Guy, 120 Liberty Street, New York.

HENRY ELECTRICAL SOCIETY meets every other Friday evening between October and May. Headquarters, 115 West Twenty-eighth Street, New [illegible]

[illegible] ASSOCIATION.—President, F. A. Bowman, of New Glasgow, N. S.; secretary, J. H. Winfield, New Glasgow, N. S. Last meeting, Halifax, N. S., September 27-28, 1898.

NATIONAL ELECTRIC LIGHT ASSOCIATION.—President, A. M. [illegible]

[illegible] ASSOCIATION. [illegible]

[illegible] OF THE STATE OF NEW YORK. [illegible]

[illegible] INSTITUTE OF ELECTRICAL ENGINEERS, New York. [illegible] June 1.

[illegible] ASSOCIATION OF THE UNITED [illegible]

THE BROOKLYN INSTITUTE OF ARTS AND SCIENCES, Brooklyn, N. Y. Henry T. Weed, secretary. Future meetings: December 2, lecture by Prof. William E. Geyer, Stevens Institute; January 6, lecture on "The Electro-Metallurgy of Copper," by John B. F. Hereschoff; February 3, lecture and experimental demonstrations by Prof. M. I. Pupin; March 3, illustrated lecture on "Electricity in the Navy," by Captain Zalinski, U. S. N.; April 7, lecture on "Cable Telegraphy," by A. E. Kennelly; May 5, lecture by Prof. William A. Anthony.

CHICAGO ELECTRICAL ASSOCIATION.—Meetings, first and third Friday of each month, from October 1 to June 1; J. R. Cravath, secretary, Monadnock Block, Chicago, Ill. Future meetings and papers for the season of 1898-99: "The Development of the Motorcycle," by F. B. Rae; December 2, "Practical Points in Street Railway Engineering," by W. A. Harding; December 16, "Wireless Telegraphy," by Arthur V. Abbott; January 6, 1899, "Telephone Engineering—Some Problems Solved and Unsolved," by S. G. McMeen; January 20, "Observations on Ventilating Fans," Gerard Swope.

FRANKLIN INSTITUTE (Electrical Section), Philadelphia, Pa.—Secretary, Wm. H. Wahl. Programme of lectures for the season 1898-99: November 22, "Thermo-electricity," by Mr. C. J. Reed, and "Electric Elevators," by Mr. Wm. Baxter, Jr.; December 13, "The Kite As an Instrument in Meteorological Research," by Prof. Charles F. Marvin, of the United States Weather Bureau, and "Standards of Light for Electric Light Photometry," by Prof. A. J. Rowland; January 24, 1899, "The Practical Application of the Electric Motor to Printing Press Machinery," by W. H. Tapley; February 14, "The Electric Inspection of Street Car Equipments," by Mr. A. B. Herrick; February 28, "Some of the Larger Transportation Problems in Cities," by E. E. Higgins; March 28, "Water Power Electric Plants in the United States," by Mr. B. C. Washington, Jr.; April 25, "Design of Electromagnetic Mechanism, with Especial Reference to High Frequency Telegraphic Receivers," by Prof. Reginald A. Fessenden; May 23, "Electrical Clocks, Historically Considered; with a description of the Most Successful Applications of Electricity to Clocks and the Uniform Distribution of Time," by Mr. James Hamblett. On February 10 Mr. T. Commerford Martin will deliver a lecture under the joint patronage of the institute and the Central Branch of the Y. M. C. A. on the subject of "Electric Power Transmission."

LEGAL NOTES.

MUNICIPAL REGULATION.—An ordinance requiring a street railroad charging 5-cent fares to sell six tickets for 25 cents, or 25 tickets for $1 is unreasonable, when the road is only making yearly net earnings of 3.3 per cent. to 4.5 per cent. on its bona fide investment and paying 5 per cent. interest on its bonds. Such an ordinance is void, under the fourteenth amendment, as depriving the company of its property without due process of law. Milwaukee Electric Railway Company v. City of Milwaukee; U. S. Circuit Court (Wis.), 1898.

SPEED OF ELECTRIC CARS.—While electric cars at street crossings must so regulate their speed and give such warning of their approach that footmen using ordinary care may cross it safely, yet the rule between crossings is different, and footmen must be aware that cars between crossings run at a high rate of speed and are not under control, and cannot be stopped instantly, and the motorman need not apprehend that a footman between crossings will put himself on the track without first observing whether a car is approaching. Bethel v. Cincinnati Street Railway Company, Ohio Circuit Court, 1898.

PERSONAL NOTES.

PROF. W. M. STINE is now at the head of the department of engineering, Swarthmore College, Swarthmore, Pa.

MR. CHARLES E. BIBBER, of the Bibber-White Company, Boston, Mass., was in New York during the past week.

MR. R. E. INSKEEP, general manager of the Akron Electrical Manufacturing Company, Akron, Ohio, was in New York on business during the week.

MR. JOHN A. SEELY, of the firm of Belden & Seely, electric and steam railroad contractors, Syracuse, N. Y., is now located in that city. His address is 601 Granger Block, Syracuse, N. Y.

OBITUARY NOTE.

MR. JOHN W. KEELY, the inventor of the so-called Keely motor, died at [illegible] Philadelphia, on November 18, from pneumonia. Mr. Keely was [illegible] a native of the city in which he died. His [illegible] talked about all over the world, was first exhibited [illegible] on November 10, 187[illegible]. These [illegible] to enable the inventor to perfect his discovery [illegible] large sums of money have been [illegible] practical results. It is not yet [illegible] he was committed [illegible] for refusing to disclose the secret.

Trade and Industrial Notes.

[illegible] Mr. A. O. Schoonmaker, [illegible] from lighting stations. Mr [illegible] to anyone interested, on application.

A NEW LAMP [illegible] called the "Ideal" is being introduced by the [illegible] in many respects, its [illegible] piece of metal and so constructed [illegible]

MR. BEN F. LAMBORN, city clerk of Alameda, Cal., desires copies of catalogues and other information touching on electric lighting and electric railway equipment, construction, cost, etc. It is proposed to draw up a set of specifications upon which bids will be invited.

THE CATALOGUE of electrical supplies issued by J. Frank Eline, 206 East Baltimore Street, Baltimore, Md., is a very complete production of its class. It contains 224 pages, and covers every branch of applied electricity, and is, besides, very profusely illustrated. The prices of the various articles are also given.

THE CENTRAL ELECTRIC COMPANY, Chicago, announces that it will have a great variety of all kinds of portable reading and desk lights. The adaptation of these lamps to so many different purposes has resulted in the production of a wide variety of types. These and many other useful articles will be fully illustrated in the Central Electric Company's new catalogue, which is about ready for distribution.

MESSRS. GEORGE C. HOFFMAN AND THEODORE W. KLOMAN, 39 Cortlandt Street, New York, who represent the Northern Electric Manufacturing Company, of Madison, Wis., have secured the Eastern agency for the sale of the inductor alternators manufactured by the Warren-Medbery Company, of Sandy Hill, N. Y.

THE UNITED STATES CARBON COMPANY, Cleveland, Ohio, reports that it is meeting with great success in the manufacture and sale of its carbons for enclosed arc lamps, which seem to meet a large demand for an efficient domestic carbon to replace the imported article. Its large presses have been very busy on carbons for electro-metallurgical and electrolytical purposes.

THE MANHATTAN ELECTRICAL SUPPLY COMPANY, 32 Cortlandt Street, New York, has just issued its illustrated catalogue No. 10 of electric light, household, telephone and telegraph supplies. The catalogue, which contains 336 pages, very completely covers these departments of electrical application, and is well arranged with a view to quick reference.

A LOCKING OR CLAMPING SWITCH.—Mr. F. A. La Roche, of F. A. La Roche & Co., of New York, was granted patent No. 613,688, on November 8, for a locking or clamping device for binding the jaws and hinges to the blades of knife switches in the closed position, these clamping devices being set and released by the motion of the switch blades themselves.

A LARGE ORDER FOR TELEPHONE APPARATUS.—The Pennsylvania Electric Company, Marietta, Pa., recently received what it claims to be the largest single order ever given by an independent telephone company for apparatus. The order calls for 2000 Crescent Ideal telephones, which are manufactured by this company, and a 1000-line switchboard of the latest improved pattern.

THE ILLINOIS ELECTRIC COMPANY, Chicago, Ill., states that its sales of Crefeld weatherproof magnet, office and annunciator wires are increasing from month to month, and claims to carry one of the largest and most complete stocks of wire in Chicago. It invites correspondence from the trade when anything in its line is desired, and advises purchasers to secure its quotations before placing their orders.

THE JEFFREY MANUFACTURING COMPANY, Columbus, Ohio, has recently taken up the manufacture of the Columbian separator-screen and bolter, and has erected an experimental machine at its works for testing of such material that may be sent to it for that purpose. Those interested in the screening and separating of cement, clinker, coal, etc., can secure further information by addressing the Jeffrey Company.

THE BATTLE CREEK STEAM PUMP COMPANY, Battle Creek, Mich., manufactures the Marsh steam pump, which is adapted to all duties. It is stated to be absolute in action and regulation. In the catalogue of this company is shown a very complete line of these pumps, for all purposes, each type being well illustrated and briefly described. A copy of this catalogue should be in the hands of all steam users.

THE CENTRAL ELECTRIC COMPANY, Chicago, announces that it is making great preparations for the usual holiday trade in miniature lamps for decorative purposes. It is carrying large stocks of these lamps in clear glass and natural colors in all candle powers and voltages. It is also introducing a new type of standard-base miniature lamp, operative upon circuits of 90 to 130 volts. Its small dimensions render is particularly adapted to sign work and most all kinds of decorative purposes.

"THE MODERN ROUND-HOUSE TURNTABLE" is the title of a handsome pamphlet issued by the Westinghouse Electric & Manufacturing Company. In THE ELECTRICAL WORLD of August 27, 1898, was described and illustrated the electrically driven turntable which forms the subject of this pamphlet. The Westinghouse method of appling electricity to the operation of turntables should be especially interesting to railroad managers, inasmuch as it requires no change in the turntable proper other than attaching the draw-bar lug to the turntable girder.

MR. WILLIAM ROCHE, 259 Greenwich Street, New York, states that the English trade is taking a decided interest in his new "Standard" dry battery, which type of cell was used on the machine guns of the United States Navy in the war with Spain. During the past week he has made two large shipments to England, and reports the receipt of flattering orders for the cells. The oval or vest-pocket cell, he states, is also meeting with great favor. In order to keep up with the orders for these dry batteries, Mr. Roche has been compelled to run his shop, which occupies two floors, overtime.

THE MANSFIELD TEMPERED COPPER COMPANY, Mansfield, Ohio, states that its business is on the increase, and present indications are that its agents at Kendal, England, and Vienna, Austria, will tax the capacity of the present plant to keep them supplied with its products. Among the recent foreign orders were several for Messrs. Siemens & Halske, of Vienna; one for 7000 bars, one for 7500 and another for 2000, and the company is about to close an order for 50,000 street railway segments. Its agents at Kendal are using from 500 to 1000 a week. This, with the continually increasing home trade, will compel the company to again enlarge its producing capacity in the near future. It is less than a year ago that it was obliged to extend its plant.

THE EASTERN TELEPHONE MANUFACTURING COMPANY, of Meriden, Conn., is placing on the market first-class telephone apparatus at the lowest possible prices, at which the various instruments can be made and sold. The principal reasons given by the company why these instruments can be sold at such low figures are that its business is done on a cash basis—selling for cash and buying for cash—it has no agents on the road and makes a limited number of styles of telephones. Everything has been standardized so as to avoid waste and loss in manufacturing the instruments, which are produced in large quantities; this also lessens the cost. The company invites a trial of its instruments, feeling confident that satisfaction will be given.

GAS AND GASOLINE ENGINES.—The Webster Manufacturing Company, Chicago, Ill., in a pamphlet recently issued describes and illustrates artisticcally the Webster vertical 2½-hp gas engine. This engine, which is very compactly built, is especially adapted for running pumps, blowers, etc. The Webster horizontal gas and gasoline engine constitutes the subject of another catalogue issued by the same company. Six sizes of the engine of the horizontal type are manufactured, ranging in actual horse-power from 4 to 28. These machines are adapted to the running of dynamos, blowers, ventilating fans, passenger and freight elevators, etc. Among the illustrations shown in the catalogue are small electric-light plants driven by the Webster horizontal engines.

THE PERFECTION DYNAMO BRUSH.—The Ohio Electric Specialty Manufacturing Company, Troy, Ohio, reports that it is making large sales to both supply houses and consumers of its style of brush known as the "Type D Perfection." The brush is composed of a specially prepared wire gauze and a sufficient amount of leaf copper for backing, lubricated with graphite and covered in a way which prevents excessive sparking at the commutator end. It is, besides, noiseless, and said to have long wearing qualities, and aids in keeping the commutator in good condition. The company states that the high quality of this brush is attested by numerous duplicate orders being placed by satisfied customers. Descriptive circulars, prices and other information will be forwarded to those interested on application to the company.

THE SEASON for Christmas decorations is always a busy one for the contractor and electric light station manager, as nearly all such decorations mean some kind of special electrical illumination. The Packard sign lamp is designed with a view of meeting the demand for a lamp of uniform candle-power, voltage and efficiency for this class of work, and it is now very extensively used for decorative purposes. It is a miniature lamp of two candle power, to be used in connection with a regular Edison candelabra receptacle and of a proper voltage to burn four in series on from 50 to 60 volts and eight in series on from 100 to 120 volts. Long life and high efficiency are guaranteed. The Electric Appliance Companv, Chicago, carries these lamps and receptacles in stock at all times, but has a specially large stock at this season of the year to meet the unusual demand.

AN IMPROVED BRUSH HOLDER.—Mr. A. E. Doman has been granted patent No. 613,669, issued November 8, 1898, on an improved brush-holding mechanism, the patent being assigned to the Elbridge Electrical Manufacturing Company, Elbridge, N. Y. The arrangement consists, in short, of a radial brush mounted on a holder swiveled on the usual pivot or spindle on the rock arm, and provided with a ball and socket or universal joint near the brush itself. The purpose of this is to prevent the oscillations of the holder as the brush rises and falls due to the irregularities in the commutator surface from teetering the brush around the pivot and causing it to make contact at its edges instead of over its whole face. The ball-and-socket joint allows a small universal movement by which the surface of the brush pressing on the commutator can adjust itself to a true bearing at all times.

NON-MAGNETIC WATCHES FOR ELECTRICAL MEN.—In electric light and power stations where electric generating machines are in operation the magnetism which permeates the air is extremely detrimental to watches. The ordinary watch invariably becomes magnetized and is rendered useless as a time-keeper. The Paillard non-magnetic watch is said to be absolutely proof against the harmful effects of magnetism and electric currents. It has been on the market for several years, and established its reputation on this fact principally, although it is said to be a first-class watch in every other respect. Dynamos and other electrical apparatus may be approached with impunity without fear of damage to the delicate mechanism. The manufacturer of the Paillard non-magnetic movement is Mr. A. C. Becken, 103 State Street, Chicago, Ill. Mr. Charles R. Randall, 54 Maiden Lane, New York City, is the selling agent.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, 714-718 St. Charles Street, St. Louis, Mo., is making a specialty of the direct connection of electric motors to all classes of light machinery, and is prepared to furnish alternating-current power motors in all sizes from one-thirtieth actual horse-power up to 30 horse-power. Over one hunded different kinds of alternating-current motors are manufactured regularly by this company, which claims that it is in a better position than any other company in the United States, or possibly in the world, to furnish users of alternating-current power motors with their exact requirements. All of the products of its factory are thoroughly guaranteed, and if prospective customers have any doubts as to the practical working of single-phase alternating-current machinery the company is perfectly willing to send machines to responsible parties on ten to thirty days' trial. The company asks that in such cases it be advised definitely and in detail just the kind of work the motor will be called upon to perform. This company has had a large amount of experience in all classes of small power work, and invites correspondence from either manufacturers, consumers or electrical dealers who have had difficulty in finding the proper electric motor for use on alternating current. In addition to motors the Emerson Company manufactures a complete line of knife switches, switchboards, tablet boards, etc. Catalogues and printed matter describing its products will be furnished to the trade or direct to the consumers on application.

Business Notice.

THE ILLUSTRATIONS in this issue were made by the Photo-Engraving Company, 9-15 Murray Street, New York City.

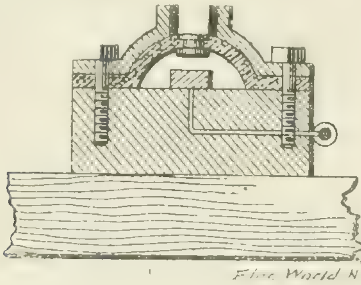
ILLUSTRATED RECORD OF ELECTRICAL PATENTS

UNITED STATES PATENTS ISSUED NOVEMBER 15, 1898.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

614,076. ALTERNATING-CURRENT MOTOR AND MODE OF OPERATING SAME; Chas. S. Bradley, of Avon, N. Y. App. filed June 22, 1896. An alternating-current motor having a winding on one element connected with a single-phase supply-circuit, a polyphase winding on its co-operating element, and a variable-speed generator supplying the latter with polyphase currents of variable rates.

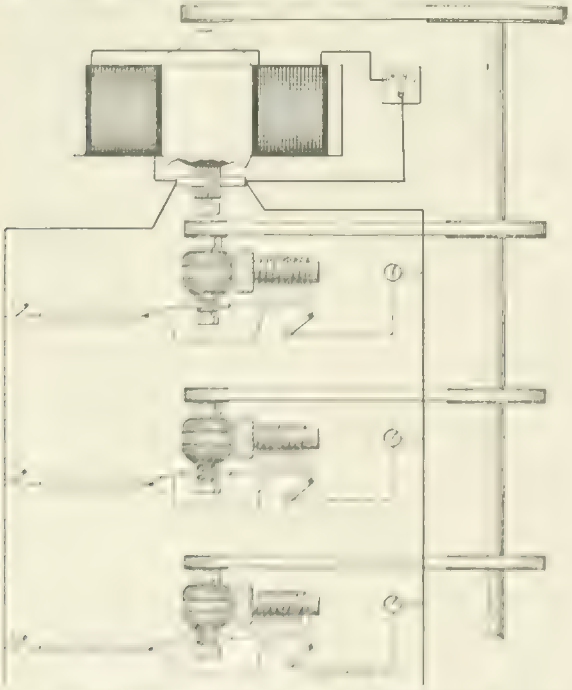
614,082. INTERMITTENT ELECTRIC SURFACE CONDUCTOR; F. Burger, of Ft. Wayne, Ind. App. filed July 23, 1897. An intermittent electric surface conductor, comprising a stringer mounted on the cross-ties, a feeding conductor supported on the stringer, a flexible covering for the conductor secured to the stringer and having a series of contact pieces extending through the covering, channel irons arranged on each side of the flexible covering and secured to the stringer leaving a slot between their adjacent edges, and insulating material applied to the adjacent edges whereby when the trolley wheel passes through the slot the contact pieces are pressed into engagement with the feeding conductor, and rise therefrom by the resiliency of the covering, substantially as described.



No. 614,082.—Intermittent Electric Surface Conductor.

614,124. ELECTRIC SWITCH MECHANISM FOR ELECTRIC RAILWAYS; J. M. Murphy, of Torrington, Conn. App. filed Sept. 3, 1897. An electromagnetic switch mechanism of the character stated, comprising electromagnets, an armature switch, a main-line circuit having contacts adapted to be engaged and closed by the shifting of the armature switch, a local circuit for energizing the magnets to throw the switch, said local circuit having a contact member continuously held in engagement with the switch during its [illegible] movement.

614,207. TELEPHONE EXCHANGE SYSTEM; W. E. M. Jackson, of Chicago, Ill. App. filed Jan. [illegible], 1897. In a telephone exchange system sev-



[illegible]—Method of Charging Secondary Batteries.

[illegible]

engaging the rims thereof inside of the outer edges of the latter, substantially as described.

614,225. ELECTRIC METER; L. Gutmann, of Peoria, Ill. App. filed Dec. 4, 1897. An armature for electric meters, consisting of two rings of electrical conductors and conducting strips angularly disposed to said rings connecting them to one structure.

614,228. METHOD OF CHARGING SECONDARY BATTERIES; C. O. Mailloux, of New York. App. filed April 24, 1891. The method of charging secondary batteries which consists in producing progressive changes of supplemental e. m. f. acting with an e. m. f. in the circuit of said battery, and in accordance with and progressively graduated to the progress of the charge, and increases of counter e. m. f. in said battery.

614,270. INSULATED SUPPORTER FOR ELECTRIC OR OTHER WIRES; C. K. King and G. A. Mead, of Mansfield, Ohio. App. filed June 29, 1898. In a support for trolley wires and the like, a clamp or ear, a hanger body, including an insulator washer, a threaded stud-bolt mounted therein and adapted to be screwed into said clamp, and a lock washer interposed between said insulator washer and clamp.

614,275. APPARATUS FOR HEATING AND AGITATING AIR; E. F. Porter, of Boston, Mass. App. filed Dec. 27, 1897. In an apparatus of the character specified, a series of plates, means for heating said plates, and mechanism for operating one or more of said plates relatively to each other to agitate the surrounding air.

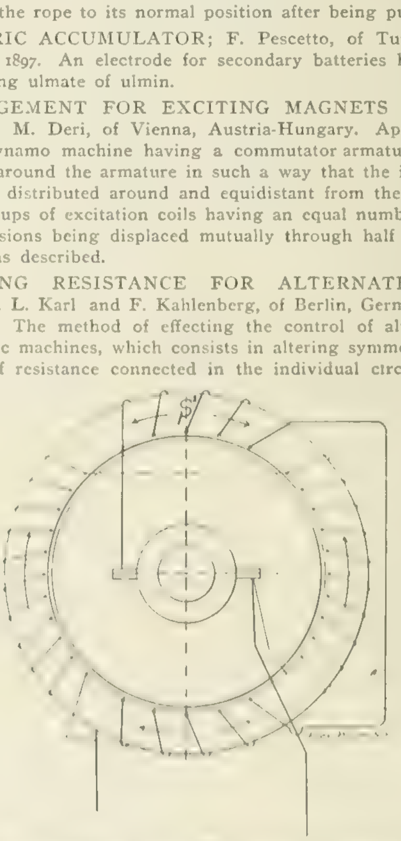
614,318. PORTABLE ELECTRIC LAMP; O. T. Bugg, Jr., of New York, N. Y. App. filed March 15, 1898. A portable electric lamp consisting of a single conducting casing carrying an electric lamp, one terminal of which is in permanent electrical contact therewith; an interior non-conducting lining and one or more battery cells, one electrode of which is connected to the conducting casing together with an insulated conductor adapted to be connected to the remaining terminal of the lamp, and a thumb knob or switch adapted to cause the free end of said conductor to bear against the remaining terminal of the lamp, substantially as described.

614,321. TROLLEY CONTROLLER; J. Dolan, of Dayton, Ohio. App. filed April 23, 1898. In a trolley controller, the combination with the trolley rope, of means for pulling said rope down when the trolley jumps the wire, and a pull cord provided at its upper end with a yoke carrying a roller, said rope passing through the yoke, thereby a downward pull on said cord restores the rope to its normal position after being pulled down.

614,339. ELECTRIC ACCUMULATOR; F. Pescetto, of Turin, Italy. App. filed Dec. 24, 1897. An electrode for secondary batteries having an active mass containing ulmate of ulmin.

614,373. ARRANGEMENT FOR EXCITING MAGNETS OF DYNAMO MACHINES; M. Deri, of Vienna, Austria-Hungary. App. filed July 27, 1898. In a dynamo machine having a commutator armature, a field magnet arranged around the armature in such a way that the iron of the magnet is equally distributed around and equidistant from the armature, there being two groups of excitation coils having an equal number of poles, and the polar divisions being displaced mutually through half a pole distance, substantially as described.

614,394. STARTING RESISTANCE FOR ALTERNATING-CURRENT MOTORS; E. L. Karl and F. Kahlenberg, of Berlin, Germany. App. filed Dec. 30, 1897. The method of effecting the control of alternating-current dynamo-electric machines, which consists in altering symmetrically the several groups of resistance connected in the individual circuits of said dy-



No. 614,373.—Arrangement for Exciting Magnets of Dynamo Machines.

namo-electric machine whereby its operative condition is governed, substantially as described.

[illegible] SIGNALING APPARATUS; M. [illegible], Malden, Mass. App. filed [illegible]. In a signal transmitting system, a signal transmitter at one station [illegible] determining devices, a receiver at a second station for reproducing the signal determined at the first station, circuit con[illegible] for controlling the reception of the [illegible] said device being [illegible] to its time of operation, [illegible]

The Electrical World.

Vol. XXXII. NEW YORK, DECEMBER 3, 1898. No. 23.

PUBLISHED EVERY SATURDAY BY

THE W. J. JOHNSTON COMPANY,

9 Murray Street, New York.

Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York.

New England Office, 620 Atlantic Ave., Boston.

Western Office, 936 Monadnock Block, Chicago.

Philadelphia Office, 929 Chestnut Street.

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THE ELECTRICAL WORLD,

9 Murray Street, New York.

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OPENING CIRCUITS CARRYING LARGE POWERS AND HIGH VOLTAGES.

With the continual concentration of greater and greater powers in central generating stations, the problems of controlling the enormous electrical loads, especially in times of emergency, have become more and more troublesome. The opening of a circuit carrying a heavy railway load, for example, is accompanied by manifestations of almost explosive violence, especially if the line opened is very heavily loaded or short-circuited and the supply is derived from a bank of large generators. With the much higher voltages obtained with alternating currents and the modern machines of this type built for close regulation, and consequently able to give many times their rated load before their fields are killed by the armature reaction, and mounted directly, as they now are, on the engine shafts, with fly-wheels weighing many scores of tons rigidly coupled to the rotating part, the problem of opening a circuit in case of emergency is no light one.

Fuses of the ordinary lead alloy are quite out of the question for such work, and for very heavy loads no satisfactory fuse has as yet been found. Aluminum is now coming into wide use in such work in preference to the ordinary fusible metal, owing largely to its greater conductivity and consequent reduced cross-section for the same load, which gives a much smaller amount of melted or volatilized metal, a higher resistance for the arc that tends to follow fusing, and less discoloration and destruction of the cut-out base and contacts. Enclosed fuses—that is, those with a fusible wire packed in a powder of some material which absorbs the heated metal and in certain cases forms with it an insulating, vitreous mass,—are in some use, in one instance on circuits carrying 20,000 volts. But these only serve for comparatively light loads, the enormous concentration of power on the cut-out of a circuit designed with a reactance sufficiently low for carrying many thousand kilowatts, in case of dead short-circuit with an ample generating capacity behind it, practically precluding the use of anything as yet designed in the nature of a fuse.

Switches for such work are generally made of the knife-blade type, with a quick-acting spring-operated break following the opening of the main contact. The object, of course, of a quick-opening switch is to break the arc before it has time to heat its terminals to the fusing point, when the melted metal would allow the arc to persist. Its action greatly assists the opening of non-inductive circuits, but it is dangerous in cases of high inductance, either in direct or alternating current work. No sensible engineer would dream of operating such a switch in the field circuit of a shunt-wound machine. The stored energy of magnetization must find a vent as the field current dies down, and the more rapidly the circuit is opened the longer will be the arc through which the current will follow, with a correspondingly higher strain of the insulation. Somewhat similar conditions exist in alternating-current circuits, especially with the iron of many transformers or motors interlinked with the circuit. A quick break sets up high inductive electromotive forces which, with the capacity of underground cables, may, and often do, set up dangerous oscillations. The remedy used in the case of field circuits is to shunt the inductive winding with a path of about the same resistance before opening its supply. A similar procedure in alternating-current work may prove valuable.

The devices designed during the last few years for breaking heavy high-voltage alternating loads are quite numerous. The switches used on the great Niagara generators, with their sixteen secondary or "follower" breaks of non-arcing metal—the primary break inserting a considerable resistance—are well known. With higher voltages even these do not seem to work satisfactorily. Plunger-type switches are quite generally used, the break being effected in the middle of a space confined by a chamber of porcelain, or some hard wood, such as lignum vitæ or apple wood, in which the heat generated by the arc blows the arc itself out. Another type, described in the article on another page on the Brooklyn Edison system, breaks the circuit under oil, and this practice seems to be finding favor. Even this, however, with twelve breaks in the circuit, does not suffice in the case of this central station, and an emergency switch is provided, consisting of simple knife-blades shunted by long, fine copper wires in fibre tubes, which take the arc from the switch when it is opened and blow themselves into vapor with such violence as to prevent the continuance of the arc after their own fusing. So-called "tank" switches have been used somewhat and always with great success, although they are rather unscientific pieces of apparatus. They consist fundamentally of a metal tank holding water, into which a long conducting rod, preferably of carbon, may be lowered. Touching the bottom of the tank, the circuit is a fairly satisfactory one for very high voltages, and may be rendered more so by shunting it with any suitable form of switch. To open the line this switch is, of course, first opened and the rod is raised through and from the water. The resistance of the water cuts down the load considerably before the carbon rod leaves its surface, and any arc which follows does no harm either to the rod or the water.

Such clumsy pieces of apparatus, however, cannot be satisfactorily embodied in automatic circuit-breakers, which are further handicapped in alternating-current work by the unsuitable character of magnetic blow-outs for this style of current. Secondary breaks of carbon, with a very wide opening, approaching in some equipments now in service five or six feet, seem to be the most satisfactory solution so far devised. Air-blasts apparently offer another solution which, if tried, has not as yet been put into commercial use, and breaking under oil may prove as satisfactory for automatic overload breakers as for switches, although, of course, overload breakers, as a rule, have the heavier service of the two.

A REQUIREMENT OF ELECTRICAL HEATING APPARATUS.

That electrical heating has a wide field of usefulness in spite of its considerable cost per British thermal unit no one can now deny. There are many places where "the best is none too good," regardless of expense, and electrical methods of heating are undoubtedly the best. In spite also of its high cost per thermal unit the heat so developed can be made much more effective in local applications than that developed by such a crude piece of apparatus as, for example, a cooking range. Cooking processes, it should be [illegible] in themselves require the delivery of much, if any, energy. It is only, as a rule, [illegible] tion against loss. If the radiation of an electrical oven, for example, can be reduced 90 per cent by careful lagging, the current [illegible] sible economy, and no improvements can be expected of them in this respect, their transforming efficiency being, of course, in all cases 100 per cent., although that of cooking apparatus may, by the reasoning given above, be considered 0 per cent.

The greatest limitation of electrical heating, however, is perhaps the danger of burnouts. An electrical sad-iron capable of maintaining its proper temperature when run rapidly, as it is in regular service, over moistened cloth, is certain, if left on the cloth with the current on, to start a fire. An electrical urn, teakettle or coffee pot, if capable of heating its contents to the boiling point in a reasonable length of time, will invariably burn out if it boils dry. If there is one thing that the average kitchen attendant may be depended upon to do it is to forget to turn the power off. What is needed to prevent accidents under this condition is the use of a resisting element with a very high temperature coefficient, and preferably a temperature coefficient turning up sharply at about the temperature at which it is intended to be worked. Automatic thermostats might, of course, be incorporated, but are much more suitable for laboratory than for kitchen work.

In a recent issue of "L'Eclairage Electrique" a new French electric heating system was described, its chief novelty being the use of silicon rods as the resisting medium. These are inclosed in glass tubes, which in turn are exhausted to prevent oxidation, the temperature of the rod being carried up to about 700° or 800° C. The high specific resistance of the material eliminates the necessity of long fine wires, and its ability to withstand a high temperature allows a far greater radiation from the same area, and these points are considered great advantages. In this country we prefer a considerable area of comparatively low temperature for air-heating purposes, as it gives much gentler currents of moderately warmed air in place of the fierce draughts of air highly heated which rise straight to the ceiling and are of little value. For the heating of liquids the resisting material should be in such intimate contact with the liquid surface that its temperature could not rise much above that of the boiling point under any condition, and metallic resistances will withstand this temperature just as well as more refractory materials. The silicon has also a temperature coefficient just the reverse of what is needed, its resistance at 800° C. being only about two-thirds of that when it is cold; in other words, the hotter it gets the more power it takes and the more it tends to still further increase in temperature and still further lower in resistance. Metals and their alloys have the proper tendency in this respect, although common ones do not possess it to a sufficiently great degree to make it of much service. The discovery of a material which would and which possessed the other requirements for this duty would be a valuable one.

Frequencies in England.

The urgent need for the standardization of frequencies is shown in a catalogue recently issued by the Langdon-Davies Electric Motor Company, in which is given a table of the frequencies of seventy-seven different alternating-current systems in England. The number of plants operating at the various different frequencies is given below:

Frequencies	No. of Plants	Frequencies	No. of Plants
40	3	80	3
50	13	83	8
50 and 100	1	83.5	2
53	1	85	1
60	8	86	1
67	1	87	1
68	1	90	1
70	2	93	2
75	3	100	22
75 to 80	1	125	1
77	1		

The New Work of the Brooklyn Edison Company.

The now well defined tendency of electric lighting work in the large cities is toward central generating stations removed from the centre of distribution to positions of greater convenience, with high-tension transmission and transforming sub-stations. In this work the Edison Electric Illuminating Company, of Brooklyn, is recognized as a leader and a pioneer in much of the original development. This company, which has now been absorbed by the Kings County Electric Light & Power Company, recognizing the tendency of best practice, boldly set out on the installation of a 6000-volt high-tension system, with all the improvements that would apparently add to the efficient and economical working of the plant. The details of many of these were not as yet standardized, and difficulties have naturally been encountered, with results that are of the greatest interest to others contemplating a similar procedure. There is given below a very brief account of the main points of the system, the interesting features being described in greater detail.

The main generating station is located at Bay Ridge, and a fair idea of the general layout can be obtained by an examination of the accompanying sectional elevation given in Fig. 2. The design is intended for a minimum amount of attendance and a maximum economy of steam. The details by which these features are obtained are given below.

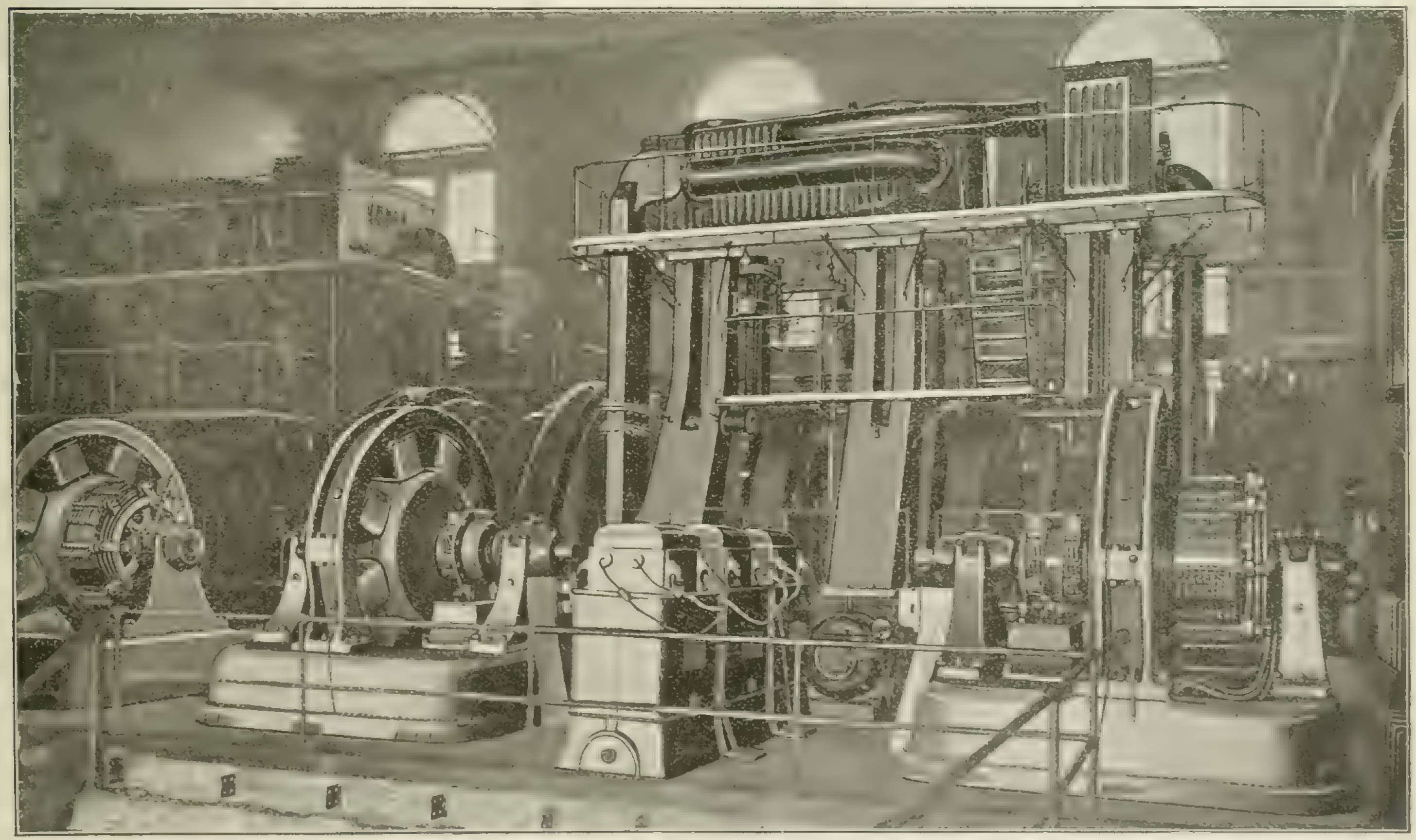

Fig. 1.—Three of the Four Rotaries in the Pearl Street Station.

A coal conveyor is, of course, used, and this part of the installation contains some novelties. The coal is removed from canal boats on the water front by motor-driven buckets hung from a boom on a movable tower, also motor-driven, these buckets dumping into one of two cars connected to each other by a steel wire cable, the one under the discharge bucket when fully loaded closing a circuit automatically and starting up a motor which sets the cable in motion, running the car up an incline above a 2500-ton bin and sending the other car down to take its turn. It is well to note that all auxiliaries of this station are motor-driven by direct-current, 220-volt motors. From under the hopper of this 2500-ton bin a regular link-belt conveyor carries coal up an incline, dumping into a V-shaped pocket (see the illustration) above the boiler room, holding about a three days' supply. Automatic recording weighing chutes from this discharge into horizontal channels along the boiler fronts just above the fire doors, the coal being distributed along these channels from the outlets of the weighing chutes to the furnaces by means of rotating screws. From these it drops into steam-driven American stokers, this part of the equipment being previously described in these columns.* Mixed soft coal slack and anthracite are burned.

There are now five triple-drum water-tubular boilers in place, supplying steam to the two main engines. The smaller of these is a Hamilton-Corliss cross-compound horizontal, with a 750-kw G. E. three-phase, 6600-volt generator mounted with the fly-wheel between the main journals. The generator itself is of the revolving field type and is protected from flying oil by means of a sheet brass shield on the side toward the engine. Beside this stands the larger and far more interesting unit, which at the time of its construction was one of the largest ever built, but is already no longer the standard for the rest of the station, which will be equipped with vertical cross-compound engines of 5000 horse-power and 3500-kw dynamos. The unit now in service consists of a McIntosh & Seymour horizontal twin-tandem compound rated at 3000 horse-power, but with a large overload margin, and driving a G. E. 25-cycle, 6600-volt, three-phase generator rated at 1500 kilowatts on a 5 per cent. regulation drop, but also with a large overload capacity and commonly worked at about 2000 kilowatts.

Near the high pressure cylinder heads of this engine stand two small G. E. single-cylinder, high-speed vertical engines coupled to direct-current dynamos used temporarily for exciting purposes. Exciting current and power for the auxiliaries is also derived from two 100-kw Edison multipolars coupled to the ends of the shaft of an Erie marine-type triple-expansion engine, this unit standing near a small auxiliary switchboard on which it is controlled by magnetic switches energized from the main switchboard.

The engines all stand at the west end of the station, a long distance from the electrical gallery, which is at the extreme east end, the intermediate space to be filled later by six generating units, which will give the plant a capacity of about 34,000 horse-power, which can be quadrupled by extensions of the structure.

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* See The Electrical World, October 8, 1898, page 3[illegible]

In the high basement where the coming units will stand a small space is now occupied by a 100-kw synchronous motor temporarily coupled to two bipolar Edison generators, which can also be used for excitation and auxiliary purposes. Further reserve direct current for use instead of the steam-driven exciters will be provided by a small storage battery and booster, and a permanent equipment consisting of two 100-kw synchronous motors, each coupled to a multipolar direct-current generator. In the rest of the basement under the boilers and engines are the various direct-geared motor-driven auxiliaries consisting of boiler-feed pumps and circulating and air pumps for the condensers.

tance. There are in this station three bus bars for each phase at each terminal of the Y combination, in which the generator fields are connected, one intended for high, one for medium and one for low pressure, and either of the main generators may be connected to the buses through an electro-pneumatic oil-break switch.

This switch, which is shown in Fig. 3, consists of three pairs of inverted U-shaped copper strips, the ends of the strips entering contacts mounted under oil contained in wooden buckets shown in the lower part of the illustration. There are two strips working in one bucket at each corner of the three-phase circuit, giving four breaks in each phase or twelve breaks altogether. The U-shaped strips are attached to and are lifted by a cross-head worked by a piston in the air cylinder shown at the top of the apparatus. This piston is moved by compressed air, in turn controlled by three magnets, one to mechanically latch the switch in either the open or closed position and the other two to operate valves which admit air respectively above or below the piston. To eliminate any possibility of arcing [illegible] two phases of each of these switches are in series with emergency switches consisting of knife blades such as those shown in Fig. 4, [illegible] by a strand of lamp cord [illegible] mounted in a [illegible] tube on cabinet above the switchboard gallery. When the emergency switch is opened, as it is when heavy loads [illegible] are to be broken, the circuit is thrown through [illegible] fuses, which, owing to their small carrying capacity, blow with great violence, thus preventing the arc holding across their ter-

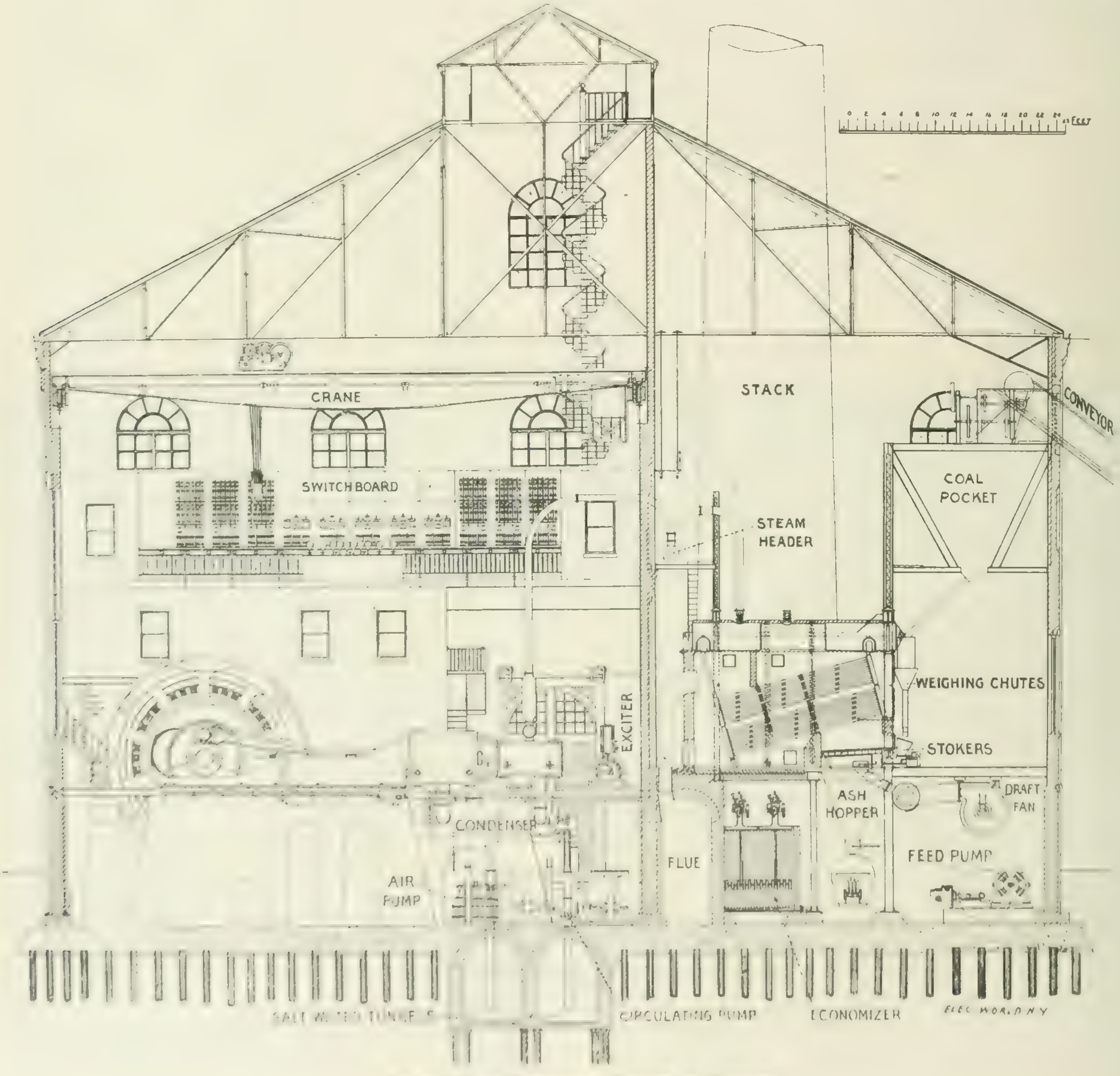


Fig. 2.—The Generating Station in Section.

Climbing to the switchboard gallery, a most interesting array of [illegible] minals. There are four of the electro-pneumatic switches, one, as noted above, between each of the machines and the switchboard system, one of the others being a cross connecting switch between the high voltage and the main bus bars, and the other a cross connecting switch betwen the low voltage and the main bus bars. The latter two give a means of simultaneously throwing in the three phases in paralleling the machines. The circuit from either one of the dynamos — after passing through the pneumatically operated oil switches and the emergency switches described—runs to a set of what might be called three - throw switches on the face of the board, similar to those shown in Fig. 4. Each phase here has three blades in a compartment or stall isolated from the others by heavy wooden barriers, as shown. The blades are not fitted with handles, but merely have holes into which may be inserted a hook on a stick or long pole, so that they may be operated from a considerable distance.

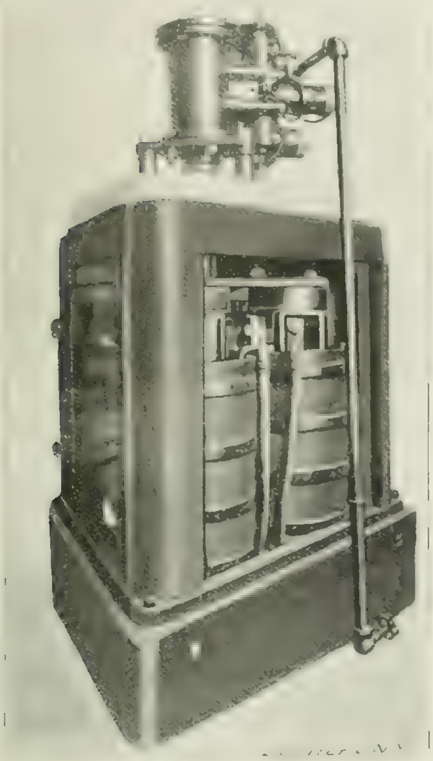


Fig. 3.—An Electro-Pneumatic Switch.

The three blades are electrically connected at their hinges and one of them, when thrown in, connects to the high-voltage bus bar, one to the main bus and one to the low-voltage bus on that phase. The outgoing feeders are fed through similar throw-over arrangements. In this way either machine and any feeder can be connected with any one of the buses, which in turn may or may not be cross connected. The loads may be divided in any way desired between the two machines, and more particularly any feeder—when it becomes desirable to open it under a load—may be transferred to and isolated upon one of the buses, which may finally be cut off from the rest of the system by opening one of the electro-pneumatic oil-break cross-connecting switches, thus avoiding opening any other type of switch under load.

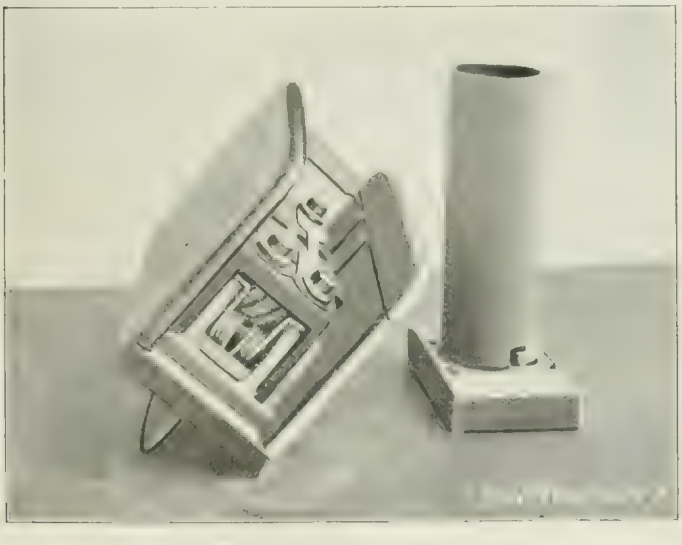


Fig. 5.—One of the Pull-Away Fuses.

The outgoing feeders are all in duplicate, so that in case of trouble with them no part of the system is shut down. They are supplied from the switchboard as noted above through high-tension switches and also through pull-away fuses, one of which is shown in Fig. 5. These consist of aluminum fuse links held between apple-wood strips and attached to swivelled copper terminals which by means of powerful springs tend to pull the ends of the fuse apart the instant it is softened by heat. The apple-wood cover, which is shown to one side, has a hole through which the escaping gases blow out through the long tubular fibre chimney which fits over it. The whole thing is mounted in a wooden frame and is attached to the circuit by means of heavy knives or blades, which enter clips on the face of the board, so that it may be removed for re-fusing without danger of shock to the manipulator.

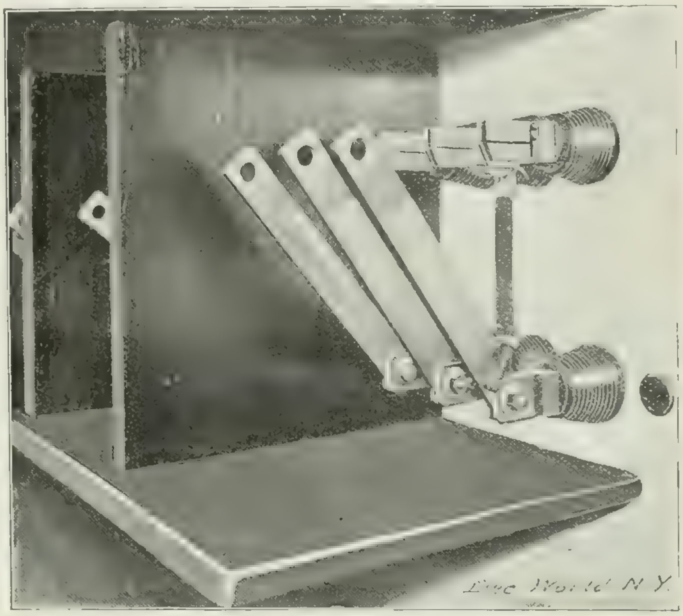


Fig. 4.—The High-Tension Switches.

The switchboard contains several other features which appear strange to the eyes of those not versed in this particular line of work, one of them being a set of discharge gaps, looking much like a number of darning needles arranged about the corners of a horizontal equilateral triangle and pointing toward each other, with gaps of seventy-eight-hundredths of an inch between them. These are connected through fuses to the three phases of the circuit and are intended to carry lightning or high-tension oscillatory discharges which may be set up by any abrupt disturbance of the circuit, such as the opening of a switch, and thereby save the insulation. The

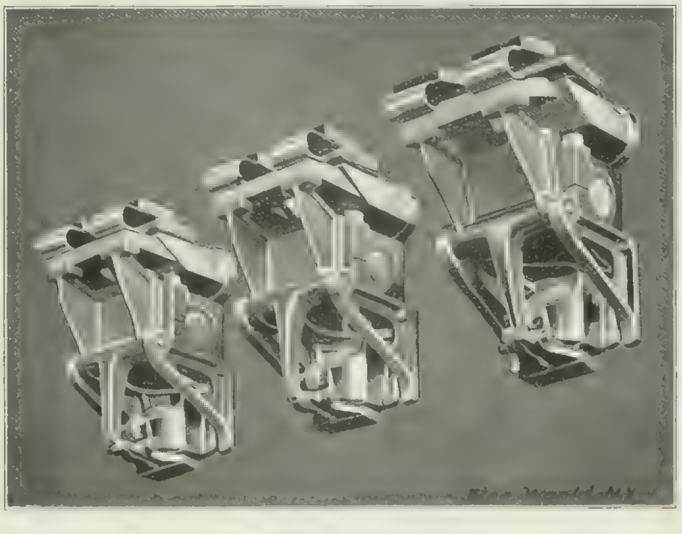


Fig. 6.—Three of the Magnetic Switches.

direct-current exciting dynamos are not connected with main switches on this board, but have a switchboard of their own located near them in the other end of the station. The switches of this board are, however, operated from the main board, and to accomplish this are magnetically controlled. Three of these switches are shown in

Fig. 6. The main contact consists of a large number of thin copper leaves which are pressed against the beveled ends of projecting copper studs, a secondary break being provided on opening by means of carbon contacts spring-supported above the others. The copper and carbon moving parts are hinged on a frame carrying the armature of a heavy electromagnet, the end of the horizontal round core of which appears at the right-hand side of each switch. By energizing this the armature is drawn up and the switch closed. To maintain it in its closed position, however, it is not necessary to leave the current on this magnet, as a long downwardly projecting arm is caught by a trigger at the lower end of the instrument. Another smaller magnet has its armature attached to this trigger, and when energized trips the long arm, allowing the switch above it to open by a spring and gravity.

There are three main feeders running out from the station, consisting of triple-conductor lead-covered cables made by the Standard Underground Cable Company, with paper insulation six thirty-seconds inch thick, a jute filler and three-thirty-seconds of paper inside the one-eighth-inch lead sheath.

SUB-STATION A.

The original station of the Citizens' Electric Illuminating Company, [illegible] operated as an arc light station with [illegible] and a great deal of leather, is [illegible] sub-station. The [illegible] shown in Fig. 7, consisting of [illegible] General Electric [illegible] synchronous motors, [illegible] arc-light dynamos. These occupy a space of about 4000 square feet as against 32,000, with engine-driven machines, and this will eventually be reduced to 500 square feet [illegible].

The [illegible] insulated three phase winding distributed in three slots per pole per phase. The motors and generators are all mounted on wooden [illegible] flexible couplings, with the ordinary cylindrical rubber cushions between the interlocked driving and driven spiders. The motors are started, of course, against only a frictional load, and sufficient starting torque is obtained solely by the hysteresial lag of the rotating field in traveling across the wide pole faces of the field magnets, thus giving a sufficient drag to overcome the slight frictional resistance.

To prevent too great a rush of current in starting there is connected in the alternating circuit a set of three reactance coils mounted in a wooden box under one of the couplings between the motor and one of the dynamos. These three reactive coils are in circuit on starting, and are short-circuited as the machine speed rises, giving sufficient torque to bring it up to synchronism when it runs for a moment as a synchronous motor with a field excited by lagging currents, until direct current is turned into the field windings to give the necessary field excitation.

The machines are supplied through the high-tension switchboard shown at the extreme left, with switches on corrugated bases and insulated by barriers, and Thomson inclined-coil instruments to measure the current flowing, which is adjusted for a slight leading wattless component. The motors shunt somewhat in time with the engine strokes, but not enough to cause trouble, the ammeters, which are not deadbeat, swinging through about a quarter of their full scale deflection.

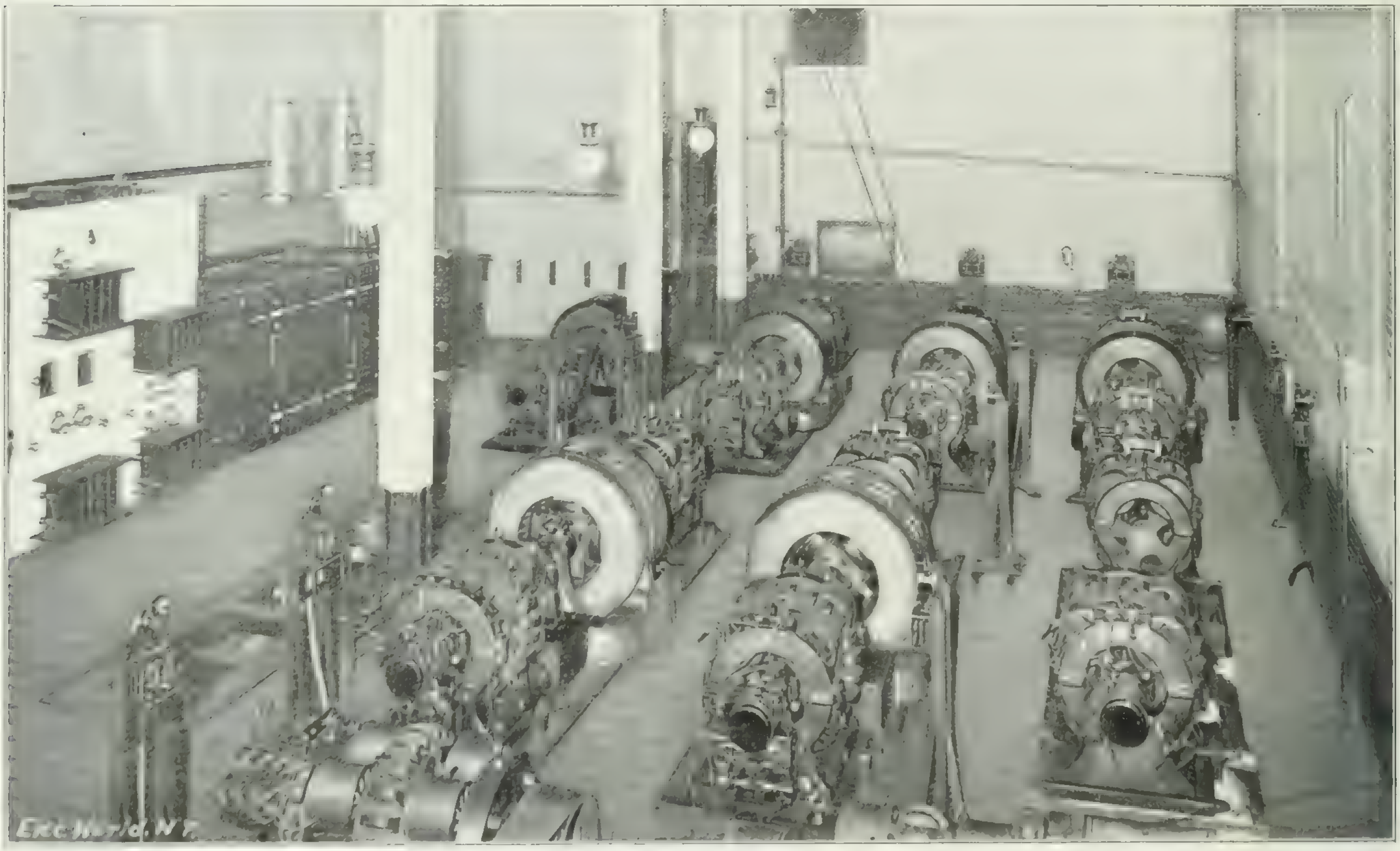


Fig. 7.—Synchronous Motors Driving Arc Machines in Sub-Station A.

This sub-station does not contain any rotaries or other machines for transforming the high-tension current into direct current for the three-wire distributing system, but does contain a 14,000 ampere-hour storage battery attached to the latter. This storage battery is used to steady the load and to regulate the voltage on this part of the system by means of four end-cell switches, two of which are shown in Fig. 8. As is clearly indicated, there are four switches in groups of two, one above the other, two attached to the positive terminal and two to the negative terminal of the battery, the neutral being connected in direct without any switching arrangement. Each switch consists of a large number of copper leaves or strips with one end bearing on the bus bar in the foreground and the other on any one of a row of contacts connected to the cell terminals. There are two groups of these strips on each switch, one [illegible] from above and the other [illegible] from below, and both attached to a nut travel-

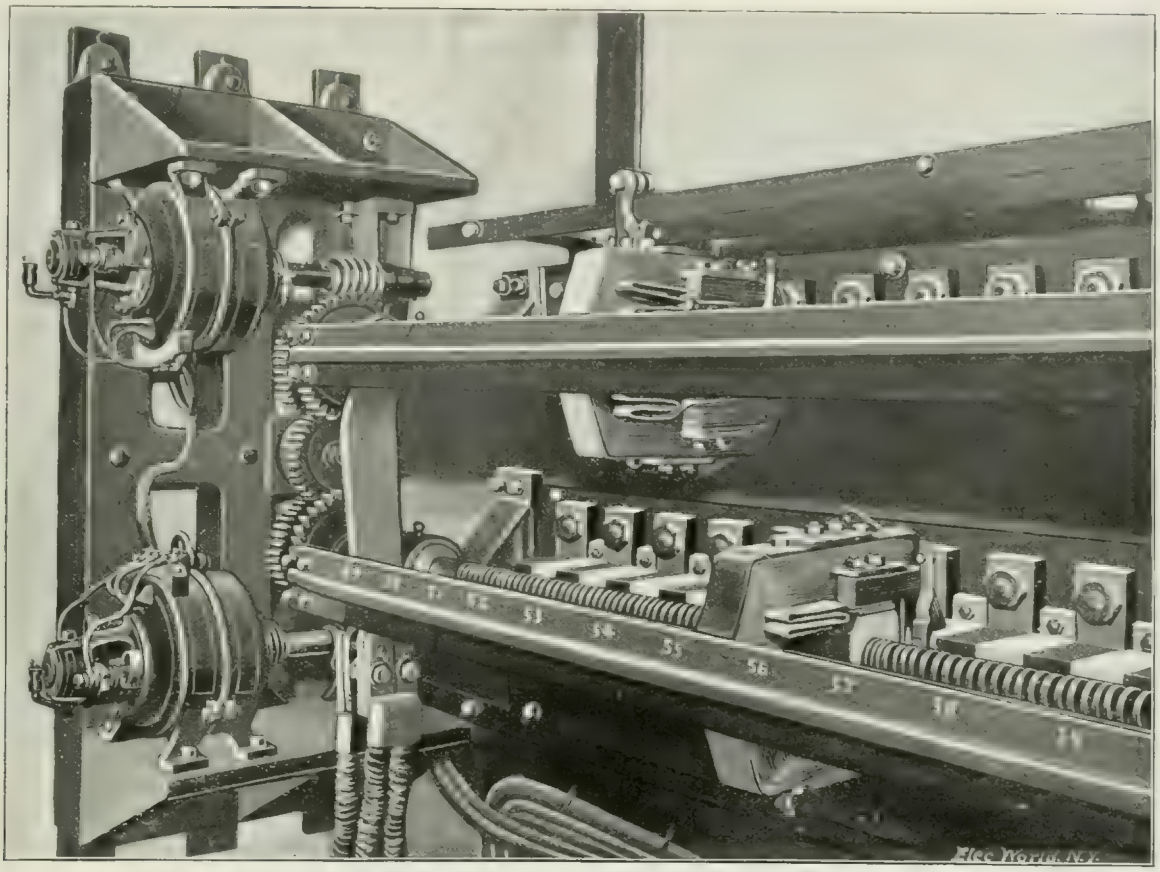


FIG. 8.—TWO OF THE END-CELL SWITCHES.

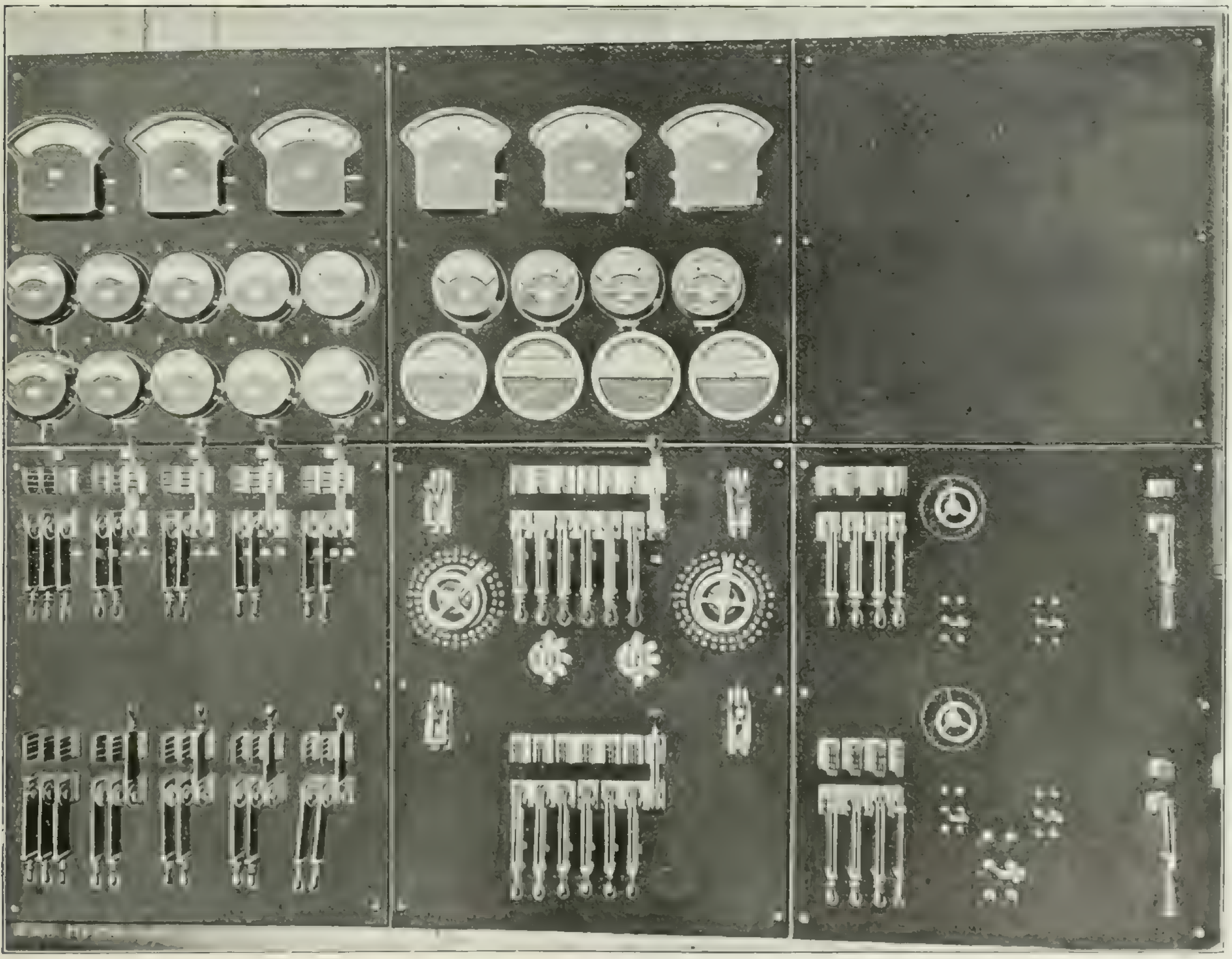


FIG. 9.—A VIEW OF THE BATTERY SWITCHBOARD AT SUB-STATION A, BROOKLYN EDISON COMPANY'S PLANT.

ing on the long screw shown. The screw is geared to a small Lundell motor, the rotation of which is controlled from the main board. To prevent the circuit from being opened in passing from one contact to another, and without short-circuiting the cell connected between these two contacts, there is attached to the main brushes of copper strips a small auxiliary brush, which is connected with the main brush through a German silver strip. This maintains the continuity of the main circuit through the battery without forming a shunt of too low resistance about the single cell.

The handsome switchboard shown in Fig. 9 allows the measurement and control of the battery and consequently of the load and voltage of this part of the system. The end-cell switches are mechanically connected with instruments on this board, showing their position, and with small hand switches by which they may be advanced step by step from contact to contact.

THE FIRST DISTRICT STATION.

One of the most interesting sub-stations is that on Pearl Street and known as the First District Station. It was originally erected in 1889 and fitted with high-speed engines belted to Edison bipolars on the floor above, this equipment being later replaced by multiple-expansion engines direct-coupled to multipolar smooth-body disc-commutator machines, from which the load has now been taken except between the hours of 5 and 12 p. m. by a row of four rotary converters installed beside them and shown in Fig. 1. These are each of 200-kw capacity, taking the 25-cycle current at about 88 volts, three-phase, on three collector rings at one end and giving off direct current at about 115 volts when running at 375 r. p. m. The machines are notable for the heavy commutator as compared with the small amount of iron in the magnetic circuit, the actual length of the commutator being considerably greater than the active length of the armature windings. This feature, while it looks odd to eyes accustomed to generators, is, of course, the proper thing in rotary converters, owing to their absence of field distortion and their low coil-heating compared with that of generating machines giving the same output. In two rows, each comprising a three-phase group, are six single-phase General Electric air-blast transformers, the two groups respectively taking the 6000-volt line current from two independent incoming three-conductor feeders and delivering low-tension alternating current from each group to a three-phase induction-regulating transformer (see Fig. 10), consisting of a group of three boosting transformers with primaries mounted on a rotatable core, which can be turned so as to either add to the pressure or subtract from the pressure of the secondary windings by any amount up to a maximum of 7½ per cent., giving a 15 per cent. range of adjustment. The rotating part is driven by a miniature induction motor through a double-reduction worm gear, the control of the motion of this little induction motor being effected by a small triple-pole throw-over switch on the main switchboard. The double reduction gear, of course, gives a good locking device and prevents the torque of the regulator from moving its rotatable part. The switch seen on the front of the regulator is designed to cut out the motor at the limit of proper motion.

The direct-current switchboard of this station is arranged for three sets of positive and negative buses for high, low and medium pressure, with switches to tie them together at times of light load and arrangements to connect any dynamo or rotary to any desired one of the three buses. The panel for the four rotaries is shown in Fig. 11. Each has one alternating and one direct current ammeter and three switches, one to throw it in series with a fixed starting resistance and the others connecting to two of the buses respectively. One pole of the direct-current end is of course permanently connected to the neutral. This panel contains no alternating-current apparatus other than the small switches by which the miniature induction motors controlling the regulators described above are operated, thereby varying the impressed alternating e. m. f. on the rotaries and—in case the engines are running—varying the distribution of the load or even reversing the direction of transformation of the converters, and when the engines are not running varying the e. m. f. delivered. The [illegible] alternating-current leads run through a board on the floor below, and in the low-tension leads there is only a triple-[illegible] switch on a pedestal at the [illegible] end.

A large number of [illegible] feeders [illegible] from the board with the usual instruments and switches. An interesting type of [illegible] the [illegible] life of the [illegible] [illegible]. The [illegible] may be [illegible] one or another position, giving different voltages.

[illegible] Mr. W. [illegible] Light & Power Co., and Mr. [illegible]

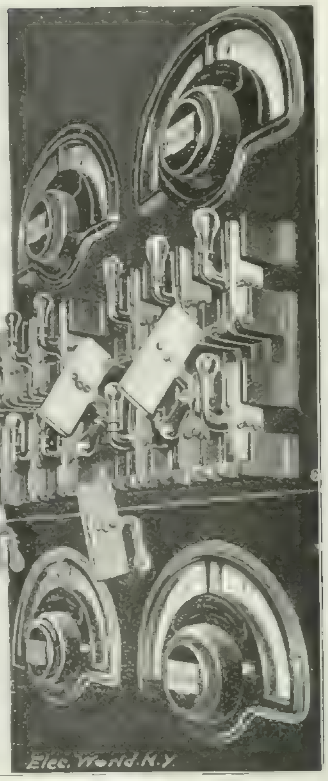


Fig. 12.—The Switches and Meters for Four Feeders.

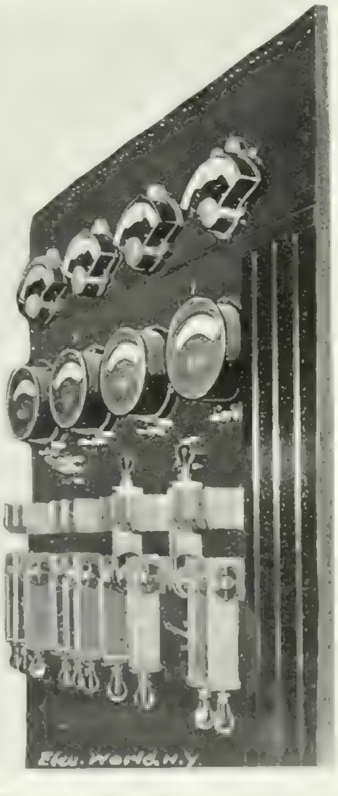


Fig. 11.—Four Rotary Panels.

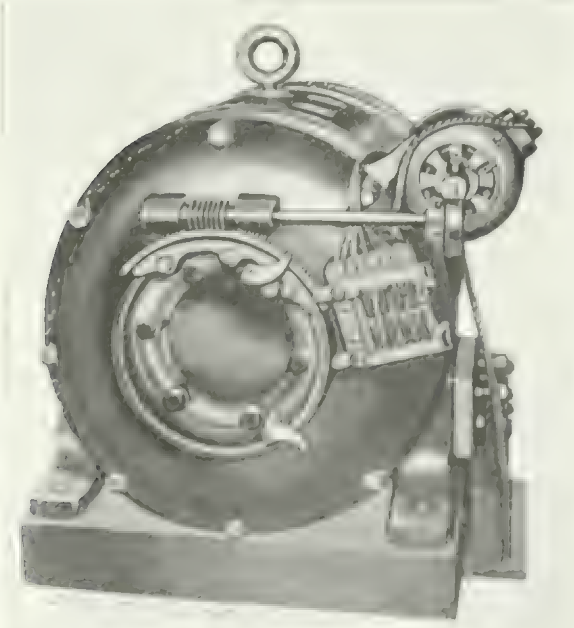


Fig. 10.—[illegible]

Dynamo Driving by Man Power.

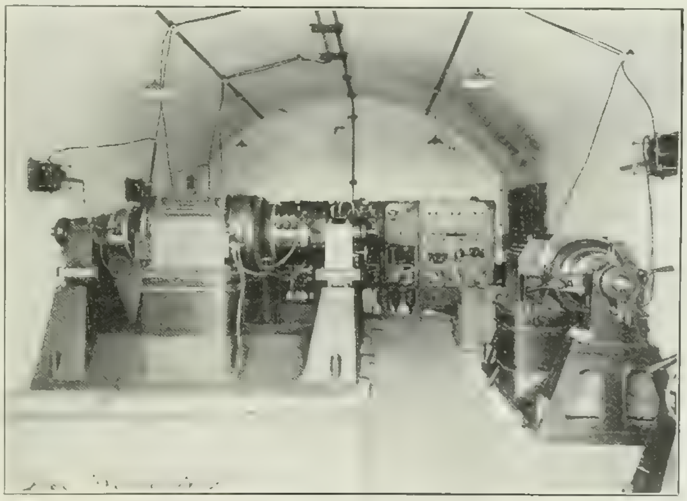
[illegible]

The Municipal Electric Lighting Systems of Hull and of Folkestone, England.

THE HULL MUNICIPAL PLANT.

A NUMBER of interesting British plants with the typical features of modern English design, bipolar dynamos, central-valve engines, a high-voltage three-wire distributing system, storage-battery sub-stations, etc., have been described in recent issues of the London "Electrician," from which the following facts and illustrations concerning two of them have been taken. The feature about both of these differentiating them most widely from American practice is the combination of a three-wire distribution with 450 volts between outers and a high-tension direct-current generating and transmitting system.

The power is generated at 2250 volts direct current by bipolar dynamos, and at this pressure is fed to single-armature direct-current transformers in sub-stations, where it is reduced to the voltage of the three-wire system. At the present date there are 863 consumers connected to the mains, and lamp connections aggregate 67,900, while no less than 16½ miles of mains have been laid, including the 3¼ miles now actually being laid. The customers include a great variety of consumers, there being, in addition to the ordinary lighting consumers, a fairly large motor load for printing and other work. We will now proceed briefly to describe the equipment of the new station and the sub-stations which have been recently erected.

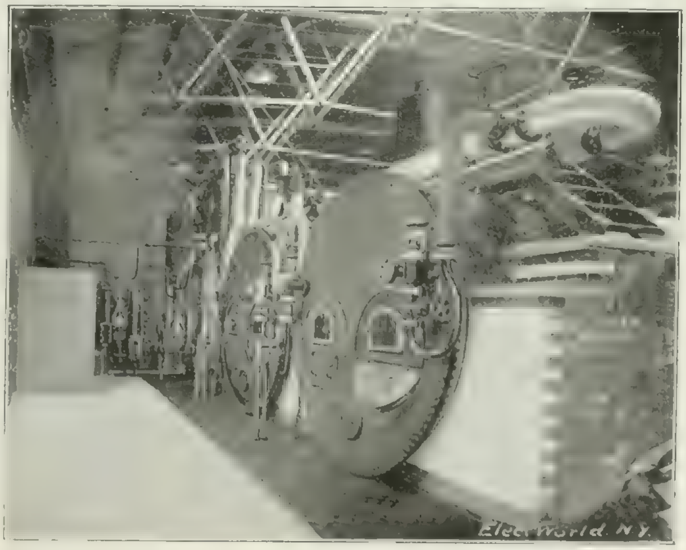

Argyle Street Sub-station Machinery Arch.

In the boiler room there are at present erected two Lancashire boilers, each 30 feet in length and 8 feet in diameter, together with a Babcock & Wilcox boiler of 150 horse-power. The boilers work at 150 pounds pressure, and are at present hand-fired. In conjunction with the boiler plant there is a Green economizer, with motor-driven scrapers. The feed pumps are of the direct-acting vertical type, with the pump underneath. They throw their supply from a tank filled with softened water, a water softener of the Pemberton type being used, together with a clarifying or filtering tank and apparatus for thoroughly mixing the reagent solution with the water to be softened. The feed supply is arranged on the duplicate ring-main system, similar to that employed for the steam supply, and arranged so that any pump can supply any boiler either with cold or hot water. In addition to the feed pumps there is an independent set of injectors. The water for the feed, as well as the condensing plant, is pumped out of an adjacent drain by means of two motor-driven centrifugal pumps, and is discharged into a large overhead tank of 29,120 gallons capacity. From this tank the water is supplied to the two ejector condensers through a 12-inch pipe. The exhaust from the engines can be turned either into the condensers or into an atmosphere pipe of 15-inch diameter which runs along under the floor and is carried upward outside the building. The steam ring consists of two parallel lines of 8-inch wrought-iron solid-drawn pipe, with welded flanges resting on cast-iron chairs behind and above the boilers and connected at the ends with copper U-bends of the same size as the pipe. Into this ring each boiler feeds by a separate copper pipe bent into an S shape so as to avoid strains due to expansion. The standpipes are each provided with a complete set of valves, enabling each boiler to be used independently, an arrangement which is also applied to the engines running off the ring mains. The plane of the ring is inclined downward toward the boilers, and it is drained at two points by steam traps.

In the machine room there is erected a high and low pressure continuous-current plant, having an aggregate capacity at present of 456 kilowatts. The low-pressure plant consists of two Willans engines, each indicating 100 horse-power under 140 pounds steam pressure. These engines run at 450 r. p. m., and are coupled direct to bipolar dynamos, each giving 130 amperes at 300 volts. These machines are for the supply of nearby consumers, also for the pump and economizer motors in the plant. A motor generator is also installed in the building, and is used for balancing purposes or for supplying light loads in conjunction with the battery. The high-pressure plant consists of two Willans engines, each capable of developing 360 horse-power at the same pressure when running at 350 r. p. m. These are coupled to bipolar dynamos, each giving 90 amperes at 2250 volts. These generators are separately excited from the 225-volt circuit. The armatures of these machines are wound on the Eickemeyer principle. All the engines are fitted with Messrs. Willans and Robinson's automatic expansion gear, and a separate condenser is provided for each engine, the condensers being of the Körting ejector pattern, and arrangements are made so that each set can be run either condensing or non-condensing, as required. A 10-ton hand-power traveling crane spans the engine room.

The switchboard equipment consists of two separate boards for the high and low-pressure plant, respectively. These have been made as nearly as possible fireproof, being composed of 1½-inch slate slabs mounted on iron frameworks. The low-tension board contains two dynamo panels, one battery panel, two feeder panels, one Board of Trade panel, one motor-generator panel, and one works distribution panel. Each dynamo panel is fitted with a Weston ammeter and voltmeter, a d. p. switch with over and under load release, a throw-over main switch and field regulating switches. The battery is placed on one side of the three-wire system, and eighteen regulating or end cells are connected to the switchboard. All motors, lights, etc., in the works are connected to throw-over switches on the works distribution panel, so as to enable them to be run from either side of the system. Thomson-Houston wattmeters are installed in the low-tension feeders both here and at the sub-stations, so that all current delivered to the distributing mains is metered.

The high-tension switchboard contains two dynamo panels, one Board of Trade panel and six feeder panels, and four spare panels for extensions are provided. Each dynamo panel contains a Wes-



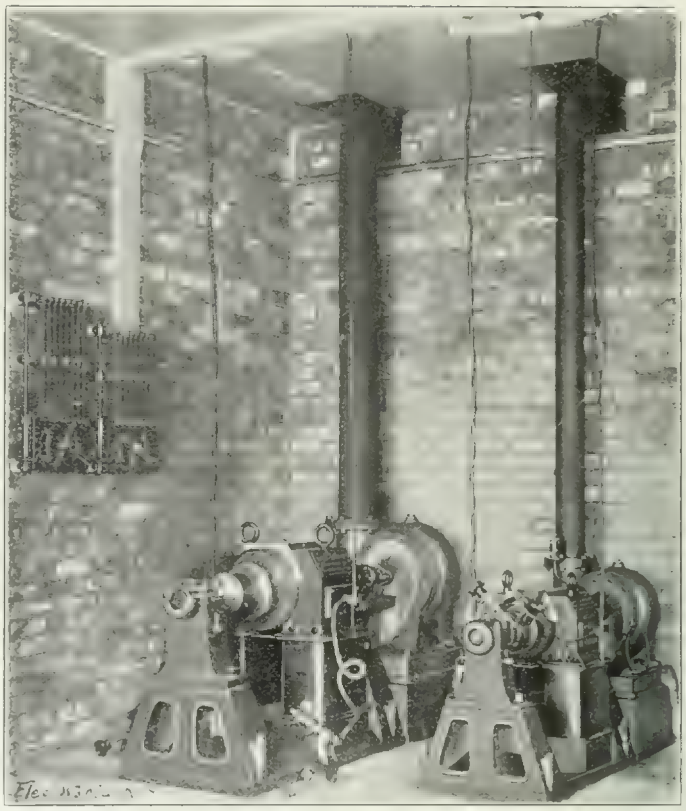
A View of the Boiler Room of the Hull Central Station.

ton ammeter, a Kelvin voltmeter, a d. p. switch with over and under load release and field regulating switches. The dynamos are connected by the d. p. switches to the high-tension bus bars, from which the feeders are tapped. The feeder panels each contain a Weston ammeter and voltmeter, a d. p. switch with maximum cut-out, and transformer, starting and regulating switches. The voltmeters on the feeder panels are connected to the feeding points on the low-tension mains, and the pilot wires are connected to them via the operating coil of a long-range switch on each transformer. By short-circuiting the voltmeter about five amperes is made to pass through this coil, and the long-range switch is actuated, connecting a transformer to that particular feeding point. A repetition of the process throws the switch into the "off" position.

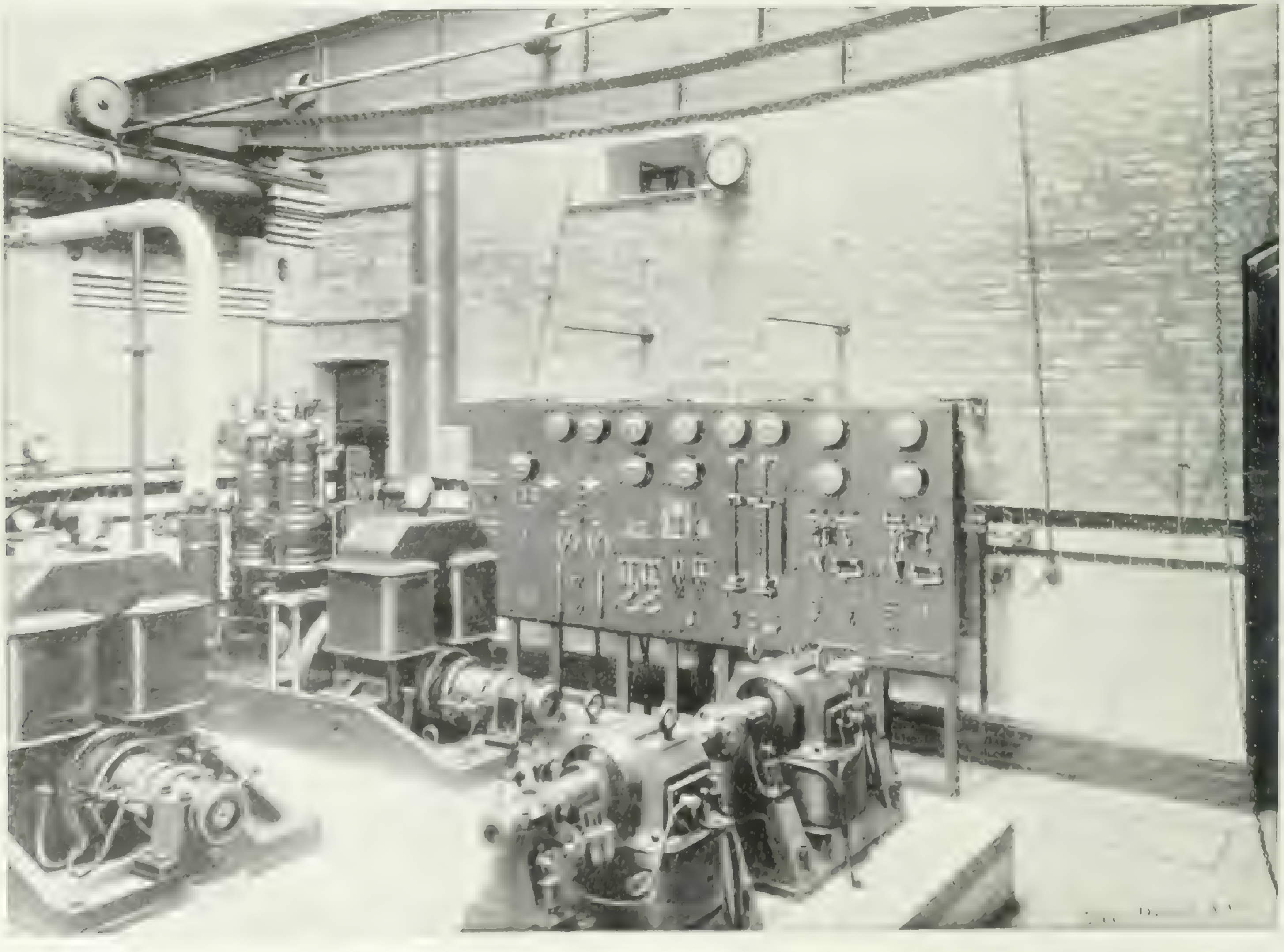
The battery room contains 126 Pritchett and Gold 11-plate cells in glass boxes. The capacity of this battery is 300 ampere hours at 225 volts.

There are at present two sub-stations, one at Albion Street and one at Argyle Street. The building at Albion Street was specially designed for the purpose, and contains two 90-kw direct-current transformers and a motor generator. Room for an extension of the plant is provided.

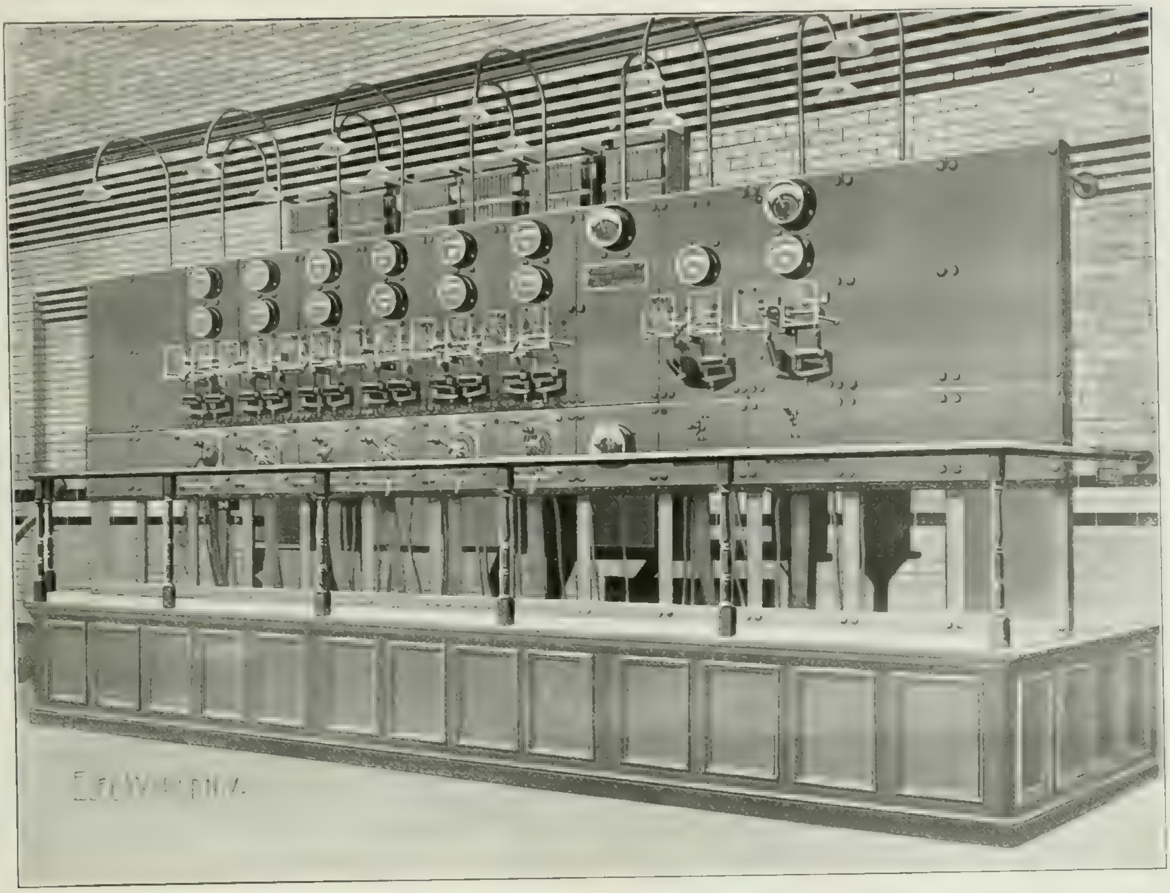
At Argyle Street four railway arches have been utilized, two of which are used as stores for the outdoor department, one as a battery room and one as a transformer chamber. (See page 585.) In the battery arch there are 240 Pritchett and Gold cells similar to those at the generating works. These are charged in three sets of 80 cells each off the distributing mains, and are discharged in two sets of 120 cells. The switchboard is situated in the transformer arch, where there are two 90-kw and two 45-kw machines, with the necessary switches, etc. The 90-kw transformers are wound for a step-down from 2250 to 450 volts, and the two smaller transformers are wound from 2250 to 225 volts. The 90-kw transformers at Albion Street supply a portion of the old network, and are wound for 2250



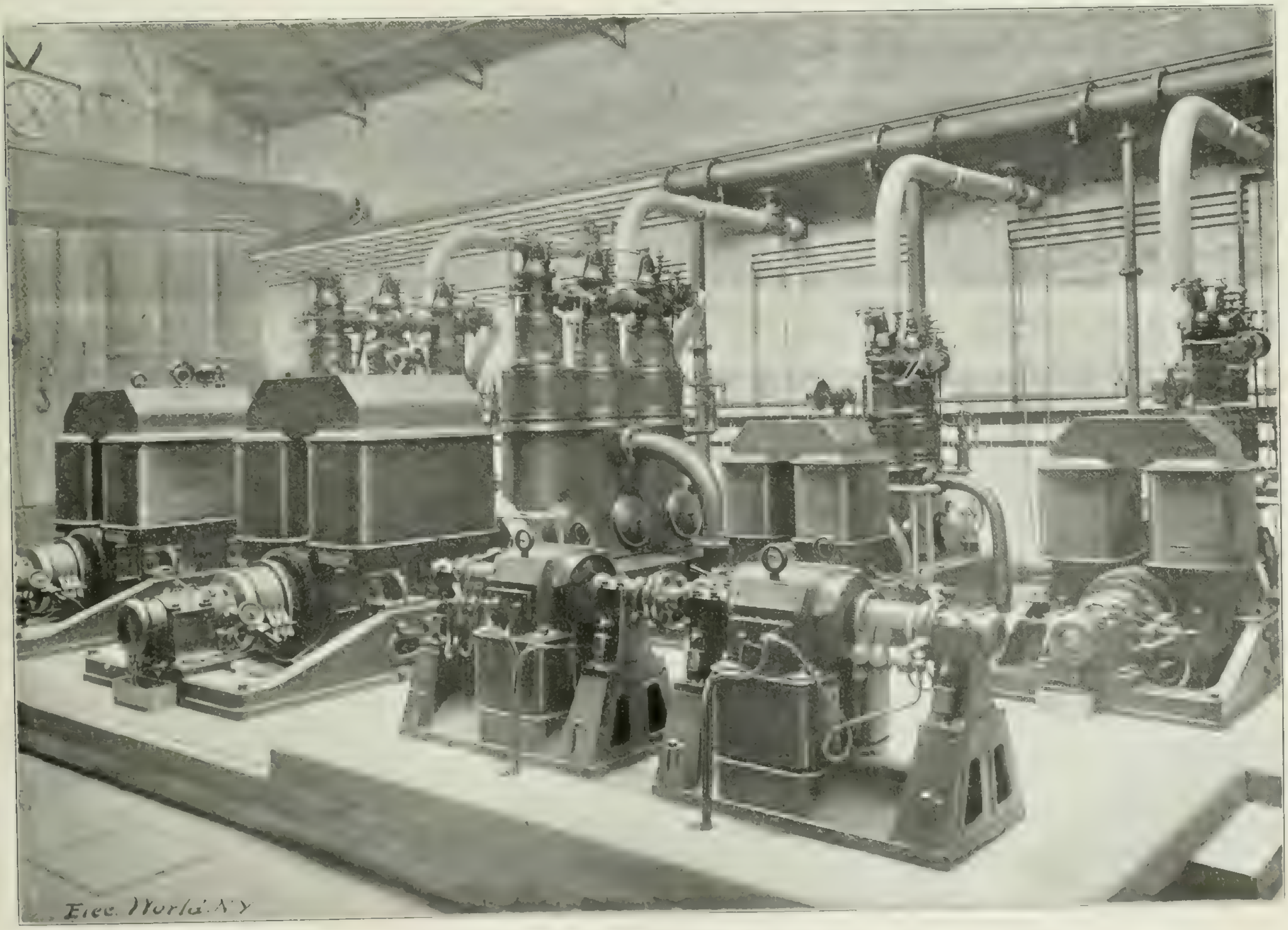
Motor-Driven Centrifugal Pumps at Sculcoates Lane Station.



[illegible] Motor Generator and Low Pressure Switchboard, Hull Central Station.



View of the High-Tension Switchboard of the Hull Central Station.



An Interior View Showing Engines and Direct-Coupled Generators of the Hull Municipal Central Station.

to 225 volts, the motor generator forming a connecting link between the old 220-volt three-wire and the new 440-volt three-wire networks. The transformer armatures are of Messrs. Parker's usual type, with high and low-tension winding on the same core and with a commutator at each end. They are "Eickemeyer" wound, with an earthed metallic shield between high and low tension windings. The lubrication is by a force pump on each bearing, and the machines can be run for long periods without attention.

MAINS.

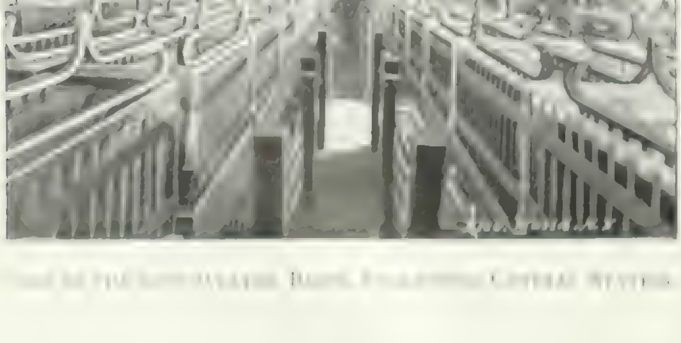
The mains extensions have been carried out by Messrs. Siemens Brothers & Co., and consist of six high-tension circuits running from the generating station in Sculcoates Lane to the two sub-stations, and low-tension feeders running from the generating station and these sub-stations to various points in an extensive network of distributing mains. The high-tension feeders, pilot and telephone wires are drawn into Doulton stoneware conduits. These conduits are made in 3-foot lengths, and are jointed by means of stoneware cradles with Portland cement. Manholes built of brickwork on concrete foundations are provided at all corners and bends and where otherwise necessary, and are provided with cast-iron frames and covers, and ventilated by means of stoneware pipes connected to a small ventilator frame. The high-tension feeders (of which about 17,000 yards have been laid) are 0.06 square inch and 0.03 square inch sectional area, concentric, insulated with impregnated fibrous material, lead-covered and externally taped and compounded. The low-tension feeders consist of about 4600 yards of 0.5 square inch concentric lead-covered cable, armored with two layers of 0.05 inch hoop-iron, and laid direct in the ground. Three 9 and 12 conductor pilot cables are laid alongside the feeders, and a 4-conductor "dry core" (air-space) telephone cable permits of communication between the generating and sub-stations.

About 24,000 yards of mains have been laid of the triple-core, impregnated-fibre insulated, lead- [illegible] The advantages of this class of distributing main for three-wire systems are now universally recognized. It combines flexibility with facility of jointing, the service and other boxes employed being of a much simpler construction than those for triple concentric mains.

The straight joints are made in cast-iron boxes in two halves bolted together. The internal fittings consist of copper sleeves and sockets for sweating the conductors into, and are embedded in the hard-setting insulating compound with which the boxes are filled. About sixty disconnecting boxes, both three-way and four-way patterns, have been in- [illegible] for testing purposes.

The internal fittings of these boxes are so arranged that either disconnecting copper links or fuses can be used. They are set in brick pits, with manhole frames and covers of sim- [illegible]

The service cables are of the twin pattern, india rubber insulated, [illegible]



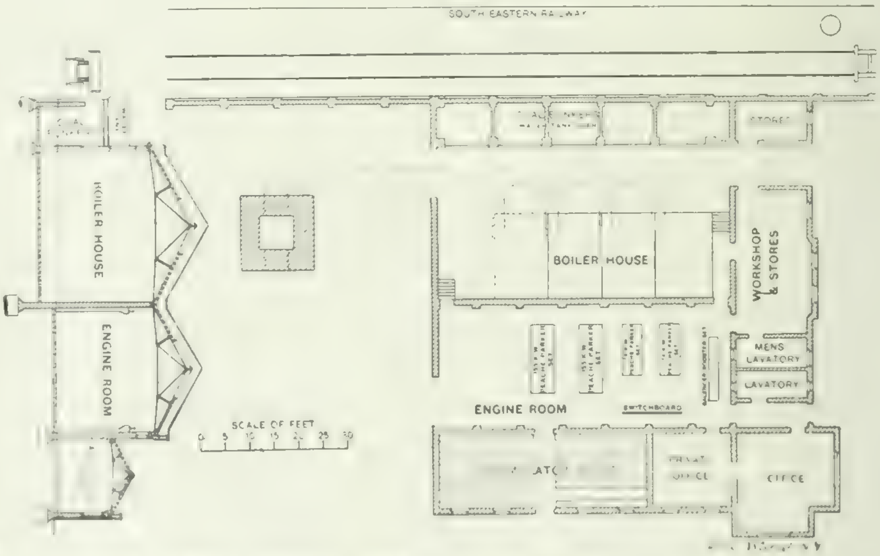
[illegible]

THE FOLKESTONE WORKS.

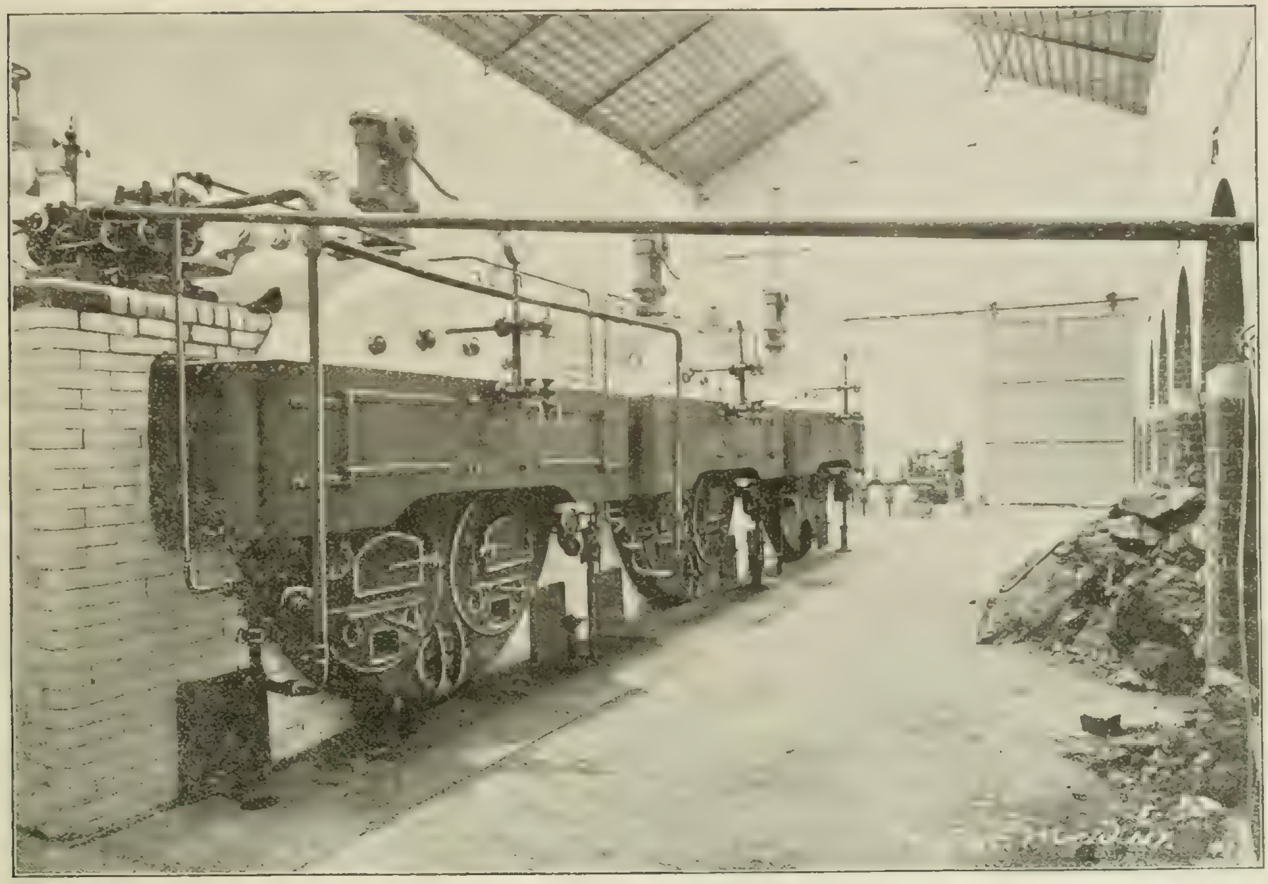
Exterior of Folkestone Plant.

The buildings are entirely of fireproof material, the roof being constructed of steel, slate and glass. The slates are fastened to the angle iron purlins by lead clips, and expanded steel lathing, plastered, is attached to the inside of the engine-room roof. The cast-iron water tank over the coal bunkers has a capacity of 17,500 gallons. The chimney is 150 feet high, and its area at the narrowest part is 49 square feet; it is lined with firebrick to about 50 feet. It is interesting to note that the chimney was built from the inside, an electric motor being employed to drive the winch (through ordinary belting and friction gear) used for lifting the workmen and the materials.

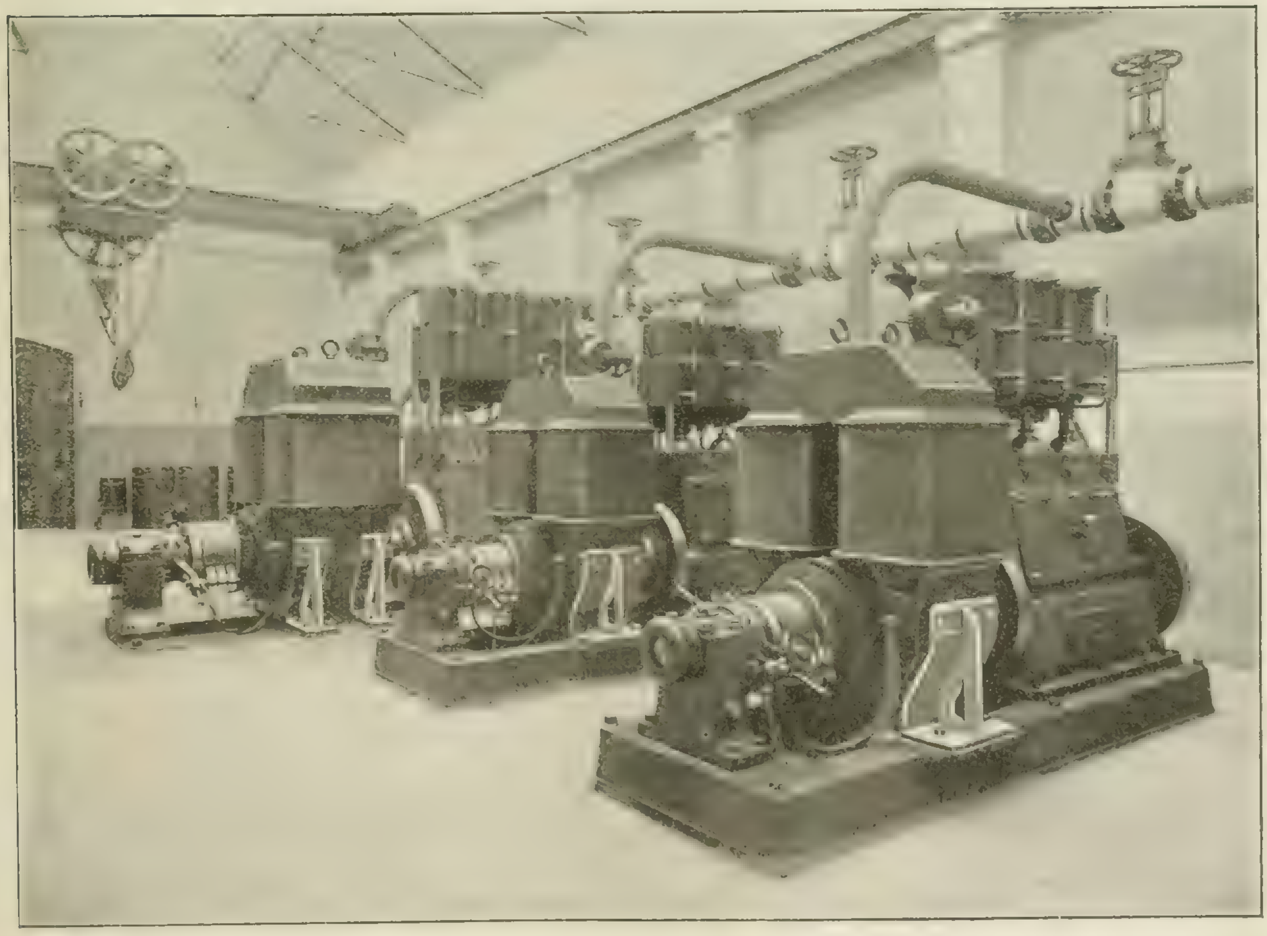
The boiler-house is at present equipped with three marine-type boilers 14 feet long by 8 feet diameter, with space for two more if required. As the water is very hard, an exhaust "heater detartoriser" of Mr. William Boby's make is employed. This is capable of dealing with 12,000 pounds of water per hour. The water enters at the top and flows downward till it reaches the suction pipe of the feed pumps, which it enters at a boiling temperature. The apparatus consists of a number of circular trays set one upon another so as to form a column. Each tray is always nearly full of water, and the exhaust steam from the engines, entering near the bottom of the apparatus, bubbles through the water, raising it to boiling temperature, while the amount of back pressure caused in the exhaust pipe is said to amount only to a few inches on the water gauge. The heating of the water causes the carbonates of lime to [illegible]



Plan and Section of the Folkestone Central Station



View of the Boiler Room of the Folkestone Central Station.



Interior of the Engine Room of the Folkestone Central Station, Showing Direct-Coupled Generators.

Switching apparatus is provided to allow a supply of 210 or 420 volts, thus giving two speeds, and further regulation of the speed is obtained by inserting resistance in the field and armature circuits of the motors. The feed piping is arranged in duplicate with two connections to each boiler, with the requisite number of valves to isolate any pump or any portion of the piping in case of failure. The pumps can either be supplied with cold water from the supply tank or with hot water from the feed heater.

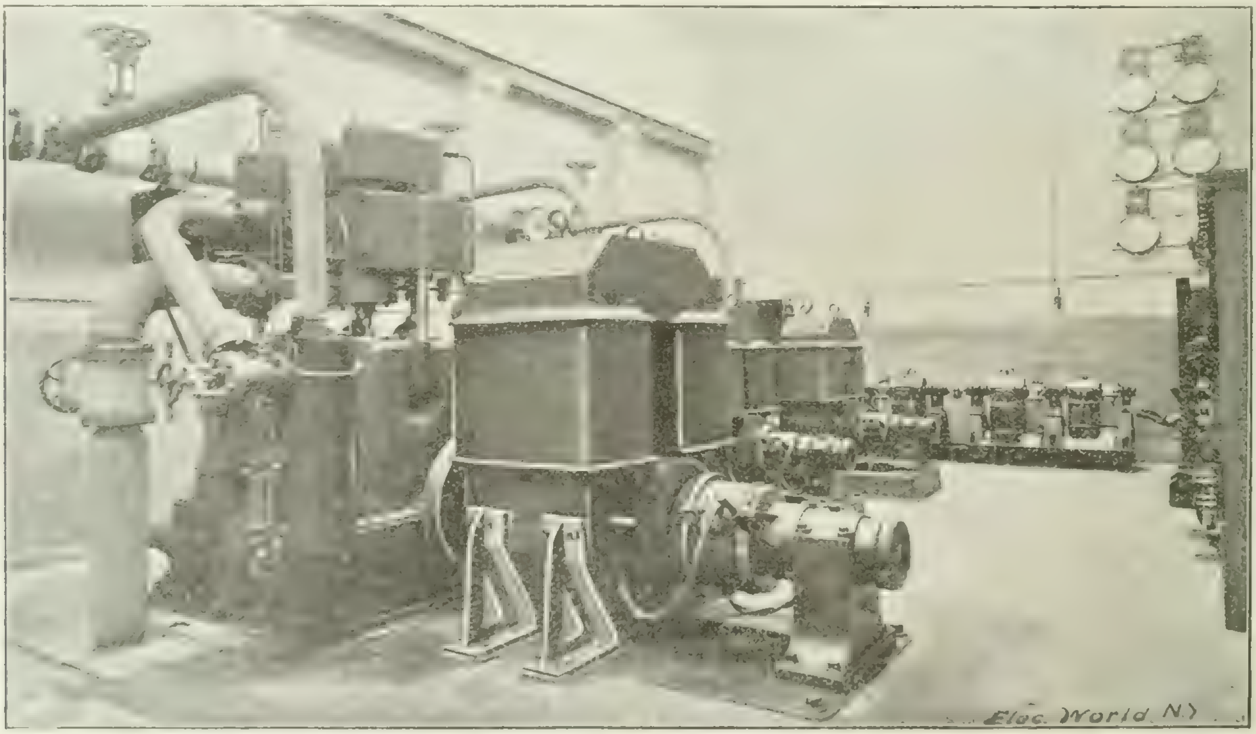
The usual ring main system is used to supply the engines. The mains are of 7-inch steel with copper bends, with 5-inch steel connections to the boiler and 2½-inch and 3½-inch copper connections to the engines. The main piping is drained at the ends of the ring to Geipel steam traps, and connections for drains are also fitted at the foot of the separators on the engine beds to similar drains. Steam being continually connected to these separators, dry steam is always available for starting up any engine.

A good view of the engine room is given in one of the illustrations. Three generating sets are installed at present, one of 246 horse-power and the other two 120 horse-power, when running at 375 and 480 r. p. m. respectively, with steam at 140 pounds at the stop valve. All are of the Peache type coupled to Parker dynamos. They are single-acting, three-crank, six-cylinder engines, and run very silently. There appears to be nothing exceptional in the construction of the dynamos. They are of Messrs. Parker's two-pole type, with steel magnets and Eickemeyer windings, designed to give [illegible]

[illegible]

[illegible] the centre cells of the storage battery and the "booster" connections [illegible] switch for each side of the battery, and a throw-over switch, by means of which the cells are connected either directly to the bus [illegible] switches are provided for the purpose of exciting the field of the boosters and short-circuiting them immediately the circuit is broken, thereby preventing an abnormal rise of pressure in their windings. The remaining double-pole switch is for starting the balancer, and it is interlocked with a resistance switch. On the upper part of this panel are the battery ammeters, the middle-wire ammeters and the zero indicators, for putting the dynamos or boosters in parallel. These zero indicators, which are of the Kelvin type, are really low-reading voltmeters. but they are designed to withstand high pressures, and have their zeros in the middle of the scale. They are connected to the poles of the switch it is desired to close, and when the indication is zero it is known that the two machines are at the same pressure, and the attendant can close the switch. This forms a simple and effective method of paralleling.

It will be noticed that, with the exception of the zero indicators, there are no voltmeters on the switchboard. The only voltmeters employed are those on the left-hand wall of the engine room. They are electro-static voltmeters of the standard Kelvin engine-room type, and are connected at the ends of the pilot wires from the feeding points. The large, open scales are visible from every part of the engine room. Thomson-Houston meters are fitted on each dynamo circuit, and Aron meters, with Miller's single-dial attachment, are used for the accumulators. These latter are 230 cells in glass boxes erected on wooden stands in two tiers. They are guaranteed to give a discharge of 80 amperes for 9 hours or 119 amperes for 4.



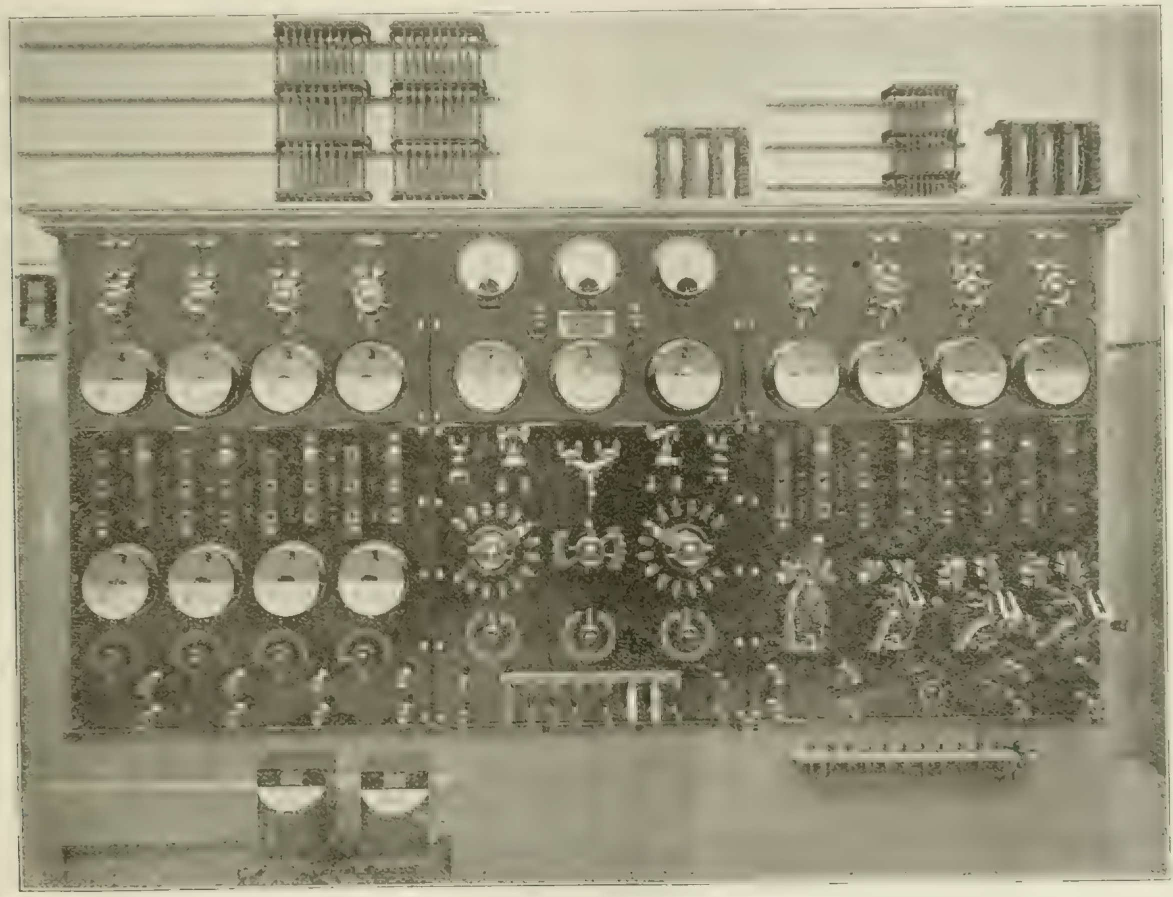
[illegible] Station, Showing Switchboard at the Right and Boosters in the Background.

The supply is at 210 volts at the consumers' lamps, and the arc lamps are connected in series of eight across the 420-volt mains. Owing to the distance of the station from the centre of the supply area, the feeders and distribution mains are a very important feature of the system. The cables are insulated with impregnated jute, lead-covered and armored, and laid directly in the ground. Tarred boards are laid over them for protection from workmen who may be making excavations in the neighborhood at some future time. The feeders are triple concentric, with heavy lead-covering and steel tape armoring, being connected to the distributing network at large feeder boxes. The pilot wires are three-conductor lead-sheathed steel taped cables laid in the same trench as the feeders. Three core, in preference to triple concentric cables, have also been used for the mains, owing to greater convenience in connecting the house services. The section of the neutral wire of the feeders is half that of the others. Sixty-eight arc lamps are being erected at [illegible] and burn for fourteen hours with single carbons. On each post are two incandescent [illegible]. The circuits of the arc and incandescent lamps are connected to main circuits tapped from the network boxes by means of four-core non-hydro[illegible] lead-sheathed and steel-armored, two of these wires being for the arc lamps and two for the incandescent. The designs of the posts selected by the corporation have very small chambers in their bases, so that there is only room for the isolating switches and substitutional resistances in them. The circuit switches and resistances are contained in pillar-boxes similar in appearance to those frequently used for the line switches of a tramway system. There are five of these switch pillars, each arranged for three circuits.

The Work of the American Institute Committee on Co-operative Research.

The committee appointed by the American Institute of Electrical Engineers to suggest problems for research on the part of scientific schools and to co-ordinate the results obtained has suggested the list of subjects given below, which will certainly be valuable to the heads of the electrical departments in the various technical schools, with results which should be of great importance in the advancement of the science:

(1) The effect of sustained high temperature upon the insulation resistance of dielectrics.



View of Switchboard at the Folkestone Central Station.

(2) The influence of sustained high temperature upon the dielectric strength of insulating materials.

(3) The influence of sustained high temperature upon the hysteretic coefficient of commercial iron.

(4) The influence of chemical impurities in iron or steel upon the hysteretic coefficient.

(5) The hysteretic coefficient of magnetic alloys.

(6) The temperature coefficient of resistivity in commercial copper wires.

(7) The temperature coefficient of resistivity in commercial aluminum wire.

(8) The temperature coefficient of resistivity in alloys commercially employed. (It is desirable to include analysis of the alloys tested as well as their physical properties.)

(9) The highest conductivity obtainable in copper wire at any standard temperature.

(10) The highest conductivity obtainable in aluminum wires at any standard temperature.

(11) The analysis of dielectric losses between parallel copper wires maintained at high e. m. f.; (1) alternating and (2) continuous, into component parts, such as chemical, electrical and mechanical.

(12) The influence of wave form of alternating e. m. f. upon the dielectric strength of dielectrics.

(13) The influence of wave form of alternating e. m. f. upon the sparking distance between needle-points in air.

(14) The influence of the room temperature upon the temperature elevation of dynamo machines under a given load, as computed from their increase in resistance under load. (Sec. 32, Preliminary Report of Standardizing Committee to American Institute of Electrical Engineers. June, 1898.)

(15) The distribution of temperature elevation in field coils of dynamo machines as dependent upon their form and dimensions.

(16) The relations between the "load loss" and "short-circuit core loss" of an alternator. (This has reference to Par. 16d, A. I. E. E. Preliminary Report on Standardization, June, 1898.)

(17) The counter e. m. f. of electrolytic deposition cells at potential differences ranging between the maximum polarization voltage and zero.

(18) The seat of the increased counter e. m. f. in storage cells during rapid discharge.

(19) The magnetic properties of alloys containing iron, nickel and cobalt.

(20) The magnetic restivity of powerfully twisted iron and steel wires, or of magnets composed of such twisted wires.

(21) The permeability of magnetic materials at low values of magnetizing force.

(22) The dielectric strength of different substances employed for insulating at different frequencies of alternation.

(23) The influence of very high frequencies of alternation upon the sparking distance between needle-points in air. (The highest attainable frequencies preferred.)

(24) The dielectric strength of vapors of different substances.

(25) Influence of wave form upon efficiency of converters.

(26) The influence of magnetic field upon electrolytically deposited bismuth.

(27) The conditions giving rise to sparking at commutators.

High Voltage Power Transmission—II.*

BY CHAS. F. SCOTT.

The wave for no load and for both conditions of load is given in Fig. 10. The current taken by the two circuits in multiple is twice that to a single circuit. The variation from a straight line in one of the current curves is due to a change in wave form as the voltage is increased. The loss for the two circuits in multiple is about twice as great as for one circuit at low voltages, but it is less than that for one circuit at high voltages. Referring now to the wave form taken at high voltage, it is seen that the wave form for the two circuits in multiple has a lower maximum than that for one circuit alone. The reduced loss on the two circuits is undoubtedly due to the different wave form when both circuits were connected. The distortion of the wave form is due to the reactions which the leading current produces in the generator and transforming apparatus.

Wave forms were also taken on the slotted armature generator at 60 cycles. The wave forms are given in Fig. 11. The conditions are similar to those just described, in that a single circuit produces a [illegible] than that produced [illegible]. [illegible] age is less than that on a single circuit.

[illegible] load and also when supplying current to one of the circuits. These [illegible] Fig. 12. [illegible] wave at no load and is greatly distorted when supplying a leading current. In the no-load wave the value of the fundamental is 72.5 per cent.; the third harmonic 21.6 per cent.; the fifth harmonic 4.8 per cent. The corresponding loss is given in Curve 1, Fig. 9. The distorted wave makes the Thomson wattmeter read too high.

OTHER OBSERVATIONS AND TESTS.

"A series of observations were taken, extending over a period of thirty-three days, to determine whether there was any connection between the loss occurring on the lines and the variations in weather conditions. Three readings were taken each day. They were, in addition to the wattmeter readings, readings for barometric pressure, temperature, humidity, wind direction and wind velocity.

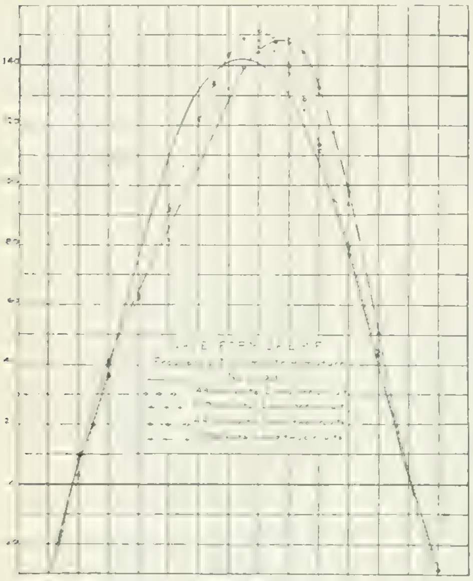


Fig. 10

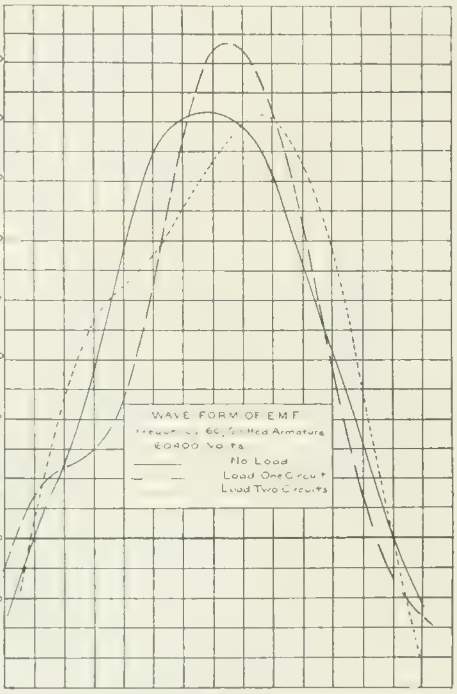


Fig. 11

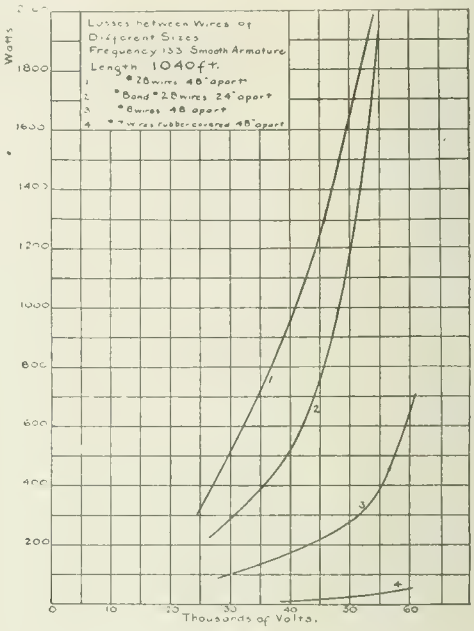
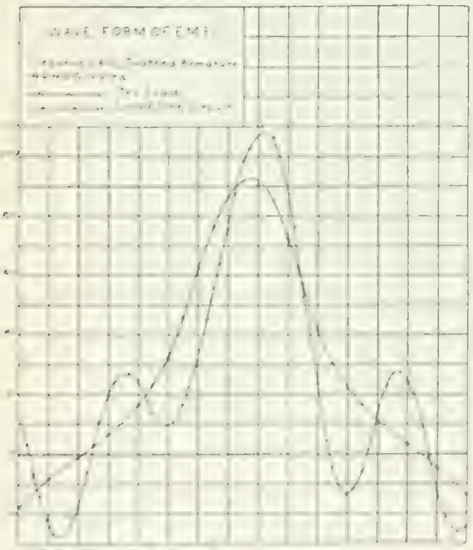
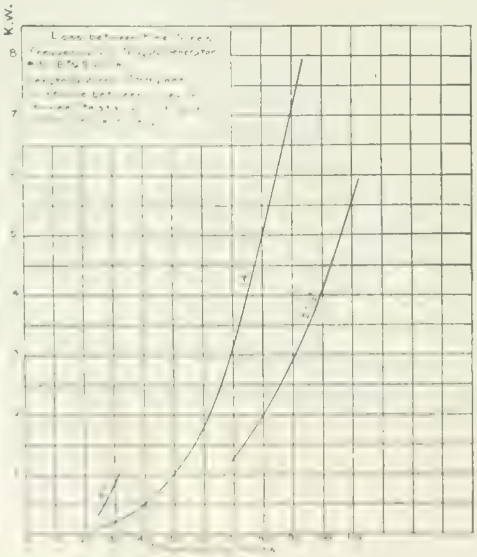
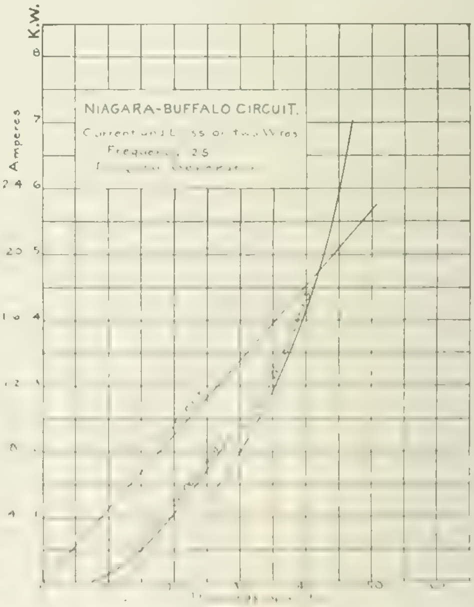


Fig. 13







The weather observations were taken simultaneously at Ames and the King, using sets of weather instruments furnished by the United States Weather Bureau. The range of these observations is shown in a table given below, in which maximum and minimum refer to the maximum and minimum results obtained at any time during the thirty-three days over which the measurements extended:

Station.		Barometer.	Temperature Deg. F.	Humidity Per Cent.	Wind Velocity Miles per Hour.
Ames.	Maximum.	22.19"	[illegible]	[illegible]	21
	Minimum.	[illegible]	[illegible]	[illegible]	2
King.	Maximum.	21.82"	[illegible]	[illegible]	20
	Minimum.	[illegible]	[illegible]	[illegible]	3

"If there was any variation in the loss on the lines for this range of weather conditions, it was so small as to be inappreciable. The results of all measurements taken during this work seem to confirm the fact that the only weather condition whatsoever which affects the loss to any practical extent is that of precipitation. The loss seems to bear some relation to the size of the particles precipitated, being greater for a fall of snow in which the flakes are large than one in which the flakes are small.

"In the power transformers used the series reactance was comparatively small because of the subdivision of the coils. A change in the condition on the line as regards loss occurred when the Weston wattmeter was placed in circuit. This was detected by measurement upon the Thomson wattmeter, both when the Weston wattmeter was in circuit and when it was not. Moreover, the lines hiss when the voltage is 55,500 and the Weston wattmeter is out of circuit, but when the Weston wattmeter is thrown into circuit the hissing ceases, although the voltage rises to 57,700. The hissing sound is a characteristic of high-voltage lines and begins at the bend in the loss curves. It always accompanies luminosity of the lines.

"Along with this change there was another phenomenon not previously mentioned. This was a discharge which took place from time to time between the terminals of individual choke-coils. The discharge would occur sometimes between the terminals of one choke-coil and sometimes simultaneously on two or three of the choke-coils. These discharges made considerable noise, sounding very much like a pistol shot, and could be heard at a considerable distance from the transformer house. As the choke-coil terminals are distant from each other about 8¼ inches, it is not thought that this discharge took place through the air, but over the surface of the wood enclosing the choke-coil. The discharge, however, left no mark on this surface. Simultaneous with these choke-coil discharges one could hear, if standing under the line some little distance from the transformer house, a slight snap which seemed to be a phenomenon rather of the whole line than of any particular spot in it. Sometimes there was a corresponding snap over the lightning arresters. As the lightning arresters make more or less noise at all voltages, this snap over them may have been present at all times, but in some cases not sufficiently well marked to be heard above the continued hissing of the lightning arresters.

"After the preceding results had been obtained, the two power transformers were connected up with their high-tension windings in series, the point of connection between them being grounded, and with their low-tension windings in multiple. With this arrangement voltage was impressed on one of the circuits, power being supplied by the smooth armature at 7200 alternations. The voltage was run by means of the machine field to 90,000.

"As the power taken by the lines at this voltage overloaded the motor used to drive the generator, a span was cut out of the circuits at a little distance from the station, leaving about 500 feet of wire in them. The voltage was run up to 133,000 volts and held there for some minutes; but the current finally jumped from the outside terminal of each transformer to the iron, smashing the heavy glass tube with which these terminals were insulated."

DISCUSSION OF RESULTS.

The following is taken from Mr. Mershon's discussion of the results of his tests:

"There is evidently a certain critical voltage at which the loss occurring between wires begins to increase very rapidly; indeed, it seems as though there might be something of the nature of a polarization similar to that which occurs in the case of an electrolyte; that there is something of this nature in the case of air or other gases subjected to an electrostatic stress is well known, and it has been taken as an explanation of the fact that in the experimental determination of sparking distances in air a certain minimum potential is necessary to establish an arc, no matter how small be the sparking distance. Also, Varley has done some work on tubes containing gases. This work was done with a series of Daniell's cells yielding 300 to 400 volts. The voltage was impressed upon electrodes sealed into the tubes. He established the following facts: First, that each tube required a certain potential to leap across; second, that the passage for the current having been once established a lower potential was sufficient to continue the current; third, if the minimum potential which would maintain a current through the tube be P and the voltage varied to P plus 1, P plus 2, etc., P plus N, the current will vary in strength as 1, 2, 3, etc., N; P always meaning the lowest value at which the current will continue, and is less than that at which the current starts.

"If such a condition of affairs obtains in this case, the loss curves of the preceding sheets must be made up in two parts, one the loss over the insulators and cross-arms, the other the loss occurring through the air. The first part of the loss curve up to or near the point where the abrupt bend begins must be the loss over the insulators and cross-arms alone; beyond the point where such a bending occurs the loss curve must be made up of a combination of the two losses referred to.

"If the action which takes place in air is similar to that obtained by Varley, we might expect that both (1) the position of the critical bend on the loss curve and (2) the law which the loss follows above the bend would be affected by the form of the e. m. f. wave impressed upon the line, for the former (1) must depend, not upon the mean square of the voltage impressed upon the line, but upon the mean square of that portion of the e. m. f. wave which is above a certain critical voltage, and the latter (2) must depend upon the form of that portion of the e. m. f. wave above a certain critical voltage because, as Varley shows, the minimum voltage at which this peculiar loss begins differs slightly from the minimum voltage at which it will continue after the action has been established. If it were not for the latter consideration it would be comparatively easy to determine the equation for such loss, at least in the case of a pure sine wave, and it might be that there is a sufficiently small difference between the voltage at which this loss will begin and the voltage at which it will discontinue for such an equation to hold practically. That the loss depends upon the maximum value, if not upon the form of the e. m. f. wave, is shown by several of the loss curves in connection with their corresponding wave forms. This is particularly noticeable in one or two cases where the loss on two lines in multiple is less than that on one line, and although some of these comparisons will have to be made between curves taken on the two different wattmeters and are, therefore, not strictly comparable, they may be compared after such correction as is mentioned below in discussing the wattmeters. In any case the curves are comparable, qualitatively, as regards the position of the critical point.

"It might be objected that the results are rendered questionable by the curves in Fig. 7. The curves were taken under presumably similar conditions, except that one was obtained by means of the Thomson wattmeter and the other by means of the Weston wattmeter. This discrepancy is attributed to a charging current passing through the shunt resistance of the Thomson wattmeter. That the amount of capacity current necessary to produce the discrepancy is small appears upon the following considerations: In one case the loss obtained upon a circuit at 38,000 volts when using the Weston wattmeter is 90 watts, and under the same conditions, but using the Thomson wattmeter, the loss is 215 watts. The difference in the loss obtained by the two wattmeters is therefore 125 watts. The current is about 0.25 of an ampere. Now, 0.25 of an ampere if in step with the e. m. f. would give on the Thomson wattmeter at 38,000 volts a reading of 9500 watts; therefore the capacity current through the shunt resistance necessary to produce the discrepancy of 125 watts is 125 divided by 9500, or about 1.3 per cent. of the current in the shunt resistance. The shunt resistance has a value of 1,202,300 ohms; at 38,000 volts the current through it would be about 0.032 amperes; 1.3 per cent. of this, or 0.00416 amperes is that required to produce the discrepancy noted. In further support of this method of accounting for the discrepancy, the results obtained at different numbers of alternations using the Thomson wattmeter show a variation for different numbers of alternations of the losses below the bend in the loss curve, and which are thought to occur over insulators and cross-arms. There should be no variation in such loss for a variation in frequency.

"Any discrepancy occurring in the Thomson wattmeter by reason of a capacity current in its shunt resistance will be affected to a greater or less extent by change in the wave form.

"It is believed that all the phenomena connected with this work may be studied in a tube which has been partly exhausted. The work could then be done with comparatively low voltage and using direct current which would much simplify the measurements. The contents of the tube might be partially rarefied air or other gas, as the action would undoubtedly be similar in all gases. With such a tube might be studied the law of variation in distance and form of electrodes, also in material and surface of the same.

RÉSUMÉ AND CONCLUSIONS.

"It is undoubtedly true that the loss is made up of a loss over insulators and a loss between wires, and that the latter is the only loss worth considering.

"The loss between wires is not affected by any atmospheric conditions except precipitation. This statement of course must be taken as applying to such a climate as that in which the measurements were taken. The lines were seldom in fogs or clouds, and when they were, or when rain was falling, the moisture was of the purest. Near cities the loss would be undoubtedly much greater than that shown in these curves, because of the impurities, both in solution in the moisture of the atmosphere and in suspension.

"There will be for a given transmission a certain economical voltage, because while an increased voltage, with a given line wire, will reduce the loss in this wire by decreasing the transmission current it will also increase the loss between the wires.

"It is believed that attention to wave form is very important. The sine wave is undoubtedly the best as giving a stable form, and because of superior results with all kinds of apparatus. A flat wave would of course give less loss, but would not be stable, and as the nearest practical approach to a sine wave will not be perfectly stable, but will still contain some harmonics, it will be of advantage to keep the series reactance of the transformers and generators as low as possible.

"It is believed that 40,000 volts is perfectly conservative and safe as regards loss between wires for any ordinarily good wave form, and in a climate such as that in which the measurements were taken, *i. e.*, where the air and precipitated moisture are practically pure, 40,000 volts comes well below the bend in the loss curve even under the worst weather conditions.

"I can see no advantage of porcelain over glass, unless it be that of superior mechanical strength. The latter is rather a doubtful advantage. The ball from a heavy calibre rifle or revolver, such as are used in the Western country, will smash any insulator, whether glass or porcelain. Porcelain offers a more tempting mark, being white. As to hygroscopic properties, no difference could be discovered so far as these measurements were concerned. It will make little difference under running conditions whether the insulator be hygroscopic or not, as the small amount of power necessary to keep the surfaces dry will be insignificant. I say under running conditions, because in starting up a 'cold' line there is danger of breakdown if current is put on suddenly at full value instead of being raised gradually. As far as the resistance to piercing is concerned, glass is just as good practically at least as porcelain. It needs no electrical test to pick out a good glass insulator, which is one advantage of glass over porcelain.

"To sum up, glass insulators are cheaper, lighter, more easily tested and less likely to be shot at than porcelain; on the other hand, they have less mechanical strength.

"In every case, in my experience, where a breakdown has occurred, it has been on a cross-arm which was 'wind shaken' and 'weather cracked,' the current following the cracks. This leads to a curious result. The mark of the current will be on the surface of the arm for five or six inches, then disappear from the surface altogether for some inches, then reappear, etc. On cutting open the arm one sees how the current has followed the best path, dodging in and out. Rain and moisture probably settle toward the cracks, carrying salts [illegible] a path of low resistance, especially in wet weather. For this reason I have in the plant of the Colorado Electric Power Company taken particular pains in treating both pins and cross-arms. The cross-arm treatment is such as fills all cracks and fissures as a section of the wood [illegible]

[illegible] Power Transmission Company [illegible] Mr. [illegible] Mr. [illegible] Woodbury [illegible]"

[illegible]

[illegible] the place of tests under the conditions of practical service, such as [illegible]

[illegible]

(1) A test was made to determine whether the wave form of the charging current to the line was similar to that through a resistance, or whether it was modified by the loss component, the loss occurring only at the higher part of the e. m. f. wave. The current to the high-voltage line, at pressures varying from 30,000 to 60,000 volts, was passed through a coil possessing high self-induction. The e. m. f. upon the coil was measured by a voltmeter. The e. m. f. was also measured when a current of equal strength was passed through the coil, the line being short-circuited and a low e. m. f. applied. It was found that the voltage upon the coil was the same, within a small error of observation, in both cases, showing practically no difference in the wave form of the current under the two conditions. The current was from an armature giving practically a sine wave.

(2) The charging current to the line was measured under several different conditions when the current was obtained from a generator giving practically a sine wave. The results of measurements were compared with the currents as calculated by the theoretical formula. The last measurement in the table was made upon the Niagara-Buffalo line, with current from a Niagara generator, which differs slightly from a sine wave.

COMPARISON OF MEASURED AND CALCULATED CHARGING CURRENT TO PARALLEL WIRES. LENGTH, ONE MILE; 10,000 VOLTS.

Size of Wire.	Distance between Wires.	Frequency.	Measured Current.	Calculated Current.
			Amperes	Amperes
No. 8 B and S	21.7"	60	.0307	.028
8 B and S	48.0"	60	.0245	.0252
8 B and S	79.5"	60	.0234	.0238
8 B add S	127.5"	60	.0225	.0222
No. 8 and ground	120.0"	60	.0427	.0412
0.71" diameter	18" for ⅔ of distance 36" " ⅓ " "	25	.0176	.0176

A table giving the calculated charging current for a number of conditions will be found in Appendix B.

(3) The fall of potential around the wires was noted by tests made with spark-gaps. The wires 48 inches apart were connected to the high-voltage terminals and a spark-gap was placed between two idle wires, also 48 inches apart, placed about 21 inches below the first wires. A spark-gap consisting of brass terminals with a one-quarter-inch radius was placed between the two idle wires. When the gap was one-thirty-second inch the sparking began when the e. m. f. from the raising transformer was 26,000 volts. A gap of one-thirty-second inch requires an e. m. f. of 2200 volts to produce sparking. When the spark-gap was made eight-thirty-seconds inch (equivalent to 12,000 volts) the sparking began at 103,000 volts from the raising transformer. At intermediate points there is a fair proportionality between the spark-gap and the e. m. f.

In another test a spark-gap was placed between one of the idle wires and the adjacent wire of the live circuit. When the spark-gap was one-eighth inch (equivalent to 6000 volts) the spark passed when the e. m. f. was 17,500 volts, and when the spark was made one-quarter inch (equivalent to 12,000 volts) the sparking began at 33,000 volts. When the gap was three-eighths inch (equivalent to 16,000 volts) sparking began at 41,000 volts. When the gap was one-half inch (equivalent to 20,000 volts) sparking occurred at 49,000 volts. The e. m. f. did not differ greatly from a sine wave. These tests have an important bearing in connection with the running of telephone and other circuits adjacent to high potential wires. It is essential that the wires of a high-potential circuit be spiraled so that each wire sustains the same relation as every other wire to the second circuit, in order that the effects of static induction may be neutralized.

(4) The effect of the size of wire upon the loss was investigated by running a pair of No. 28 brass wire 0.0126 inch in diameter and then replacing it by large rubber covered wire. The rubber covered wire was No. 7 B. & S. gauge 0.144 inch in diameter; the outside diameter of the rubber covering was 0.3 inch and the diameter over the braid was 0.37 inch. In each case measurements were made upon another circuit which was unchanged during the different tests, and thus served for comparison. The results of these tests are shown in Fig. 12, which also gives the conditions when one fine wire and one wire of larger size, No. 8 B. & S., constituted the cir-

cuit. This comparison shows the very marked increase in loss when the fine wire is used. The loss is greatly decreased when the rubber-covered wire is used. The loss on the rubber-covered wire, however, increased considerably after the voltage had been raised and the rubber had broken down, thus permitting the current to pass freely to the outer surface of the insulation. It is quite probable that the loss would increase as the insulation became defective, until it was nearly equal to that of a wire having the same total diameter.

The measurements on wires of different size given in Fig. 13 are qualitatively correct, although some of the readings on which the curves are based were quite small, so that the absolute values may not be exact.

(5) The effect of the current in drying the surface of the insulators was illustrated in a test made during a rain. Upon applying 45,000 volts to a circuit the wattmeter indicated 116. After four minutes the deflection had decreased to 72, the current remaining the same. The e. m. f. was then increased to 60,000 volts, the wattmeter deflection increased to 155, and at the end of three minutes it had fallen to 138. The current was one-third greater than at the lower voltage, but remained constant while the wattmeter changed. The rain continued during the test, which shows, therefore, that the condition of the insulator is materially improved by the presence of the current.

(6) It was noticed that when there was a break-down upon the line and the current passed suddenly between wires over the surface of the cross-arm that there was a sparking between the terminals of the ammeters in the high-tension circuit across the surface of the instrument. This was further investigated by placing in circuit a coil of low resistance through which one ampere would be sent by about 1½ volts at a frequency of 125. A spark-gap was placed in shunt to this coil. A 2-inch spark-gap was also placed between the line wires. The voltage of the primary was gradually raised until at 35,000 volts the current passed across the spark-gap between the line wires. A spark also passed across a gap of three-eighths inch, shunting the small choke-coil. This test shows the remarkable suddenness of the rush of current when the short-circuit occurs due to the breaking down of the spark-gap on a high-voltage circuit. This phenomenon was observed by Mr. Mershon in choke-coils used in connection with lightning arresters at Telluride.

Running tests were made on four lines in multiple at high voltages. Each line consisted of two wires 1040 feet in length held by twenty-six insulators. The insulators were of various types of glass and porcelain, some of the ordinary form and some underhung. For hours at a time 100,000 volts or slightly more were kept upon the line. For about six weeks voltages ranging from 70,000 or 80,000 to 100,000 volts were kept on the lines for about eight hours a day. When there was rain the line would short-circuit and the voltage had to be reduced. During a driving rainstorm 48,000 volts were kept on the lines, and it may have required a considerably higher voltage to have caused short-circuiting.

(7) A high-tension wattmeter similar to the Thomson wattmeter at Telluride was used. To correct the wattmeter for the errors caused by charging current in the shunt resistance a condenser was placed in parallel to the shunt circuit of the wattmeter. This condenser should be so adjusted that the current through the shunt circuit of the wattmeter is the same that it would be if there were no condenser and the shunt resistance had no capacity. This permits the capacity current in the circuit to be shunted round the wattmeter by the condenser. The condenser in shunt to the wattmeter was capable of adjustment, and by varying its capacity the deflection could be made positive or zero or negative when current was delivered to a constant load. The proper adjustment was made by taking a comparatively low voltage, at which the charging current was very high in comparison with the loss, so that the loss was nearly negligible, and adjusting the wattmeter to indicate zero. At higher voltages, when there was a considerable loss, the error with this adjustment would be inappreciable. Certain variations with temperature and humidity were noted which would be explained by a variation in the capacity of the resistance, causing a variation in the charging current to the shunt circuit of the wattmeter. The high resistance for the shunt circuit was wound upon fuller-board plates containing brass stiffening pieces. Tests were made upon individual plates by measuring the capacity between the wire and the supporting strip of brass, and it was found that the capacity and the insulation resistance both varied with the amount of moisture in the fuller-board insulation. In order to prevent variations of this kind subsequent resistances were wound upon glass plates, which seems to be a very satisfactory form of construction.

TESTS AT NIAGARA.

Some measurements have been made upon the Niagara-Buffalo transmission line. There are two circuits of three wires each, one of which was in service and the other was available for tests. Each circuit consists of three cables each of 350,000 cm, approximately 0.7 inch in diameter. The cables are run on porcelain insulators, and are on the same cross-arm. Adjacent insulators are 18 inches apart and the circuit is spiraled, so that each of the three wires occupies the middle position for a third of the distance. Current from one of the 5000-hp generators was applied to the line through a raising transformer, by which the voltage can be increased by small steps to 100,000 volts. This transformer is part of a high-tension testing outfit which is described by Mr. C. E. Skinner in THE ELECTRICAL WORLD, March 5, 1898. The wattmeter is a Thomson inclined coil instrument with a high resistance shunt of German silver wire wound on glass glates. The ammeter is a Thomson inclined coil instrument, connected directly in the high-voltage circuit.

Measurements were made between the various pairs of wires, i. e., 1 and 2, 2 and 3 and 1 and 3; the current was found to be practically the same in each case; the loss on one of the circuits was slightly greater than that on either of the other two, on which the losses were about equal. The accompanying curve shows the measurements of current when two wires were connected and the measurement of loss; the latter measurements were made upon one pair of wires up to about 26,000 volts and then upon a second pair. The results are given in Fig. 14.

On another day measurements were made of the resistance between each wire and the ground, and corresponding measurements of loss were made by placing the high potentials between each wire and the ground. The measured loss was somewhat greater than the loss calculated by using the e. m. f. and the measured resistance. In these measurements, at voltages from 13,000 to 23,000 volts, the power factor calculated from the current and wattmeter measurements varied from about 4 per cent. to 6 per cent., so that a very small charging current in the wattmeter would produce a considerable error in the reading.

Some measurements were made upon a pair of fine wires, in which the wires were placed at different distances apart. No. 31 B. & S. gauge spring brass wire 0.0089 inch in diameter was used. The length of the parallel wires was 744 feet. They were suspended by light strings successively at 6 inches apart, 14 inches apart, and about 25 inches apart, the distance varying from 24 inches to 27 inches. The wattmeter readings are given in the curves in Fig. 15. The power factor of the measurements made above 100,000 volts is about 95 per cent., and is over 80 per cent. above 70,000 volts. There can be but little error in the wattmeter due to charging current in the resistance at these power factors.

The measurements on the Buffalo line were made by the writer. Those on the fine wires were made by Mr. E. M. Tingley, who conducted the tests at East Pittsburg, and rendered valuable assistance in the preparation of this paper.

POWER TRANSMISSION PLANTS IN OPERATION.

Beginning with the plant at San Bernardino and Pomona, which began operation in 1892, using 10,000 volts and transmitting 30 miles, a constantly increasing number of plants have been installed operating at 10,000 or 15,000 volts. In some cases there has been little or no trouble experienced with the transmission lines, while in other cases the experiences have been less satisfactory. The principal trouble seems to have been a poor grade or an insufficient size of porcelain insulator. In other cases the insulators, sometimes porcelain and sometimes glass, have given almost perfect satisfaction.

The superintendent of a power company which has been running fifteen months with about 15,000 volts reports that they "have had absolutely no trouble whatever of an electrical nature." Some insulators were broken because they had been used as targets by small boys or hunters, but only the outer petticoats were broken, and no short-circuits occurred, although in some cases insulators were in use for months with most of the outer petticoats chipped off. The distance of transmission is 12 miles. Porcelain insulators are used.

In another plant which has been in operation about a year and a half, employing 15,000 volts for a distance of nearly 30 miles, there have been but three shut-downs on account of line difficulties. These were due to the breaking of insulators at a point where the line was spiraled. In one case the repair was made in half an hour, and in the other case a few minutes' interruption to the service was sufficient for repairs.

The line is regularly patroled, and if a defective insulator or pin is found the generating station is notified by telephone and the line is shut down for a few moments at noon. In one case two poles were burned by a defect in the insulators on the top of each. The poles burned to the ground, leaving the line hanging clear without any one at either the generating station or sub-station being aware of the fact.

Troubles have arisen on some lines by the burning off of pins by the passage of sparks from the outer edge of the insulator to the pin. These sparks make small holes in the pin no larger than a needle point, but after continuous sparking for some time the pin becomes entirely charred. An iron pin suggested itself as a remedy, but additional strains and liability to break down are liable when a conductor is placed within the insulator. The burning off of pins has occurred where small porcelain insulators are porous and the outside glaze is imperfect, while the glaze on the inside is good. When the porcelain is filled with water the current readily passes through it to the lower rim of the insulator and then sparks across to the pin. In one place which has been running for about three years some 250 pins burned off. The early insulators have been replaced by larger and better ones, and this defect has disappeared.

A 10,000-volt line which runs for a dozen miles or more within a few hundred yards of the Pacific coast has burned cross-arms on nearly every pole. The cross-arms near the ends of the line, which are away from the coast, are not burned. Usually the burning appears as a mere blackening of the cross-arm for a short space between the insulators, on one side of the arm. In some cases the charring is deeper, and appears on both sides. The side on which almost all of the burning occurs is the one toward which the winds come from the ocean, bearing the mist of salt water. The wire shows discoloration, and the iron braces for holding the cross-arms are in a few cases eaten through. Moreover, the cross-arms were green and full of sap when erected. The early porcelain insulators were porous, and have now been replaced, and the pins are of iron. [illegible] were put up.

[illegible] principal duty of the insulator is to prevent the current passing over the surface and jumping to the pin or cross-arm, a matter with [illegible]

[illegible]

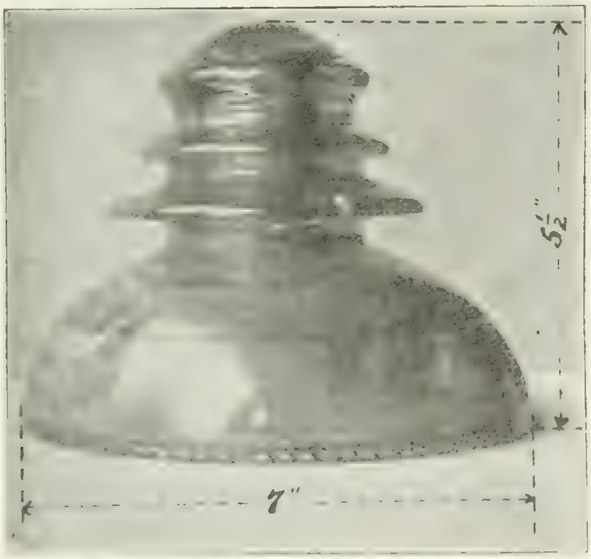


Fig. 16.—Insulator Used at Provo for 40,000 Volts.

crossed at frequent intervals. The telephones in general work very satisfactorily.

There appears to be practically nothing in power transmission in Europe using high potentials outside of Switzerland. The installation in Paderno in Switzerland is operating at 15,000 volts, the highest voltage which has been used in that country. The damp weather is one of the limiting factors. The insulators used are porcelain with a triple petticoat.

40,000 VOLTS IN COMMERCIAL SERVICE.

The highest voltage which is used for transmission is in the Provo plant of the Telluride Power Transmission Company in Utah, which transmits power 35 miles to the Mercur mills at 40,000 volts. Raising transformers are three in number and are connected in the star form. Each transformer has a capacity of 250 kilowatts. The middle points of both the high-tension and low-tension circuits are grounded. In general design these transformers resemble the transformers used in the high-tension tests at Telluride, the design and construction having been under the direction of the same man in both cases. The line extends from Provo at an elevation of 4500 feet to Mercur, at 2000 feet above Provo, and the line reaches an extreme height of about 10,000 feet above the sea level. Three miles of the line are strictly mountain construction. The lightning protection is afforded by choke-coils and Wurts non-arcing metal arresters. The insulators are of glass. The design was based on the tests at Telluride and they were made specially for this plant. The form is shown in Fig. 16. The insulators are held on special pins of oak which are thoroughly paraffined. The lower part of the insulator is 5 inches above the cross-arm.

In dry weather there has been no difficulty whatever in operating. The insulators do their work as effectively as could be expected if the voltage were only a few thousand volts. When everything is dry the line will operate without difficulty, even if some of the insulators are off and the wire rests upon the cross-arm. When it rains there is sometimes trouble. It is indicated in the station by the ammeters giving quick swings, showing momentarily strong currents. Sometimes this is apparently a short circuit and blows a fuse. In every case when there has been trouble on the line it has been in rainy weather, and broken insulators have been found which located the trouble. It is certain that in most cases these have been previously broken by bullets, and in other cases it is probable that the insulators were likewise broken. It is believed, therefore, that had there been no intentional breakage of insulators there would have been no trouble upon the line since the plant began operating in February last. A few of the insulators near the station are not [illegible] equivalent to a rain all the time without doing any damage. Snow has often backed from the cross-arm up against the bottom of the insulator and around the [illegible] found that the part of the insulator [illegible] deposits of moisture or frost, but remains dry, the particles being repelled. At this plant current for about 700 horse-power is carried through three fuses of copper wire 0.01 inch in diameter. Iron wire is used on a branch line for transmitting about 100 horse-power for about three miles.

This plant has been in operation in winter and in summer, "in [illegible]" the sole supply of power for the

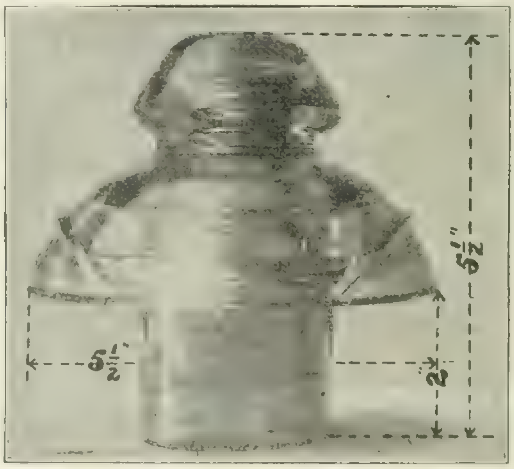


Fig. 17.—Insulator Used by Colorado Electric Power Company for 20,000 Volts.

enormous De Lamar mines and mills, at Mercur, and is a happy and fitting consummation of the high-tension tests described in the beginning of this paper.

LIMITATIONS OF HIGH-VOLTAGE TRANSMISSION.

The important commercial question is: To what distance can power be transmitted? The relation between distance and voltage is well known. The same weight of copper can transmit with equal efficiency the same power to any distance provided the voltage is increased directly as the distance is increased. The limiting commercial ratio between voltage and distance is easily found. If the distance be 3 miles per 1000 volts and the loss 16 per cent., the cost of copper is about $20 per horse-power. The interest on the latter investment is about $1 per year. A distance in miles equal to three times the number of thousand volts may therefore be covered without an excessive annual charge per horse-power for copper. The limits to the voltage which are practicable depend principally upon the insulator and upon the loss between wires.

The two fundamental requirements are dielectric strength sufficient to prevent puncture, and a size and form which will prevent the passage of the current around the insulator. A given insulator will be adequate for a higher voltage where the atmosphere is comparatively pure and dry than it will be under other conditions. The rapid progress which has been made in the design and construction of insulators during the last few years will doubtless provide an insulator which will accommodate the highest voltages that can be used due to other limitations. The insulator, therefore, while remaining the critical point in a transmission system, will probably not determine the limit of practicable voltages.

The loss between bare wires at high voltages seems to determine a positive limit beyond which the voltage cannot be increased. This loss is subject to variation due to diameter of wire, distance between wires, and wave form of the e. m. f., but the variations which may occur under favorable commercial conditions locate the point of increase of loss about 50,000 or 60,000 volts. Under favorable conditions this may be raised somewhat, but it is not probable that any material increase can be made.

The amount of power to be transmitted involves some interesting commercial limits. There are certain elements in a transmission which do not vary greatly with the amount of power transmitted. Thus, the charging current to the line will be practically the same whether the wire will transmit 1000 horse-power or 100 horse-power. If the charging current happens to represent 300 horse-power it would be insignificant in one case, but for the smaller output it would require generating apparatus several times that necessary for the actual power.

It is not mechanically practicable to use wires as small as would be sufficient, in so far as conductivity is concerned, for transmitting a small power. For example, a No. 7 copper wire, which is as small as is ordinarily used, if employed in a three-phase circuit 50 miles in length will transmit over 1000 kilowatts at 40,000 volts with 10 per cent. loss. If only a few hundred kilowatts were to be transmitted the cost per kilowatt would be excessively high, and on the other hand a lower voltage could be used without undue loss. In some cases, indeed, where a high voltage is used for small power, as for example on a branch circuit, an iron telegraph wire would have ample conductivity. In other cases an aluminum wire could be used to advantage, as an aluminum wire of the same conductivity as a copper wire has only about half the weight, and possesses greater mechanical strength in comparison to its weight.

It may also be noted that high-voltage transformers cannot be economically built for small output, as the insulation spaces required are so large. The cross-section of the copper is often not more than 10 or 20 per cent. of the area of the opening in the iron. The cost per kilowatt increases very rapidly when the size of transformer falls under a few hundred kilowatts.

The overhead transmission line has been considered, and its limitations are the insulating strength of the insulator and the losses through the intervening medium. In a cable or a conduit the insulation must be provided continuously instead of at points a hundred feet apart. Rubber covered cables are made for 10,000 and 20,000 volts, but it is quite possible that it will not be commercially practicable to make cables for much higher voltages. The effect of continued electric stresses on the insulation of the cable, which is an unknown factor, may prove to be a very important one. A conduit composed of a pipe containing oil, in which the wires are separated by glass tubes, has been proposed. Many mechanical difficulties arise in construction of this kind; the cost is high and the action of continued high voltages on solids and liquids opens a field which is little known. A suitable insulation on the wires on high-voltage lines may enable higher voltages to be used than can be used with a bare wire.

Liquid air with its high insulating properties and the low temperature and consequent high conductivity which it would give to a conducting wire may enable us to use air insulation in a new way.

High voltages have been referred to in this paper with perhaps undue familiarity. Familiarity with high voltages is not one which breeds contempt. A voltage which can produce sparks several inches in length, which can be felt through several feet of air, which causes hissing sounds, which produces luminosity and which in a confined room generates strong odors of ozone, is one which creates profound respect. Dangers and difficulties accompany it, and the highest intelligence, vigilance and excellence must be employed to avoid accident and insure success. While ordinary types of construction do not seem to reach their limitations until some 50,000 volts is reached, and pressures of this order have been and are in regular use, nevertheless they are not to be used indiscriminately or where they can be avoided. There are difficulties enough in handling 15,000 and 20,000 volts. As the pressure is raised the liabilities to trouble increase at an alarming rate. It is, however, a fact that these voltages have been and can be used, and also that no new or modified methods of transmission will be required before 50,000 or 60,000 volts can be employed for distance up to 150 or 200 miles.

Profits of Alternating-Current Central Stations.

BY T. M. MESTON.

The most interesting problem confronting central station managers is how to increase the net revenue of the plant so as to make a more satisfactory balance sheet to present to stockholders at the annual meeting. Any line of policy that promises to result in a larger gross revenue without adding in the same proportion to labor and expense is consequently a gain in net profits.

The most important debit items in any central station are interest on investment, taxes, salaries and maintenance of pole lines. These charges are fixed by the conditions surrounding each individual plant, and do not, in any case, permit of being reduced to an extent that would materially affect the results of the year's business. Many managers, very properly, will not consider reducing some of these charges even as far as possible, feeling that too great economy in the matter of salaries and maintenance would be unwise policy for reasons that need not be entered upon at this time.

The writer has watched the development of alternating-current central stations with a great deal of interest, and is more and more impressed with the fact that most stations allow a great deal of revenue to escape them by lack of intelligent efforts to secure customers that are easily within their reach. The only practical remedy lies in the establishment of day circuits for power users in connection with intelligent and persistent canvassing to see that the merits of electric power are understood by all classes of people who can use power.

Many managers will stop here and say, "This is all very well in theory, but I have tried it and the results compelled me to abandon the project." But in spite of this view a day circuit can be made to pay in almost any town of over 5000 inhabitants. The opportunities for this power business are almost unlimited, but, like every other good thing, it requires hard work to start it going. Once started it will, like the proverbial snowball, continue to grow from its own momentum.

Some of the uses that occur to the writer are: Clothing factories, family sewing machines, dentists, lathes, jewelers, doctors (for operating Holtz machines), coffee mills, forge blowers, organ blowers for churches, pumps for houses where water supply is taken from wells and stored in tanks. Probably there is not a single station manager who cannot think of as many more right within his reach. A great many managers will say, "We run a 500-volt circuit for this purpose," but upon reflection they will see that this is at best a subterfuge, and is the most expensive way of attaining the results desired.

The greatest economy can only be procured in any business by reducing everything in connection with that business to a standard as far as possible. This point is now being recognized by central stations in the large cities, and what is probably the largest single-phase station in the United States is running all classes of service from the same machine. This company operates incandescent light, series arc and power all from the same machine, and is intelligently pushing its power business, paying special attention to small users, as they can often be supplied with sufficient power for their needs without changing transformers, wiring, etc. Every small motor thus added is a source of revenue which is practically net profit.

A few years ago this plan would not have been practicable owing to the lack of a reliable single-phase motor. This objection can no longer be raised, as several makes of these motors are now on the market, and they are, in many ways, better than direct-current motors.

For small purposes the simple induction type is probably the best, as the absence of commutator renders them particularly suited to operation by inexperienced persons. The drawback to this type is that the load must be thrown on after the motor has reached speed, or the motor must be given a little assistance at start. This objection is practically negligible in sizes under one-half horse-power. Sizes one-half horse-power and over must be provided with some automatic starting device, usually consisting of a commutator which is short-circuited after the machine reaches speed, when the motor will carry a full load running as an induction machine. As the commutator is used for only five to ten seconds each time the machine is started, the trouble it might cause is practically eliminated.

Another great advantage over 500-volt circuit lies in the freedom from danger, which often deters the layman from taking advantage of electric power when he can only procure it in the 500-volt form.

As an incentive to the weak-kneed brother to look into this matter, the writer will say that he was much surprised to hear of a manager in a remote Texas town of less than 4000 inhabitants who was running a day circuit in summer. The writer expected, of course, that the venture would be a failure, but the man engineering the matter was a true hustler and he kept at it actively for about four weeks, and after that time his day circuit was a paying feature of his plant. This, of course, was only a summer circuit, but it was in a town of extremely small size. In view of this instance will any manager of a plant in a town of 10,000 or over maintain that he cannot make profit on a day circuit all the year round?

The only additional expense of a day circuit is coal and day attendance, the main items of cost not being affected at all.

Our grandfathers did not feel the need of kerosene and electric light until some one educated them to appreciate better things, and central station managers must educate the layman to depend on electric motors instead of less adaptable sources of power.

The writer believes that along the lines indicated above lies the solution of the success or failure of every alternating-current station, and would be pleased to see some active discussion of this [illegible]

The Conductivity of Aluminum.

[illegible]

The following tests of the conductivity of some aluminum rods manufactured by the Pittsburg Reduction Company were recently made with considerable care. Some of the specimens tested were [illegible] alloyed with certain percentages of copper.

A potentiometer method slightly different from that usually employed was adopted partly on account of its accuracy and partly [illegible]

[illegible]

[illegible] potentials against each other. In one circuit was a Thompson balance [illegible] and ten [illegible] in parallel. [illegible] Haldey 10-ohm standard. Knowing the current by the balance to an accuracy [illegible] accuracy of one-tenth of one per cent. or less, the potential drop [illegible]

[illegible] with another Thompson balance which would read 2½ amperes to within an accuracy of one-fifth of one per cent.

A delicate D'Arsonval galvanometer and a key *K* were placed between these circuits as indicated, and *p p'*, the contact points, were mounted on a steel rod so that the distance between them could be varied and accurately measured. The distance between these points was then changed until on touching them to the aluminum rod no deflection was observed on the galvanometer *G*. The method was sufficiently sensitive to indicate different resistances at different portions of the same rod due to the varying thickness of the rod itself. The test was made in a room of nearly constant temperature, and the current through the rods caused a scarcely appreciably rise in their temperature. This temperature was 26.9° C.

Proper corrections were made for the known error and temperature of the resistances *r*. The diameters of the rods were measured in several places by micrometer calipers. The conductivities were all reduced to the conductivity between the opposite faces of a centimetre tube and compared with the conductivity of a similar cube of pure copper at 27° C. The value taken for this was one divided by 0.000,001,767. In actual practice the percentage conductivities of the different specimens of aluminum were calculated by the formula:

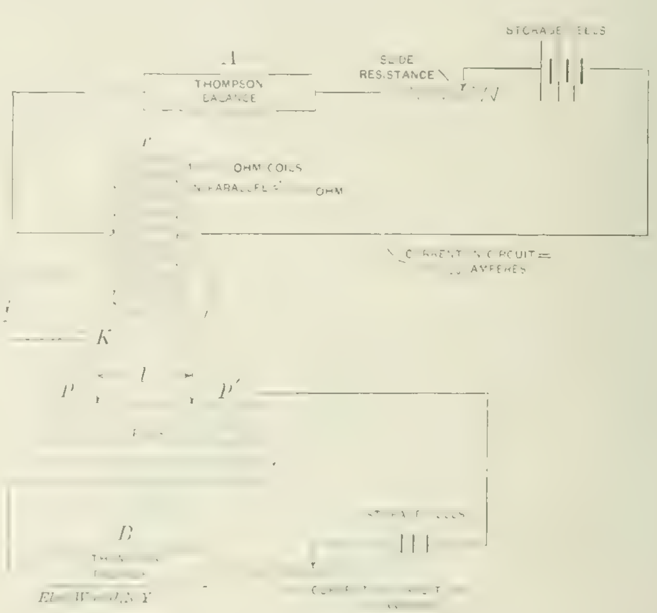


Diagram of Connections.

$$K = \frac{0.000,001,767\; l}{0.785 \times D^2 R}, \text{ where}$$

K = percentage conductivity of aluminum compared with copper at the same temperature as that of the aluminum, *l* = distance in centimetres between contact points on aluminum rod, D^2 = square of diameter of aluminum rod, and *R* = resistance of aluminum rod between contact points. *R*, of course, $= \frac{e}{c}$, where *c* is the current (2½ amperes) measured by one balance and *e* is the known drop over the resistance *r*.

The following table exhibits the character of the specimens tested and the results obtained:

Character of Specimen.	Length of Rod, [illegible] Necessary to Balance.	Cross-Section in Square Centimetres.	K = Per Cent Conductivity.
Pure al.*	[illegible]	[illegible]	61.50
Pure al.	29.00	[illegible]	61.50
[illegible] copper	[illegible]	[illegible]	56.37
Pure al.	[illegible]	[illegible]	61.45
[illegible] copper	[illegible]	0.2704	58.16

*[illegible] amperes in circuit through known resistance for this specimen, [illegible]

It is interesting to note that alloying copper, a better conductor for an equal cross section than aluminum, reduces the conductivity of pure aluminum.

The writer believes that these results can be relied upon by users of aluminum to within certainly one-half of one per cent., and probably a little closer.

DIGEST OF CURRENT ELECTRICAL LITERATURE AMERICAN AND FOREIGN

By Carl Hering

Dynamos, Motors and Transformers.

ROTARY CONVERTERS. S. P. Thompson. Lond. "Elec. Eng.," Nov. 11.—The beginning of a reprint in full of his recent paper before the Inst. Elec. Eng. After giving a table of the twelve principal conversions which can be accomplished between continuous and alternating currents of one, two and three phase and different voltages, he begins a discussion of those machines which convert continuous into alternating currents of one, two and three phase and the reverse; he limits himself to such machines and mainly to that form in which the armature contains but one set of windings with a commutator at one end and contact rings at the other, the same winding serving both to receive the primary and to generate the secondary current; this he calls a rotary converter, or more briefly a converter, the word transformer being applied to stationary apparatus. A table points out the relation between the number of contact rings and the use to which such generators may be put with respect to the phase relations of the currents. Another table gives the voltage on the alternating-current side, that on the continuous-current side being 100, the data being given for different numbers of contact rings. Another table shows the corresponding currents for an output of 10 kw. He then begins the discussion in detail of how the current, in the act of being converted from alternating into continuous or the reverse, flows through the windings of the armature; this he claims has not heretofore been considered in detail in any publication. With the aid of a number of diagrams he then shows clearly what the currents will be on the alternating and the continuous current sides, in a simple concrete case—namely, that of an ordinary armature to which two contact rings connected to two diametrically opposite points of the winding are added. The reprint is to be continued.

ENERGY IN SHORT-CIRCUITED ARMATURES. Roessler. "Elek. Zeit.," Nov. 10.—The first part of a long article in which he discusses the distribution of the current and the energy consumed in what is known as the squirrel-cage armature of alternating-current motors invented by Dobrowolsky and consisting of an iron cylinder with copper wires running through it near the periphery, all being connected together at their ends by copper rings. Such armatures are used with non-synchronous rotary field motors or non-synchronous single-phase motors which depend on a revolving field. In these the loss of energy in the armature winding not only affects the efficiency but is a very important quantity in the operation of the motor, as it determines the drop in speed for increasing loads; this diminution in speed is to the speed at no load as the amount of energy lost in the armature is to the total energy; the calculation of these losses is therefore of importance, as is also the distribution of the currents in that armature. He shows how to calculate the distribution of the current and the energy losses for the forms of armature occurring in practice. What occurs in such armatures is very complicated, but the theory in general is simple if it is assumed first that the resistance of the connecting rings and then that the resistance of the rods may be neglected. The description of the method does not admit of being abstracted, but some of the results may be of interest. He shows that if the resistance of the rings is zero a current will flow in each rod, independent of their number, the number of poles and the shape of the field—which is equal to that which would flow in that rod if its ends were connected with zero resistance. If the resistance of the rings is only a hundredth part of the resistance of the rods, the mean value of the current will be reduced to more than half; the torque will be reduced in the same proportion, as this depends on the product of the current and the field strength; for the same torque one armature would therefore have to have double the slippage of another similar one. With a large number of poles the armature current is only diminished to a slight degree. Not only the resistance of the rings but also the intermingling of the different currents depending on that current and the number of poles will diminish the total current. In general it may be said that this diminution will become less, the less the resistance of these rings or the greater the relation of the number of poles to the number of rods, for the same resistance of the rings. A table gives the distribution of the current in an armature of a certain kind.

INDUCTION MOTORS OF VARIABLE SPEEDS. Niethammer. "Elek. Zeit.," Nov. 10.—Multipolar non-synchronous motors for alternating currents sometimes show the property of running at a speed of one-half, one-third, one-fifth, etc., of their normal speed, and tend to maintain that speed. In the present article he explains the cause of this phenomenon as based on the magnetic relations and the arrangement of the windings. He shows that the rotating field is of the nature of the sum of several rotating fields of different periods. In conclusion he states that for rotary field motors, switching devices for the windings can be constructed on the principles which he points out, which will enable the motor to be run at quite different speeds; one switch in general will give two different speeds. For simple alternating-current motors in which the regulation would be in the armature winding, the switching arrangements would be somewhat complicated.

TESTING TRANSFORMERS.—"Elec. Eng.," Nov. 24.—A reprint of some illustrated instructions issued by a manufacturing company showing simple methods for testing and caring for transformers.

Lights and Lighting.

REGULATING ARC LAMPS.—"Elek. Rundschau," 15, p. 107; abstracted briefly in "Science Abstracts," Oct.—A description of a new method of regulating lamps in groups of three or more in series. Immediately behind a resistance, "arranged in series with and at the supply end of the mains supplying the group," is put a relay coil in parallel with the mains; this relay opens and closes a circuit containing a series of shunt coils acting in conjunction with the feed mechanism of each of the upper carbon holders; this feed mechanism in each lamp is also controlled by an independent coil arranged in parallel with the arc; when the catch controlled by the relay and the shunt coil, and that controlled by the independent coil, are both out of engagement, the lamp will feed, but not otherwise. The feeding of each of the lower carbons is similarly controlled by two catches, one actuated by coil in series with the arcs and the other in series with the independent shunt coils controlling the upper carbon of each lamp. A diagram of the connections is reproduced in the abstract.

INCANDESCENT SAFETY LAMPS. Courriot and Meunier. "Comptes Rendus," Oct. 17; abstracted in "L'Eclairage Elec.," Nov. 12, and more briefly in Lond. "Elec.," Nov. 11.—They show that an incandescent filament is incapable of producing a gas explosion; they filled an incandescent lamp with that mixture of marsh gas and air which has the greatest explosive power; the current was switched on and the bulb then filled with the explosive mixture; the glow then diminished rapidly except at one point, where the filament eventually broke; no explosive effect was produced. The explanation of this behavior appears to be that the gas is gradually burnt up without explosion, and when the spark occurs at the rupture there is no longer an explosive mixture in the bulb. To obtain an explosion it is necessary to break the filament and produce a spark by shaking the broken ends until they collide.

SWITCHES FOR SIGN LAMPS.—"Elek. Zeit.," Nov. 10, and "Elek. Anz.," Nov. 10.—A brief, illustrated description of the automatic switch for lighting and extinguishing lamps used for making up the letters of a sign or advertisement. The switches are operated by an eight-hour clock.

NERNST LAMP.—"Science," Nov. 18, reprinted in the "Elec. Rev.," Nov. 23.—A short article by Smith, from a recent description in a German daily paper; it is accompanied by two illustrations showing suggestions for heating the incandescent rod. The material he uses is magnesium oxide, which does not become a conductor until it is heated, after which it becomes "a perfect conductor" and emits a brilliant white light while the current passes. The preliminary heating may be made by placing it in the focus of a reflector on the inside of which is a spiral wire of platinum, which is brought to incandescence by the current. Another illustration shows a device, which has already been described, in which the body is heated electrically by radiation from a coil, from which it is afterward withdrawn magnetically. The same journal contains a short communication from Heidelberg (Germany) by Cooper, in which he states that Nernst has been developing and perfecting his inventions, and that "his researches have been crowned with such success that we may look forward to the early appearance of the finished lamp, and perhaps the confirmation of the most sensational rumors." He states that if the material is heated above 3000° C., or 6000° Fahr., which is far above the melting point of platinum, a very weak current is sufficient to keep them in an intensely luminous condition; either direct or alternating currents may be used, and the magnesia is little injured by use; the only difficulty lies in the method of heating the substance to make it a conductor. He adds that "the work is, however, progressing, and those who know the ability and courage of the inventor are confident that he will succeed."

ARC LAMP. Ross. "Can. Elec. News," Nov.; reprinted in "El'ty," Nov. 23.—An article reviewing recent improvements, with special reference to the enclosed arc lamp. For interior illumination, and in many cases for outside lighting, he claims that this lamp has decidedly the advantage, which has been recognized in the larger cities of the United States. A table gives the efficiencies of different arc-light systems.

Power.

SHAFTING V. DIRECT DRIVING.—Lond. "Elec.," Nov. 11.—An editorial discussion, with special reference to the recent paper of Langdon. When a number of shafts have to be driven there can be no question of the advisability of using electricity from a single centre in place of long lines of shafting or a number of separate engines and boilers. It discusses chiefly the merits of the two methods of distributing the power in the shaft itself. Langdon showed that 72 per cent. of the energy supplied to the main shafting was lost in transmission and that such a case was a frequent occurrence. The loss of energy, however, should be compared with the cost involved in direct driving by motors; such a comparison is made and the figures are given, showing that in spite of the low efficiency of the shafting in that particular case there is still a saving in cost. It is therefore said that in shops in which machines are all small it is advisable to use larger motors driving shafting; a point is reached, however, as the power becomes greater when it is more economical to use a single motor driving a group of tools through a single short line of shafting; it is thought that about 5 horse-power is a suitable unit. In a large shop with heavy tools it is undoubtedly more economical to do away with the shafting altogether. The well-known advantages of the electric method are then enumerated. It is concluded that tools should be grouped into units when small, and separately driven when large, although this should not be applied too rigidly. Some small tools are sometimes advantageously driven by their own motor. The rage for very small motors is a mistake.

PRINTING PLANT.—"Elec. Eng.," Nov. 24.—An abstract of a discussion of Damon's paper (see ELEC. WORLD, Nov. 12). Cutter referred to the control of printing press motors; in such plants there is a considerable difference of opinion as to the desirability of using two circuits of different voltages for obtaining a wide variation in the speed; with one voltage it is necessary to use armature resistance to get a speed variation over the 25 per cent. which varying the field will give; but this resistance in the armature circuit is fatal to good regulation with varying loads. He mentions the importance of providing for the discharge of the field circuit of a shunt motor when it is opened. Damon described a lock device used to keep the pressmen from running the presses at less than the proper speed; a device is put on the controllers whereby they will not lock at anything less than the full speed for which they are set, while the controller may be used for starting and stopping, during which operation, however, the controller handle will have to be held. Roe expressed the opinion that a great number of speeds is not called for by practical printers, but in this printers seem to differ.

SHOREDITCH DUST DESTRUCTOR.—Lond. "Elec. Rev.," Nov. 11.—Some editorial remarks in which attention is called to several points and some estimates are made. It is concluded that there must be defects in the design and construction of the steam-raising plant. The value of combined plants is already being quietly demonstrated elsewhere, while the Shoreditch results are being given undue and premature prominence.

MUNICIPAL ELECTRICAL SUPPLY. Gibbings. Lond. "Elec.," Nov. 11.—The continuation of his long serial. He enumerates the chief advantages of the electric motor and considers briefly the cost of working as compared with gas, oil and steam, giving figures. He also gives a table of a sliding scale of charges for electric power, based on six months' use.

LOSS IN TRANSMISSION LINES.—Lond. "Elec. Eng.," Nov. 11.—Several answers to the question what considerations should determine the permissible loss in the line wires of a transmission plant.

POWER FOR ELECTRIC CURRENT IN PRUSSIA.—"Zeit f. Beleucht.," Nov. 10.—A table giving the amount of power used for generating electricity in Prussia for each year from 1891 to '98.

ELECTRICITY IN AGRICULTURE.—Lond. "Elec. Rev.," Nov. 11; reprinted in "El'ty" (N. Y.), Nov. 23.—An abstract of the article noticed in the "Digest" Nov. 12.

GROWTH OF ELECTRIC POWER TRANSMISSION.—"Elec. Eng.," Nov. 24.—Some curves and data given by the General Electric Company showing the growth of power transmission [illegible] company are concerned.

[illegible] "Engineer," Nov. [illegible] Club of Cleveland. [illegible]

[illegible] tions.

Traction.

[illegible]

AUTOMOBILE MOTORS.—Lond. "Elec. Rev.," Nov. 11.—A brief, illustrated description of a motor to be used with direct chain gearing from both ends of the spindle Lightness in weight, great starting power, high efficiency and small space are the chief features claimed.

MULTIPLE-UNIT TRACTION SYSTEM. Cravath. "Elec. Eng.," Nov. 17.—A short reply to the recent article of Shepard (see "Digest" Nov 19). He disclaims having made any attack on the Sprague system; this system, he says, stands without a practical competitor for elevated roads on which a schedule of 15 miles per hour and over is to be obtained with trains of over four cars and stations about 2000 feet apart; he does not question the wisdom of its adoption on that Chicago road. For trains of four cars and less and for schedules of 17 miles per hour and under, that system and the locomotive systems come into competition in elevated service. In his previous statement about the lower efficiency of small motors in that system he referred to the time after acceleration when they are working on the friction load only, as distinguished from the acceleration. The acceleration should be as rapid as the traction on the drivers will permit and motors able to do this are very inefficient on the subsequent light load when the train is in motion. The energy to accelerate in the multiple-unit system will be less than that required by a locomotive to accelerate more slowly to a higher speed necessary for the steam schedule; but it is possible that this difference may be more than compensated for by keeping the current on in the multiple system, after the train is up to speed, thereby resulting in a greater waste than with a locomotive. The comparative efficiency of the two systems in watt hours per car mile depends much on the motorman; drifting is more essential to success on that system than with the locomotive. Some errors in his and in Shepard's remarks are pointed out. He cannot see why the cost of the installation of the power plant is less for rapid acceleration than for lower acceleration; while the watt hours used in acceleration are less with the multiple-unit system than with the locomotive for a given schedule, the maximum current is more by a large amount; several maximums may come at the same instant, resulting in high peaks. The extra investment in apparatus might, however, be compensated for by the watt-hour consumption.

ACCUMULATOR TRACTION. Krueger. "St. Ry. Rev.," Nov. 15.—A long abstract of his paper read at the Geneva meeting of the Tramway Union, and noticed in the "Digest" some time ago. He gives some data obtained from experience on the Hanover line, where the mixed trolley and accumulator system is used. Among other figures he states that the grid of a battery plate is made to last through six repastings, or about 150,000 miles; the cost of filling the negative plates with new paste is $18.20 per car, and the positives $169.55. During a period of two years, in spite of unfavorable relations, the cost of maintenance and renewals of the batteries has been only 0.81 cent per car mile. The average lives of the batteries in thirty-seven cars was 23,417 miles, that of the positive plates being 24,528 and that of the negatives 23,321 miles.

CHICAGO.—"West. Elec.," Nov. 19.—A short article on some innovations on the trolley lines in that city. One of them has a vestibule train consisting of a smoking car, with motors, and a regular coach as a trailer, with only one conductor. On one system only wooden trucks are used. A different form of ventilating the car is also mentioned.

SURFACE CONTACT SYSTEM. Johnson. "Elec. Eng.," Nov. 24.—The beginning of a reprint of a recent paper in which, after a brief introduction describing several systems, he describes the Johnson-Lundell system. It is a surface-contact system in which the contacts are made alive by the car passing over them.

CONDUIT SYSTEMS. Hedenberg. "El'ty," Nov. 23.—An illustrated article, being a brief, historical description of the development of conduit systems for railways.

ELECTROLYSIS OF WATER PIPES. Brown. "St. Ry. Rev.," Nov. 15.—A reprint of the whole of his paper, an abstract of which was noticed in the "Digest" Nov. 19 and Oct. 22.

RAILWAY RETURN CURRENTS. Fleming. "St. Ry. Rev.," Nov. 15.—A reprint of a large portion of his Brit. Assn. paper, which was noticed in the "Digest" Oct. 15.

MEASURING THE RESISTANCE OF STEEL RAILS.—"St. Ry. Rev.," Nov. 15.—A reprint of the short, illustrated article [illegible] how the resistances of rails is [illegible] in England.

NEW ZEALAND. Cicott. "St. Ry. Rev.," Nov. 15.—A short [illegible] to the possibilities of electric traction in that country.

Installations, Systems and Appliances.

BREAKDOWN AT BRIGHTON. Dallas. Lond. "Elec.," Nov. [illegible] (see "Digest" last week), [illegible] the minimum cut outs [illegible] installation in the United [illegible] on three-wire mains, each being [illegible] all four were nearly loaded when [illegible] to a fault on one of the machines [illegible] of that same pole, thus short circuit[illegible] The other machine on the same side was then overloaded, running the faulty dynamo as a motor, the two being on the same side, the field of the dynamo then dropped owing to the engine slowing down, and its minimum cut-out [illegible] cutting out all the lights on that side. After that the machines were separately excited. An entirely different type of minimum cut-out was afterward used with great success.

The Brighton breakdown is also discussed in the Lond. "Elec. Rev." It is thought improbable that the cut-out of the injured machine should have operated until the speed of the machines had been reduced on all the others sufficient to cut them out, but supposing this to be the case, as was suggested, the substitution of return cut-outs would not improve matters, as they would be equally liable to stick. Another possible solution is that the short circuit caused a sudden rise in the current in all of the cut-outs, which induced a momentary current in the solid iron core in the opposite direction, thus partially or wholly depolarizing it for an instant, and they would then operate; this could be avoided by using a laminated core.

VIENNA. Neubeck. "Zeit. fuer Elek.," Nov. 6.—An illustrated description of the plant for the tramway company in Vienna; it is for supplying light and power, but does not seem to include power for traction purposes. One of the illustrations is a good diagrammatic representation of the somewhat unusual system of circuits. The primary system of distribution of the current is according to the three-wire system with a bare neutral wire, and the generators therefore consist of two direct-current, fourteen-pole dynamos of 650 volts in series, each pair being driven by one engine. In the two outer wires there are also two equalizing accumulators of 1110 ampere hours each, of eighty cells, in series; the regulation of these is automatic; from these the current is divided into six pairs of feeders, going to six sub-stations, each of which has two batteries of accumulators and a rotary transformer for charging them; from each of these sub-stations the distribution is by means of the five-wire system, with a voltage of 240 between each two wires. The transformer consists of a four-pole dynamo operated with a 480-volt current, and coupled to a four-pole dynamo, which delivers current of 480 volts in two circuits; the neutral wire of this system is also uninsulated; the incandescent lamps are operated at 240 volts. There are also arc lamps and a number of motors for power purposes. (The description of this somewhat odd system is not very clear.)

FOLKESTONE.—Lond. "Elec.," "Elec. Rev." and "Elec. Eng.," Nov. 11.—An illustrated description of the lighting plant. The continuous-current three-wire system is used, with 420 to 460 volts on the outers, the dynamos being connected only to the outer wires; besides these there are a booster, a battery of accumulators and a balancer.

NURNBERG. Scholtes. "Elek. Zeit.," Nov. 10.—The conclusion of the very long. detailed description of this plant, noticed last week. A number of tables showing the operation and costs are given.

RUNNING COSTS OF PRIVATE PLANT.—Lond. "Elec. Rev.," Nov. 11.—Details of the running costs of a private plant at the Blackpool winter gardens.

HAMILTON MUNICIPAL PLANT.—"Can. Elec. News," Nov.—A reprint of the report by Domville to the City Councils of Hamilton, Ont., on the cost of installing and operating a municipal lighting plant.

HAMBURG.—"Zeit. f. Beleucht.," Nov. 10.—A long extract from the report on the operation of this station during the past year.

CHICAGO.—"Elec. Eng.," Nov. 24.—A brief description of some new work in the Harrison Street station.

ECONOMIES IN SMALL LIGHTING PLANTS. Roberts. "West. Elec.," Nov. 19.—A reprint of a long paper read before the Ohio Elec. Assn., in which he shows how to operate most economically stations which are in existence, as distinguished from the question of how to design them. It is followed by the discussion.

WORKSHOP HINTS. Fells. "West. Elec.," Nov. 19.—Brief descriptions, with illustrations, giving practical hints for repair shops.

Wires, Wiring and Conduits.

HIGH-TENSION LINE. Semenza. "Elettricita," 17, p. 166; abstracted briefly in "Science Abstracts," Oct.—A brief description of the Paderno line. There are two sets of three-phase lines; by putting all the load on one set, repairs can be made on the other, as the generators are capable of giving a higher voltage to compensate for the greater drop. There are two separate pole lines, and the wires on each one "are divided into three lines, so as to diminish the self-induction;" the existence of three lines, however, tends to produce idle currents in wires of the same phase, if any dissymmetry exists in the relative positions of the wires; the most symmetrical disposition was found to be the following: "The wires are fixed, four on one side and five on the other side of the pole, at such distances that any three consecutive wires are at the vertices of an equilateral triangle, the phases being in the order 1, 2, 3, 1, 2, 3, 1, 2, 3, alternately on each side of the pole."

MOISTURE ON HIGH-TENSION INSULATORS. Stuart-Smith. "Jour. of El'ty," Sept.—A short article in which he shows that the tendency of an electric charge is to prevent the accumulation of moisture on the surface of a charged body; the presence of the charge and the tendency to increase the surface result in a repulsive force between the water molecules, and if the voltage is sufficiently high they will fly off; this action will continue until every vestige of moisture disappears. When the voltage is sufficiently high, as is the case in modern transmission lines, any further accumulation will be impossible, since the water will be dissipated as fast as it is condensed; this action will increase with increasing voltage, and the hygroscopic quality of the surface will be practically nullified when the voltage is a little greater than that necessary to produce a rapidity of dissipation equal to the rapidity of condensation. With the voltages used on transmission lines it is probable that no surface will condense moisture as fast as the force of repulsion can dissipate it even in a fog. The character of the surface is therefore practically immaterial, and glass is at no disadvantage on account of its property of condensing moisture; its hydroscopic power may be ignored when very high voltages are used. This is commented on editorially in the issue of Oct., under the heading of "The Burial of a Bugaboo." His explanation is said also to give a plausible reason why it was found very difficult, and sometimes impossible, to start the Provo-Mercur 40,000-volt transmission plant during rainy weather, although when once started the heaviest rains do not affect the operation of the line. The problem which remains to be solved is a means for cleaning insulators of the dust that cakes on the windy side. Insulators on long telegraph lines are cleaned periodically to prevent leakage; in some cases it is even necessary to take down the insulators and clean them as often as three or four times a year; if this is necessary for telegraph lines the same procedure may be found a remedy for some of the difficulties in extremely high-voltage transmission.

CABLE CONDUIT.—"Elec. Eng.," Nov. 17, and "West. Elec.," Nov. 19.—A brief, illustrated description of a new section of conduit which has just been laid in the Niagara Falls power house. It is built of vitrified tile, is 1230 feet long, embedded in cement.

Electro-Physics and Magnetism.

DURATION OF ROENTGEN-RAY EMISSION. Morize. "Comptes Rendus," Oct. 17; "L'Eclairage Elec.," Nov. 5; abstracted in Lond. "Elec.," Nov. 4.—He devised and carried out a method of determining the duration, and believes it to be capable of great accuracy. He fixed the photographic plate at the end of the shaft of a high-speed motor and photographed a slit when the motor was at rest and when it was moving, and found the images drawn out sideways. The results show that each current impulse in the primary of an induction coil corresponds with several successive impulses of the rays; successive images of decreasing intensity are produced, separated by uniform intervals; on some plates four images can be traced. The durations ranged from 65 to 107 millionths of a second, the mean being 82; the intervals were 0.00033 second on an average.

DIFFERENCE BETWEEN ROENTGEN AND CATHODE RAYS. Geitler. "Wied. Ann.," No. 9; abstracted briefly in Lond. "Elec.," Nov. 4.—He endeavors to bring out clearly the essential difference between them by a study of their electrification or ionization properties. Roentgen rays are absolutely incapable of conveying a charge, although they can equalize opposite charges by rendering the air between them conducting. His arguments are in favor of regarding Roentgen rays as essentially different from cathode rays. This is also the view taken in the new theories of Roentgen rays and the English wave theory, in which cathode particles, when stopped, generate single-wave impulses; also the Dutch corpuscular theory, which regards Roentgen rays as discharged cathode particles.

X-RAYS IN WAR.—Lond. "Elec. Eng.," and "Elec. Rev.," Nov. 4.—A brief. illustrated description of a demonstration of Roentgen-ray field practice in the British Army.

POTENTIAL GRADIENTS IN VACUUM TUBES. Wiedemann and Schmidt. "Wied. Ann.," No. 10; abstracted briefly in Lond. "Elec.," Nov. 11.—A lengthy investigation of potential gradients as affected by the source of current, by heat, magnetism, light and photo-luminescence of the gas itself. The results were practically the same whether an influence machine or a battery of accumulators was used as the source; the luminous appearances are characteristic of the discharge potential; the heating effects in the glowlight are quite out of proportion to the potential gradient there; in the positive light the whole of the energy given out by the discharge is converted into heat.

DEFLECTION OF DISCHARGES BY MAGNETIC FORCES. Henry. "Phil. Mag.," Nov.—A long paper giving the results of experiments undertaken to find the explanation of the change produced in the magnetic deflection of the electric discharge in rarefied gas, when the gas is changed.

ELECTRIC WAVES. Lord Kelvin. "Phil. Mag.," Nov.—A short paper giving the substance of his recent Brit. Assn. paper. The subject is "Continuity in Undulatory Theory of Condensational-Rarefactional Waves in Gases, Liquids and Solids, of Distortional Waves in Solids, of Electric Waves in All Substances Capable of Transmitting Them, and of Radiant Heat, Visible Light, Ultra-Violet Light."

The Lond. "Elec.," Nov. 11, gives a brief abstract of this paper. It states that this throws a flood of light on the connections which exist between all types of wave motion, from those of sound to Hertzian and light waves, and to luminous and ultra-violet waves. The imaginary apparatus is briefly described in the abstract, and it is shown how first a low sound will be produced, then a shriek, then light, and so on.

POLARIZED ELECTRO-MAGNETIC WAVES. Waitz. "Wied. Ann.," No. 10; noticed briefly in Lond. "Elec.," Nov. 11.—He describes his researches with the polarization of electric waves by a metallic slit. He found the energy transmitted by the slit undergoes a periodic increase and diminution as the length of the slit is enlarged. The minima are very pronounced and closely approach zero; the maximum occurs when the wave at the slit "has the same length as the resonator and electrometer combined." The first minimum occurs at a length of slit double that of the first maximum.

COHERERS. Aschkinass. "Wied. Ann.," No. 10; abstracted in Lond. "Elec.," Nov. 4.—The results of investigations made to assist in finding the nature of coherer actions; he criticises the views held by Lodge.

TEMPERATURE COEFFICIENTS OF DIELECTRIC CONSTANTS. Pellat and Sacerdote. "Comptes Rendus," Oct. 17; "L'Eclairage Elec.," Nov. 5; abstracted briefly in Lond. "Elec.," Nov. 11.—They determined the dielectric constants of paraffin and ebonite at various temperatures. They show that in charging a condenser at constant temperature the charge as usually calculated must be multiplied by a factor depending upon the temperature.

ALTERNATING CURRENTS IN BRANCHED CIRCUITS. Lyle. Lond. "Elec.," Nov. 11.—The continuation of his mathematical article on currents in branched and in mutually inductive circuits produced by harmonically varying e. m. fs. (see "Digest," Nov. 5). In the present portion he gives some examples of the application to the transformer of the principles which he described in the previous portion.

APPLICATION OF IMAGINARY QUANTITIES. Guilbert. "L'Eclairage Elec.," Oct. 29.—A long, mathematical article on the application of imaginary quantities of the problem of a uniformly distributed capacity.

CAPACITY OF POLARIZATION. Grimaldi and Platania. "L'Eclairage Elec.," Oct. 29; abstracted at some length from an Italian journal.—They measured the capacity of polarization of very thin metallic membranes, corresponding to very short, known periods of time.

RESISTANCE AND LONGITUDINAL STRAIN. Cantone. "L'Eclairage Elec.," Oct. 29; abstracted from "Accad. Lincei.," 6, p. 175.—He describes experiments with silver and nickel and obtains proportionality between the forces and the elongation in the variations of the electrical resistance; beyond a certain limit, however, it is no longer true; the ratio of the increment of resistance to the total resistance, divided by the ratio of the increment in length to the total length, is nearly a constant.

CONDUCTORS IN ELECTROLYTES. Stark. "Wied. Ann.," No. 10; abstracted briefly, with a diagram, in the Lond. "Elec.," Nov. 11.—He shows a method of representing the occurrences at the surface of a metallic plate immersed in an electrolyte through which an electric current is passed; the curves show the distribution of the current.

THEORY OF HALL EFFECT IN A BINARY ELECTROLYTE. Donnan. "Phil. Mag.," Nov.—A reprint of a Physical Society paper. He calculates what effect might be expected theoretically.

ELECTRICAL SOLAR HYPOTHESIS. Delta. Lond. "Elec. Rev.," Nov. 4.—Reproductions of the results of some magnetic observations which tend to substantiate his electrical hypothesis of the solar system.

ENERGY OF A MAGNETIC FIELD. Pellat. "L'Eclairage Elec.," Oct. 29.—An Academy paper deducing some formulas based on the quantity of heat absorbed or given out in order to maintain the temperature constant during the charge.

INTERNATIONAL MAGNETIC CONFERENCE.—Lond. "Elec., Nov. 4.—A reprint of the report of the Committee on Terrestrial Magnetism and Atmospheric Electricity, appointed in 1896. It refers entirely to terrestrial magnetism, and makes a number of recommendations regarding such observations. It refers briefly to the disturbance caused by electric railways, and recommends that special precautions should be taken to protect the observatories from the effects of railway currents.

POWER TRANSMISSION THROUGH AIR. Trowbridge. "Elec. Rev.," Nov. 23.—A reprint of the article noticed in the "Digest," [illegible]

INDUCTION COIL CONDENSERS. Dell. "Elec. Rev.," [illegible] which are a continu[illegible] He used an adjustable con[illegible] [illegible] capacity of the con[illegible]

Electro-Chemistry and Batteries.

[illegible] in which, however, [illegible]

other surfaces deviate from this, the better the accumulator. Similar surfaces representing the data obtained with the separate electrodes (with the aid of the cadmium electrode) are said to be even more interesting, and several are given; these are reduced to what they call the unit electrode. The results obtained from these three accumulators are then discussed. Some similar charging curves are also given, and are said to be of greater interest than the discharging curves. One of these shows that in all three systems the spongy lead electrode charges better than the peroxide electrode; the negatives also act better at the discharge.

RULES FOR ACCUMULATOR FACTORIES.—"Zeit. f. Elektrochemie," Oct. 30.—A reprint of the rules adopted by the German Government concerning precautions which should be taken in accumulator factories to protect the workmen against lead poisoning.

ELECTROLYTIC PRODUCTION OF IODOFORM.—"Elek. Anz.," Oct. 9.—Descriptions of several processes with which good results have been obtained.

ZINC ANALYSES. Paweck. "Zeit. f. Elektrochemie," Nov. 3. —A short article describing experiments made to find a reliable electrolytic method for a quantitative analysis of zinc. In one of these he used as a cathode an amalgamated zinc or copper plate, as an anode a perforated platinum electrode, the electrolyte being an acid solution of zinc. He also experimented with a cathode made of wire gauze amalgamated electrolytically. The results obtained seem to agree very well with the calculated value, and the zinc deposited was said to be very good. In the second method he used an unamalgamated brass wire netting for the cathode, the solution being slightly acid and containing potassium or sodium sulphate.

ELECTROLYTIC ANALYSES. Smith and Wallace. "Elektrochem. Zeit.," Nov. 1.—A brief description of a method for uranium and another for cadmium.

TIN. Cowper-Coles. "Elektrochem. Zeit.," Nov. 1.—A short article describing briefly electrolytic methods for purifying tin and obtaining it from its ores.

ELECTROMETALLURGICAL LABORATORY. Borchers. "Zeit. f. Elektrochemie," Nov. 3.—A short article describing recent additions to the laboratory at the high school at Aix-la-Chapelle, of which he has recently taken charge. It refers more particularly to the installation for experimenting with the electric furnace.

ELECTRO-CHEMICAL SOCIETY. Muller. "L'Eclairage Elec.," Nov. 5.—A continuation of the report of the papers read at the recent meeting of the German society.

WATER PURIFICATION.—"Elec. Eng.," Nov. 17.—A reprint of a short discussion in the "Eng. News." It is concluded that the direct treatment of water by the electrical current is of little value, but it is hoped that a coagulant might be produced electrolytically in preference to the chemical methods. The recent experiments in Louisville, Ky., showed that the cost of the electrolytic production of aluminum hydrate was not only excessive, but that the method was unreliable; but an iron hydrate could be produced much more advantageously and will be cheaper than commercial sulphate of alumina, but it could not safely be used at Louisville. Iron and aluminum are said to be the only metals available for electrolytic production of coagulants.

Units, Measurements and Instruments.

PHASE METER.—"L'Elec.," Oct. 29.—An illustrated description of the Dobrowolsky phase meter, a description of which was noticed several years ago. It consists of a coarse wire and a fine wire coil perpendicular to each other like in an electro-dynamometer, except that both coils are stationary, but in place of the needle there is a large disc of iron with a pointer, kept in position by a spring but capable of a slight rotation around its axis. The main current and the shunt current, if not in phase, produce a revolving field which causes the disc to tend to rotate; the amount of rotation, indicated by a pointer, is proportional to the value of the wattless component of the current; the graduation is empirical. The use of an iron disc makes the readings dependent on the frequency, and each instrument can therefore be used only for the frequency for which it has been calibrated; this would be overcome by the use of a copper disc, but the coils will then have to be much larger.

DETERMINING THERMAL AND ELECTRIC CONDUCTIVITIES. Straneo. "Accad. Lincei. Atti," 7, p. 197; noticed briefly in "Science Abstracts," Sept.—A mathematical paper showing how with simultaneous observations the thermal and electric conductivities of wires at high temperatures may be ascertained.

MAGNETIC UNITS AND MEASUREMENTS. Schmidt. "Zeit. f. Elektrochemie," Nov. [illegible]—The beginning of a short article [illegible] explaining magnetic [illegible] the latter are measured, also [illegible] in so far as they [illegible]

HOW ACCUMULATORS SHOULD BE TESTED.—Lond. "Elec. Eng.," Nov. 11.—A reply to this question referring to wheth[illegible] should be used. The dif[illegible] that the best method to [illegible] to be used for charging [illegible]

Miscellaneous.

PRESIDENTIAL ADDRESS. Preece. Lond. "Elec.," "Elec. Eng." and "Elec. Rev.," Nov. 11.—The conclusion of his presidential address (see "Digest" last week). In discussing lighthouses he states that the introduction of electricity in English lighthouses has not been such an unqualified success; no new electric light has been installed on the coast of Great Britain since 1888, and there are only four such lighthouses on that coast; this is due chiefly to the great first cost and cost of maintenance; moreover the sailor cannot judge distances by it, as it is too brilliant in clear weather, while in bad weather it penetrates no better than an oil lamp. The subject of traction is then considered. Hamburg, he thinks, is one of the best trammed cities on the continent; the electric street railways are constructed by private enterprise under a lease, the municipality supplying the electric energy at a fair price. The trolley and conduit systems are briefly compared, the former being favored. The seriousness of the corrosion of pipes is mentioned, but he states that the remedies are simple, easily obtainable, and very effective. Electric traction, he thinks, must sooner or later be considered for the suburban traffic now carried by steam railroads. The transmission of power is briefly discussed, and a table gives the records of some interesting installations. The Lond. "Elec. Rev.," in a short article, takes exception to some of his remarks.

DEVELOPMENT OF ELECTRICAL ENGINEERING. Raworth. Lond. "Elec. Eng.," Nov. 4.—A long abstract of his presidential address before the Northern Society of Electrical Engineers. He points out the rapid development, including the whole range of all electrical practice, but it is chiefly of local interest, as it refers to progress in that country. It contains some statistics and data.

ELECTRICITY IN SWITZERLAND.—"Bul. Soc. Int. des Elec," Aug.-Oct.—Long, illustrated extracts from a report of an excursion to Switzerland made by some students in April. The extracts include a chapter on the regulation of turbines in which a number of forms are illustrated and described; a chapter on the different methods of distribution in general in which a brief reference is made to the continuous-current system, which is always at constant current, the generators being all in series and the motors being provided with special regulators; the system is of use exclusively where the source is a water-power of high falls, on account of the high speeds required. The distribution with diphase alternating current is discussed and a number of applications described; similarly for the three-phase current. There is a short chapter on electric traction and one on switchboards and accessory apparatus; another describes the visits to the Brown and the Oerlikon works; the last is on electro-chemistry.

ELECTRIFICATION IN PAPER MANUFACTURING.—"Elec. Tech.," Oct. 15.—A note stating that none of the usual methods for discharging paper which has been electrified during its process of manufacture have proved satisfactory, the reason being that the paper is not only electrified on the surface but throughout its mass, and that therefore after the surface has been discharged it will again be charged from the interior portions. The desired result has now been accomplished by providing large discharging spaces in which the surface of the paper is subjected to the action of a large number of discharging points, which, owing to their large number, discharge the paper during a longer period.

EFFECT OF ELECTRICITY ON PLANTS. Lemstroem. Lond. "Elec. Rev.," Nov. 4.—The beginning of a reprint in full of his recent Brit. Assn. paper, abstracts of which have already been noticed.

INSULATING MATERIAL. Andreoli. "L'Elec.," Oct. 29.—A short note calling attention to the fact that in England use is made of fish oil for insulating materials, a fibrous material being impregnated with heavy fish oil; this material is superior to vulcanized fibre and can replace ebonite. He has recently ozonized this oil, which thickened it rapidly; he thinks there is a great field for oil thus treated.

TURIN.—Lond. "Elec.," Nov. 4.—The continuation of the description of electrical exhibits, including illustrations of two alternators, an enclosed motor and an oscillometer, all made by Italian companies.

PARIS EXPOSITION.—"Elek. Zeit.," Nov. 10.—An editorial giving some information about this exhibition. The amount of power used will be about 20,000 horse-power, three-quarters of which will be used for electric lighting and one-quarter for power purposes. This is to be generated in only two boiler houses, one of which is to contain French and the other foreign boilers. All the power to be used is to be transmitted electrically; in each power house both the continuous current and single and multiphase alternating currents will be generated. The voltages of continuous-current dynamos are to be only 125, 250 or 500, and of alternators 2200 at a frequency of 50. The distribution of the currents will be in charge of the exhibition authorities; what machines are to be used has, it appears, been decided, but not published. Some further details are given, including the cost of power and the charging for coal.

VIENNA EXHIBITION.—"Zeit. f. Elektrochemie," Oct. 30.—The continuation of the illustrated description of the electrical exhibits.

BIOGRAPHICAL.—Lond. "Elec.," Nov. 4.—A biography, with portrait, of Latimer Clark, the inventor of the Clark standard cell, who died Oct. 30. The Lond. "Elec. Rev." and "Elec. Eng." also contain biographical notices. See also ELECTRICAL WORLD last week, p. 546. The "Elek. Anz.," Oct. 30, publishes a short biography, with portrait, of the late W. E. Fein, one of the pioneer electrical manufacturers in Germany.

HIGH-FREQUENCY CURRENTS IN THERAPEUTICS. Tesla. "Elec. Eng.," Nov. 17.—A reprint of a paper read before the Amer. Elec. Ther. Assn. in September.—While chiefly of interest to physicians, it contains some things of general interest, besides good diagrammatic illustrations of the various systems of producing high-frequency currents. One of the remarkable features of such currents is their apparent harmlessness, which makes it possible to pass large amounts of electrical energy through the body without pain or discomfort. The electrical actions may be divided into three classes, the statical or that depending chiefly on the magnitude of the potential; the dynamical, depending chiefly on the quality or quantity of the current, and thirdly, effects of a distinct nature due to electric waves. These three actions are generally coexistent, but one or the other may be made to predominate. Various methods of connecting the circuits are described with the aid of diagrams, and are briefly discussed. When one terminal of a high-frequency series is connected to ground, certain peculiarities will be noticed; it may be of some consequence which terminal is connected to the ground, as in high-frequency discharges the impulses in one direction are generally preponderating. One of the noteworthy features of these currents is the facility which they offer for conveying large amounts of energy to a body entirely insulated in space; currents strong enough to fuse may be passed through a wire entirely insulated at one end; this method affords great possibilities in the hands of the physician, and is discussed at some length; he does not think it impossible to convey to a human body or to give off in space, energy at the rate of several horse-power, while a small part of this amount applied to the human body in other ways could not fail to be injurious. He shows how by varying the period the points of highest potential of the secondary may be shifted along the terminal, and this point may therefore be brought to any part of the body or made to move through it; the body may by this method be subjected to several million volts without injury. With such high electrifications small particles adhering to the surface are torn off violently, and this is the case even with the toughest of the metals; he thinks this can be made use of by the physician as a substitute for a water bath. The inductive action of such high-frequency currents is discussed, both the electrostatic and the electrodynamic, and an illustration is given of an apparatus for producing these effects. He describes some experiments made to produce intense inductive action in a small space, and obtains some surprising results; when the end of a heavy bar of iron was placed within the loop it was raised to a high temperature in a few moments; a sheet of tin was fused instantly, the action being comparable to an explosion; the energy at that point may have been as much as 10 horse-power. He studied the effects of this action on living tissues and found that he could thrust his hand within the same loop and hold it there; he even held his head there, but there is danger in such an experiment; if a conducting path was so formed within the living tissue of the head it would be instantly destroyed, which would be accompanied by death; such a method of killing would be absolutely painless. The only explanation he can offer for the peculiar action is that the tissues are condensers. Pieces of metal embodied in living tissues could thus be heated, affording a possibility of sterilizing wounds or of locating bodies. Most of the results which he obtained are made possible only by the discharge of a condenser; to give an idea of such an effect he states that a condenser small enough to go into a vest-pocket may create pressures a hundred times greater than those produced by the largest static machine ever constructed; or used in a different way, currents may be obtained far superior to those in the largest welding machines; this is possible because the condenser can discharge in an inconceivably short time. In conclusion he describes a physician's instrument for generating and using such currents.

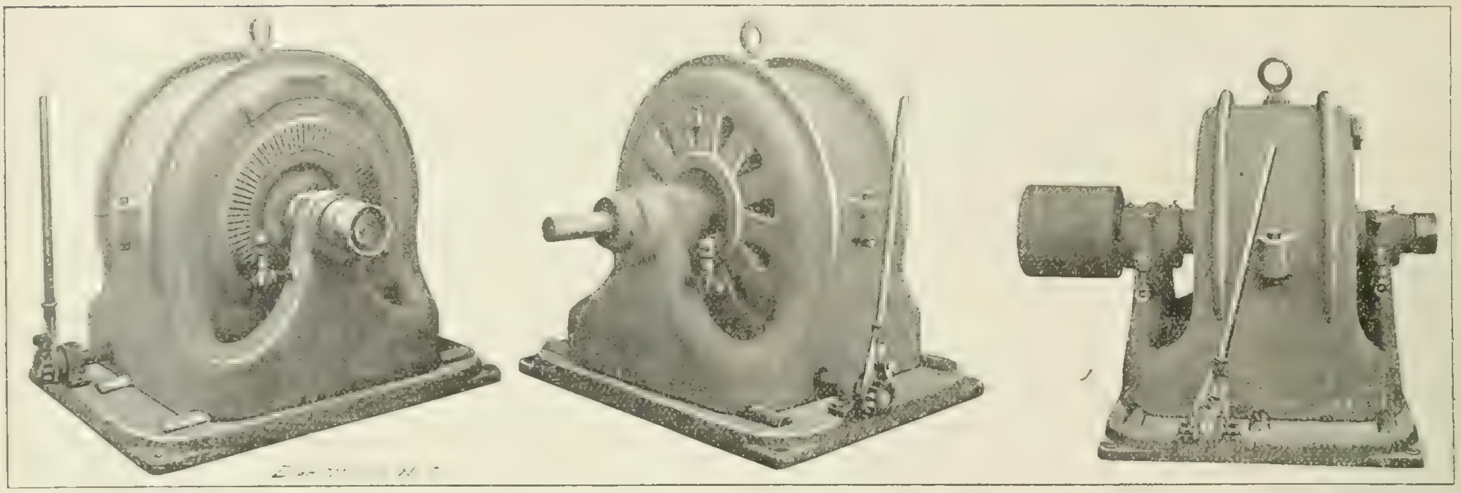
M'GILL UNIVERSITY.—"Can. Elec. News," Nov.—A short description of the new electrical equipment.

ELECTRICAL INVENTION. Rosenbaum. "Elec. Eng.," Nov. 17; "West. Elec.," Nov. 19, and at greater length in "Elec. Rev.," Nov. 23.—An abstract of a recent Franklin Institute paper on the status of electrical invention. Each of the main branches of the science of electricity is discussed and the inventions described which have been responsible for the development of the science. It will appear in full in the "Jour. Frank. Inst."

BIOGRAPHICAL. "West. Elec.," Nov. 12.—A long biography, with a portrait, of the late Charles H. Summers.

Telegraphy, Telephony and Signals.

PROTECTING TELEPHONE CIRCUITS FROM DANGEROUS CURRENTS.—"Elek. Zeit.," Nov. 3.—An editorial discussing the probable cause of the recent fire in the Zurich telephone central station. The switchboard was the 1893 model of the Western Electric Company; in this the subscriber's line is momentarily earthed in making the connections; a telephone line wire which broke fell across the trolley wire; it is calculated that a current of 25 amperes could then have passed at 500 volts, and this could maintain a continuous arc at the switchboard. This seems to have been the true cause; it might have been prevented by a fuse in the line circuit; another way of preventing it would be to introduce a resistance of 20 to 30 ohms in the earth connections. Another experience in Vienna is cited, and in this the current from the trolley



Figs. 1, 2, and 3.—General Elevation Views of Warren-Medbery Alternator.

wire crossing passed through one of the wires of a cable leading from the roof to the switchboard, starting a fire, due to a fault in the insulation. Such fuses should not only break the circuit, but should simultaneously earth either the outside or the inside circuit of the station, but even in this case the Vienna fire would not have been prevented. The fuses had best be placed in a chamber on the roof of the building where the wires enter, so that all the wires and cables in the building would be protected.

TELEPHONE CALL.—"Elek. Zeit.," Nov. 3.—An illustrated description of the method used in Paris noticed in the "Digest" Sept. 24. It is for the purpose of calling any one of a number of stations without disturbing the others.

TELEPHONE SWITCHBOARD. Dubreuil. "L'Elec.," Nov. 5.—A brief description, with some diagrammatic illustrations, of the new switchboard for 9000 subscribers which has just been installed at the station on Rue des Renaudes, Paris, the cost of which, including the erection, will probably exceed $200,000.

SUBMARINE CABLE VESSELS.—Lond. "Elec. Rev.," Nov. 4.—A complete list of those used in submarine cable work. There are forty-one vessels, with a gross tonnage of 64,615 and 8971 nominal horse-power.

SUBMARINE CABLE GRAPNELS. Bright. Lond. "Engineering," Nov. 4.—The beginning of an article in which he discusses and describes, with the aid of illustrations, the different forms of grapnels which have been used to a large extent in practice with complete success.

TELEPHONE SWITCHBOARD.—"Elec. Eng.," Nov. 24.—A brief description of a new switchboard which has been placed in the Harlem central station. This new board is said to be a great advance on the self-restoring drop system. The method used is known as the relay system, the incandescent lamp signals being operated by relays.

EVOLUTION OF THE TELEPHONE SIGNAL. Clausen. "West. Elec.," Nov. 19.—An article of a historical nature.

Warren-Medbery Inductor Alternators.

Among the foothills of the Adirondacks, less than 50 miles north of Albany and about 20 miles from Saratoga, is located the home of the Warren-Medbery Company, Sandy Hill, N. Y. The excellent train service from north and south by the Delaware & Hudson Canal Railroad Company, puts Sandy Hill within [illegible] Railway, and all Canadian points.

Much interest is displayed throughout the country by engineers and station men in the new types of inductor alternators manufactured by the Warren-Medbery Company, and it seems fair to suppose that this type of machinery is a favorite one in the modern electrical field by reason of the increasing demand reported by its manufacturer.

The Warren-Medbery Company is building a full line of single-phase alternating-current machines, of belt-driven type, adaptable to all forms of lighting-service. The standard machines are wound for 1000 or 2000 volts primary, and machines of either voltage may be provided with a subsidiary armature winding for local lighting at any standard voltage, usually 110 to 220 volts, arranged for distribution by either the two or three wire methods. The practicability of subsidiary winding for station or adjacent property lighting is at once apparent both from the point of economy and safety, as the use and cost of transformers for short-range lighting are dispensed with, and the point gained that the station is not plunged in darkness, with the customary confusion, in case of the opening of the primary circuit in fuse, circuit breaker or elsewhere.

A machine equipped with a subsidiary winding is installed in a southern New York lighting station, where about 125-light capacity is provided for and used in the station and residence of the owner of the plant situated nearby. A machine operating in Mexico has a capacity in its auxiliary winding of 150 lights, which are distributed by the three-wire system, 220 volts between the outside wires, with the customary neutral arrangement.

The Warren-Medbery Company, recognizing the demand for machines of low voltage, to be used for local lighting or isolated plant work, is connecting its alternators in such a way as to give the full-rated output in kilowatts, at any desired voltage, between the terminals and for any system of distribution. A plant installed by this company in northern Kentucky is connected for three-wire distribution, so that there is a potential difference of 240 volts between its outside wires and 120 volts to the neutral from either of the outside wires, when the load on both sides of the system is equal. A novel method for compensating for unequal distribution, by reason of different load on the two sides, is used. It consists of an arrangement placed on the switchboard whereby it is possible to vary the connection of the neutral wire to either side of the true central point of the armature, thereby increasing the length of active conductor and consequently raising voltage on the heavily loaded side, while the voltage of the light side is decreased proportionately. A rheostat, in series with the alternator field, gives further and more delicate control of the voltage.

It has evidently been the aim of the designer of these machines, Mr. H. B. Warren, to combine every feature which his long, practical experience among station men and engineers would teach as desirable and thoroughly practicable, and to eliminate every feature likely to prove troublesome or not durable when in service.

The testimonials now in the possession of the Warren-Medbery Company, as to the performance of the machines, which have been in service for a considerable time past, prove the advantages of many of the original improve

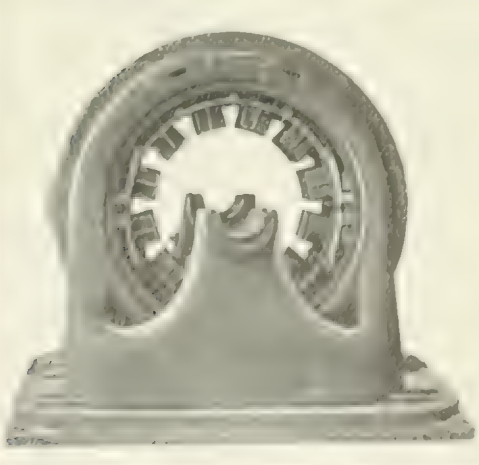


Fig. 4.—[illegible]

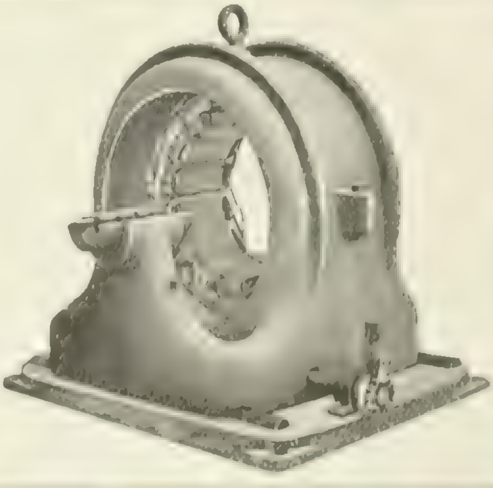


Fig. 5.—Armature Winding.

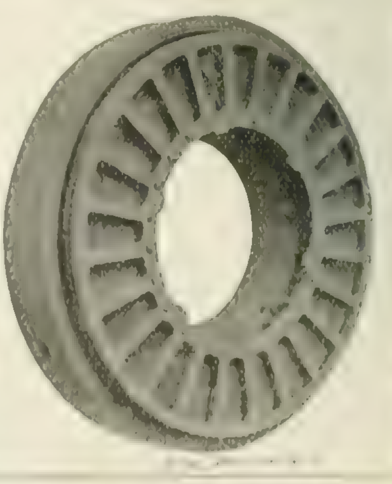


Fig. 6.—Annular Yoke.

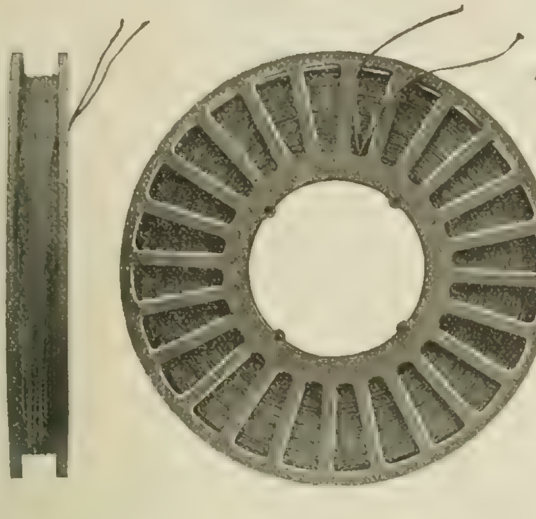


FIG. 7.—END AND SIDE VIEWS OF FIELD COIL.

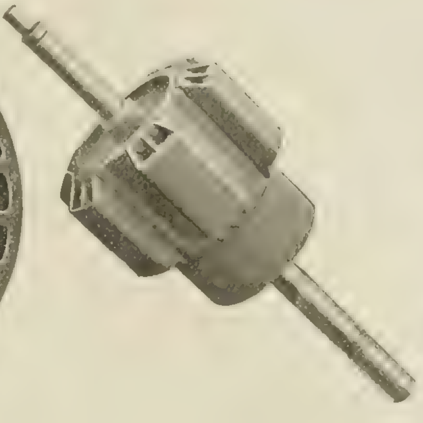


FIG. 8.—INDUCTOR.

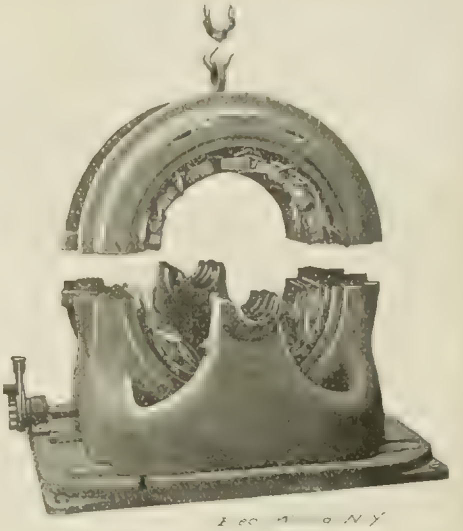


FIG. 9.—END VIEW OF MACHINE.

ments designed by Mr. H. B. Warren, which are embodied in the Warren-Medbery alternators. The utmost care has been taken in the working out of details throughout the entire machine, the idea having been to obviate all such parts as were fragile or not necessary to the good working of the machine, not, however, falling behind the foremost rank in regulation of economy.

In the illustrations shown herewith, Nos. 1, 2 and 3 are general elevation views of the Warren-Medbery alternator in its different positions. It will be noticed that such details as belt tightener and oil gauges have been carefully worked out to meet the approval of station men by reason of their simplicity and effectiveness.

The frame rests on three skid-ways of cold-rolled steel shafting, having nine footings of large dimension, thereby permitting the machine to move easily back and forth when it becomes necessary to tighten or slacken the driving belt. The skid-ways are set into the sub-base, carefully lined and anchored in position. The belt tightener consists of a screw, operated with a ratchet and pawl from the lever, causing the machine to advance or recede in a true line on the skid-ways, thus preserving the alignment between the dynamo shaft and the driving shaft.

Fig. 4 is an elevation view of the machine, showing the general structure of the stationary uni-tooth armature and frame. It will be noticed that the armature-coil slots are unusually deep and generous in proportion, giving this part the almost appearance of a field frame, thereby permitting the armature coils to be thoroughly insulated and set well back from the surface of the air gap, thus lessening the liability to mechanical injury, in event of chips or other foreign matter accidentally getting in between the inductor poles and the armature iron.

Especial attention is called to Fig. 5, showing the arrangement of the windings on the stationary armature. It will be observed that no clamps are used, and a strip of fibre only is required between the armature teeth to hold the coils and insulating troughs in position. The smooth bore seen on the inside of the frame, near the armature body, is intended to make contact with the outer face of the annular yoke, shown in Fig. 6. Station men having had experience with antiquated types of inductor machines, wherein it is necessary to remove the inductor to get to the field coil, will appreciate this feature in the Warren-Medbery machine.

If it should ever be necessary to remove the field coil for inspection or repair it is but the work of a few moments, and a very simple operation to remove the coil and yoke from the frame. It is further entirely practicable, in event of destruction of the field coil by lightning or accident, to wind a new coil without removing the old field coil or inductor. The process consists of loosening the field coil from the yoke and blocking the coil on the inductor, which is readily accomplished by means of a few wooden wedges; the coil will then turn freely with the inductor and the old wire may be unwound quickly; the new wire may then be wound on exactly as if the coil was mounted in a winding lathe.

Fig. 7 shows two views of the field coil. The frame on which the coil is wound is of brass and is lined in every portion which comes in contact with the coil with sheet fibre, treated to prevent absorption of moisture, and of such a thickness as to thoroughly insulate the winding from the coil frame. The structure of the coil frame allows of perfect ventilation and permits overloading the coil without danger to the insulation. Currents of air induced by the rotating part of the machine pass freely about the coil to the outer air by way of the yoke openings. The coils are proportioned for heavy overloads, and in no single instance has it been found necessary to replace a field coil injured by overload.

The inductor, the only moving part of the machine, is shown in Fig. 8. It is a solid steel casting, with a single ring of poles of laminated steel firmly held in place by being dove-tailed into grooves cut in the body of the inductor. The shaft, in bearings, is made extra large and long for the work required, thus insuring cool running and long life to bearings. The bearings are of the most modern construction, self-oiling from oil reservoirs of large capacity. The bearing sleeves are made solid and lined with a high grade of low-friction metal.

The bearing sleeves and supports for same are so designed that when it becomes necessary to move the sleeve the only process required is the removal of the bearing cap, allowing the sleeve to be turned and slipped endwise off the shaft. In the outboard bearing machines the centre-bearing sleeve is split to enable its being removed without withdrawing the shaft or taking down any parts other than the bearing cap of the centre bearing. The Warren-Medbery Company has devoted very careful attention to the subject of bearings, and it is safe to say that for accessibility and perfection of operation the bearings are in the front rank.

Fig. 9 shows an end view of the machine with the upper half lifted. This arrangement greatly facilitates assembling or installing the machine, and by reason of the fact that the machine may be shipped in so many parts it renders unnecessary the use of bridging or expensive temporary structures generally used in the installing of heavy machinery.

The Warren-Medbery Company believes that it is consistent with the best practice to test every one of its machines to full load for a considerable period of time, and to make a run at or above the guaranteed overload before permitting the machine to leave the shop. The company has at its disposal several hundred horse-power in a set of turbines operating under a 16-foot fall on the Hudson River, and also the most modern apparatus to simplify and facilitate the process of testing.

Through the columns of THE ELECTRICAL WORLD the Warren-Medbery Company earnestly invites all prospective purchasers of electric light machinery to witness tests employed in the construction of its machinery.

The two-phase 60-cycle generators manufactured by the Warren-Medbery Company are meeting with great praise from all concerned in their operation. The subject of two-phase machinery will be treated at length in a special bulletin to be issued by the Warren-Medbery Company at an early date.

The Westinghouse Gas Engine.

The ancient myth of the Greeks that Athene, the goddess of wisdom, sprang into being full armed from the brain of Zeus is being constantly disproved, even in its allegorical sense, by the experience and science of to-day. All our concrete embodiments of wisdom have grown by a process of evolution from small or crude beginnings to their present state of perfection. The Westinghouse gas engine is no exception to this rule. As long ago as 1886 Mr. George Westinghouse saw that there was a very promising field for a gas engine which should run with the steadiness of a steam engine, and he set several of his engineers to work on the problem. They built several experimental engines and gained much valuable experience; and then the Fuel Gas & Manufacturing Company bought the patents which had been obtained, and pushed the work forward with more men and better facilities. Mr. Westinghouse gave it his personal attention, and a number of practical engines were built and sold. Soon, however, the business became too big for the limited facilities of this company, and it was transferred to the Westinghouse Machine Company in the fall of 1896.

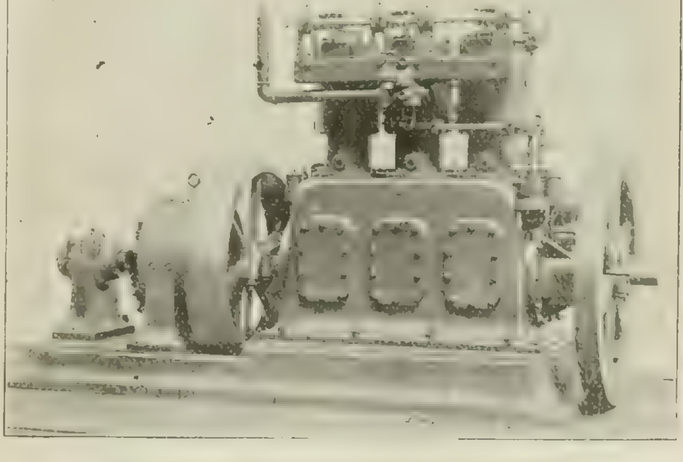


FIG. 2.—50-HP "ENGINE TYPE" GAS ENGINE.

The mechanical design of the engine was at that time thoroughly overhauled and made to conform to the ripe experience of the machine company in steam engine construction. Structurally the gas engine resembles closely Westinghouse standard steam engines, having the same vertical cylinders, single-acting trunk pistons and enclosed crank case. A complete line of sizes of engines was designed and the business put on a thoroughly commercial basis. To illustrate the thoroughness with which the experiments have been carried on, take the case of the 225-hp engine now doing regular commercial work (shown in Fig. 1), which was built as an experimental engine in the early days, and has, by a process of successive changes, completely lost its identity, for no portion of the original engine is left. Such readiness to try new and promising ideas has given the company an experience on which it can rely in designing new styles. It can well be imagined that a great deal of money has been spent in conducting such experiments, especially when it is realized that it is the Westinghouse policy to first build a big experimental engine, and from it get the data for designing a whole line of smaller one. The result has justified this foresight, for to-day the company is regularly selling engines ranging all the way from 1 [illegible] brake horse-power, and is extending the range up to 250 brake horse-power. Step follows step, and a 650-brake horse-power engine has been built and installed in the power house of the Westinghouse Electric & Manufacturing Company for regular service.

These engines operate on a modified form of the Beau de Rochas cycle. They draw in a charge of gas and air on the first down-stroke, then compress it into the clearance on the up stroke and ignite it near the top centre. The piston then moves down during the second down-stroke under the pressure of the exploded gases, and these are exhausted during the second up-stroke. They depart from the Beau de Rochas cycle in that the incoming gas and air are throttled to a greater or less degree by the action of the governor, according to the load on the engine. This method of governing insures an explosion with every other revolution in each cylinder or one per revolution for the two-cylinder, and one each two-thirds revolution for the three-cylinder type, instead of a reduction of the number of explosions, as with the so-called "hit or miss" governors. The frequency and regularity of the impulses insure such steadiness of running that [illegible] rigidly on the engine shaft and obtain perfectly steady electric light.

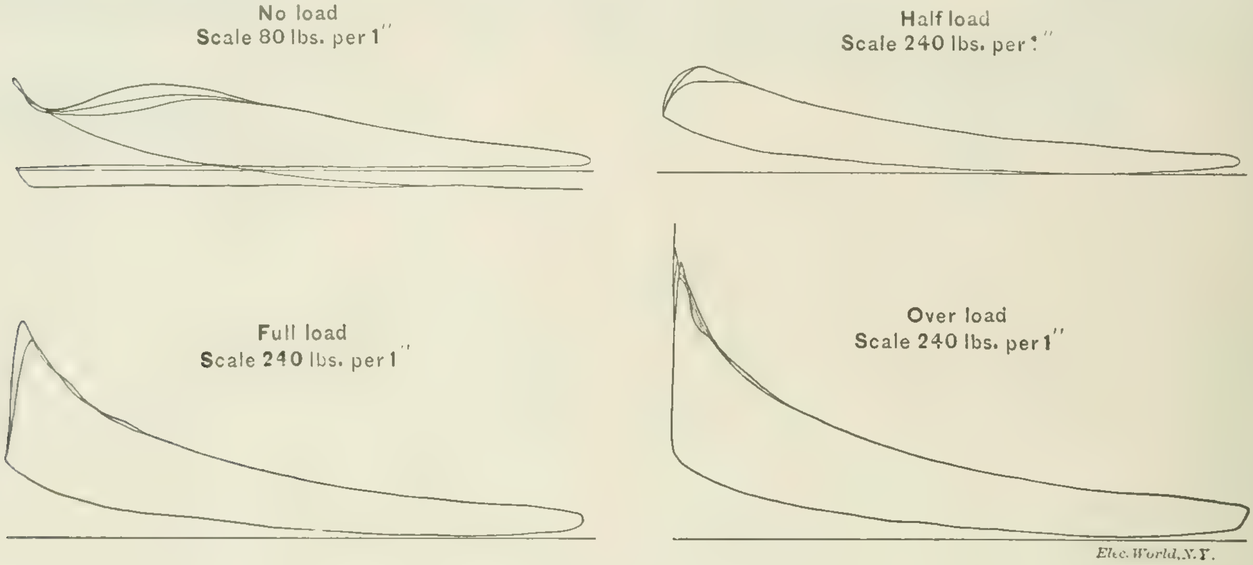
Fig. 2 shows an engine and dynamo of this type, which is on exhibition at the shop. The method of governing is very characteristic. The air and gas enter each through their own set of ports, and are mixed in the interior of the valve, and then passed on to the poppet inlet valves by way of the larger ports, which are not materially diminished by the motion of the valve. To provide for the variability of the gases in different locations the capacity of both gas and air ports may be varied by adjusting either half of the valve and thus proportioning the amount of gas and air taken in. The position of these adjustments is determined once for all when the engine is first started.

After being mixed and measured in the mixing valve the charge passes into the cylinders through poppet valves, which are mechanically opened at the proper time. These valves are mounted in small covers or bonnets, which makes it very easy to remove them for examination, but their construction is so simple that they require practically no attention.

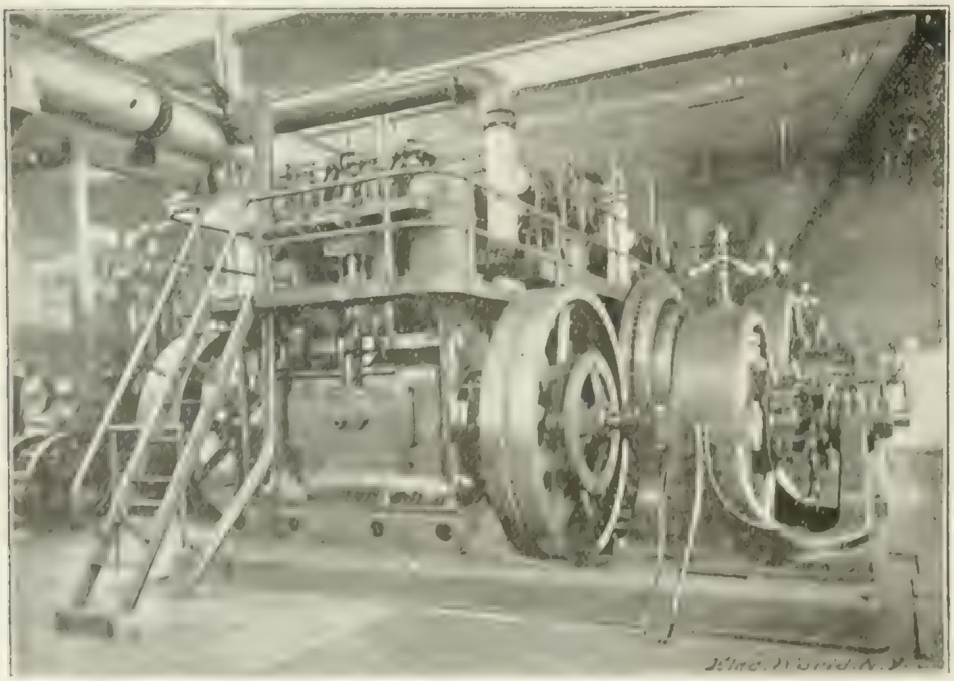
The ignition is accomplished by means of the igniter shown in Fig. 3, which is strongly protected by patents. This igniter has two pairs of terminals, from either of which the spark may be drawn, and, as the change can be easily made while the engine is running, it furnishes an insurance against a shut down in case of accident to one pair of points. The electric current for the ignition may be obtained from either a battery or lighting dynamo or from a small dynamo installed for the purpose. This current passes through a choke or spark coil and then through the points in contact. At the proper instant the points are quickly separated, and the kick of the inductive coil produces a bright spark which causes the explosion. At the end of the stroke the poppet exhaust valves are lifted by cams inside the crank case and allow the burnt gases to escape.

The accompanying set of cards taken from an engine show plainly the reason for the regularity of running, for they indicate a nice adjustment of the power of the explosion to the work required. The throttling of the admission below the atmospheric line shows clearly in the no-load card.

These engines are conservatively rated, for they are all tested in the shop up to a maximum or overload of at least 10 to 15 per cent. above their rating, and



Gas Engine Cards.



[illegible] Gas Engine.

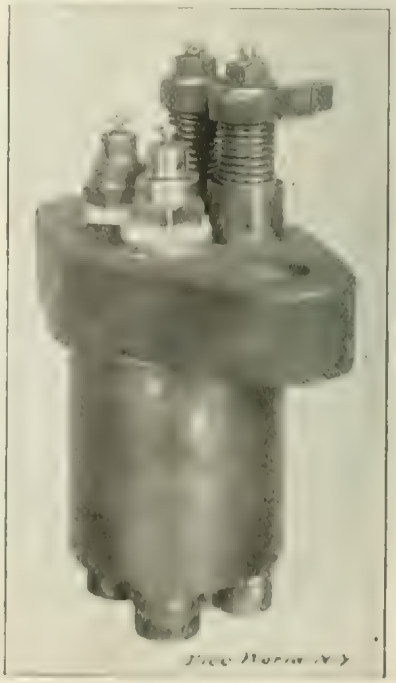


Fig. 3.—The Igniter.

they are run on the testing foundation for a number of days and their behavior critically noted. The gas consumption is, in all cases, measured and seldom varies from the limits of 10 to 12 cubic feet of natural gas per brake hp-hour at full load.

Anyone who has had any experience with gas engines will be quick to ask about the starting of such large engines, and will be pleased to learn that it can be easily done by one man or boy, for all the larger sizes are provided with a small automatic valve which, when thrown into action, admits compressed air on every down stroke into one of the cylinders, whose regular inlet valve is, for the moment, thrown out of gear, and whose exhaust valve, through the medium of a movable starting cam opens each revolution. The cylinder, for the time, acts as an air motor, and drives the engine until the charges drawn in by the other cylinder or cylinders explode. Then the air is shut off and this cylinder thrown into normal action. The air is obtained from an air reservoir, which is charged by means of a small air pump driven by the engine. When the required pressure is obtained in the reservoir the belt is thrown off and the valve of the tank closed, thus insuring a supply of air for the next start. The air pump is supplied with a handle so that in case of accident to the air supply the tank can be recharged.

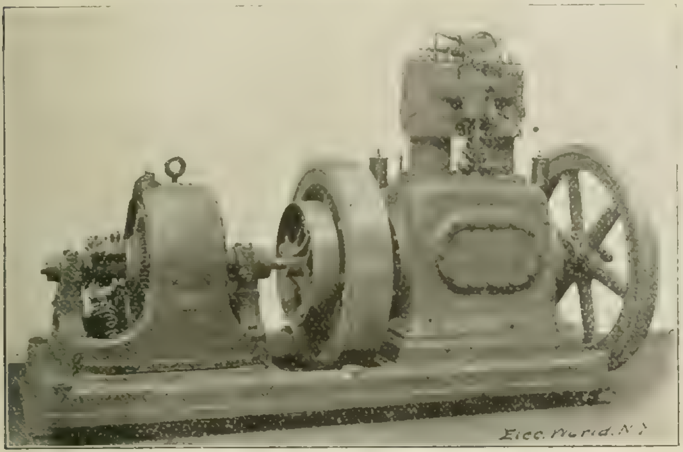


Fig. 4 —10-Hp "Kodak" Gas Engine.

The lubrication of these engines is very similar to that of the Westinghouse steam engine, for the closed crank case carries a pool of oil which is splashed up to the pistons and other internal bearings by the lower ends of the connecting rods. The main bearings carry oil cups which serve to lubricate them and to keep up the supply in the crank case. The small cups and oil holes on the other bearings require but little oil, and are in plain sight.

The extensive experience of the company in steam engine construction has been particularly useful in the design of the gas engine. The bearings of the shaft and connecting rods are furnished with convenient means of taking up the unavoidable wear without affecting their alignment.

Altogether, the engines are uncommonly well constructed, and large numbers of them are being installed all over the country, using many varieties of fuel and doing all kinds of work. They are particularly well adapted for electric lighting and run as steadily as the best steam engines.

For the information contained in this article we are indebted to Mr. William P. Flint, an engineer of unquestioned ability, who has for several years past been a recognized authority on gas engines.

A Central Station Episode.

The manager of an electric light plant who has a duplicate set of machinery for generating the electric current that lights residences and streets, as well as the one that is struggling along "on the ragged edge," with his station taxed to its utmost limit, will appreciate the situation which confronted a manager in the capital city of Vermont.

There are two companies in Montpelier, and competition is very sharp; the new company having three 150-kw alternators driven by water power, with a load for only one, while the old company has two 100-kw alternators of modern construction, six arc dynamos and a job lot of ancient machines that a few years ago cost a large sum, but to-day are not salable. In this lot are three A 6 T.-H. self-exciting alternators and a 500-light Heisler dynamo. These four machines have been moved out to make room for the new alternators, but the old switchboard and station instruments are still in place, the circuits being connected to the new machines. Two engines and five water wheels, by the medium of a jackshaft and belts, supply power for the street and interior lighting.

This was the situation the day before the Legislature assembled for its biennial session of 1898. The men had been working night and day for two weeks, getting ready for the increased business, which included the lighting of the capitol. The material had been late in arriving, so that, at the last minute, a circuit was connected to one of the alternators without being protected by circuit breakers, but fuses were substituted for these and everything hitched up for a trial run; the next night business would commence in earnest. Everything went well, and a tired lot of men congratulated each other. But about 9 o'clock a wire fell across the new line, and the resulting short circuit failed to blow the fuses, but did wreck the armature, so that it could not be replaced without sending it to the factory. The three small alternators together had a sufficient capacity for the load of the disabled machine, but there was room to belt up only one of them, and each of the four circuits had a heavier load than any one of the machines could handle. A hasty calculation showed that by running about 2 miles of wire another circuit could be formed and the load divided up so that the small machines could carry it, provided they could be belted up. The manager was acquainted with the L. P. & D. system of belting, and he found room to one dynamo between an engine and the jack shaft; then, by moving an arc dynamo, and making the belt a few feet longer, there was just room to squeeze in the third machine. A trip to the L. P. & D. shops showed that they had transmitters and split pulleys on hand of the size required. The foreman reported several miles of wire, not in use, that had formerly carried the Heisler current, but which had not been taken down, and his ability to take down the same, string it on the poles of the proposed line and make the necessary connections ready to start up the next night. The engineer said that he could move the machinery, set up and belt the transmitters and have his part ready, and the manager was to try his hand at wiring the machines to the old switchboard. About 4:30 the next afternoon, all the circuits were started up, not a customer being left out, the capitol lighted from dome to basement, and the Governor's reception, the event of the session, was a grand success.

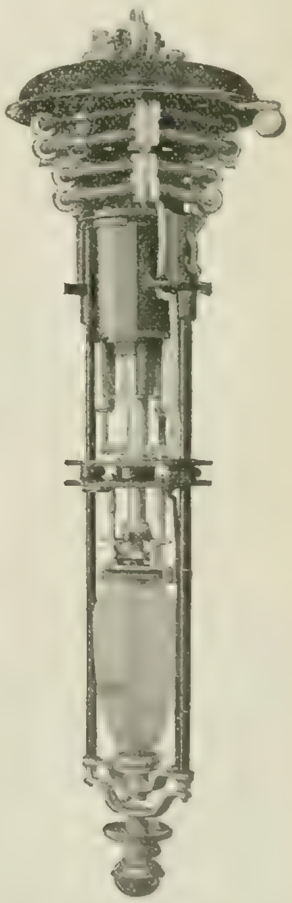
This remarkable performance was possible, first, on account of employees that had great courage and faith in "a long pull, a strong pull and a pull all together"; second, by using the L. P. & D. system, which makes it possible to run the driven and driving pulleys close together, utilizing space that would not be available with any other method of driving. In belting up the machines no lacings were used, but all belts were made endless, as the engineer is supplied with a kit of belting tools, and many a dollar is saved by repairing and building up belts that otherwise would be thrown away.

The electric lighting company is now engaged in developing a water power at Bolton Falls on the Winooski River, 17 miles below its present plant. The equipment will consist of two 450-kw General Electric direct-connected generators of the revolving field type, which will generate current at 12,000 volts. The line is to be of bare copper, and step-down transformers will be used at the station to adapt the current to the present lines.

A 220-Volt Enclosed Arc Lamp.

A perfected form of carbon-feed arc lamp for direct connection across 220-volt mains is being placed on the market by the General Electric Company. It operates with 120 volts at the arc, takes a normal current of 2.5 amperes and, with one trimming, has a life of from 130 to 150 hours. The light is of less volume and more violet in color than that of standard 110-volt lamps, but the advantages of a 220-volt lamp, capable of independent operation, sometimes compensate for the diminution of light as compared with the General Electric 5-ampere power-circuit lamp for use two in series across 220-volt mains. A variable resistance at the top of the mechanism allows the use of the lamp on circuits of from 210 to 250 volts.

Lamp Complete.



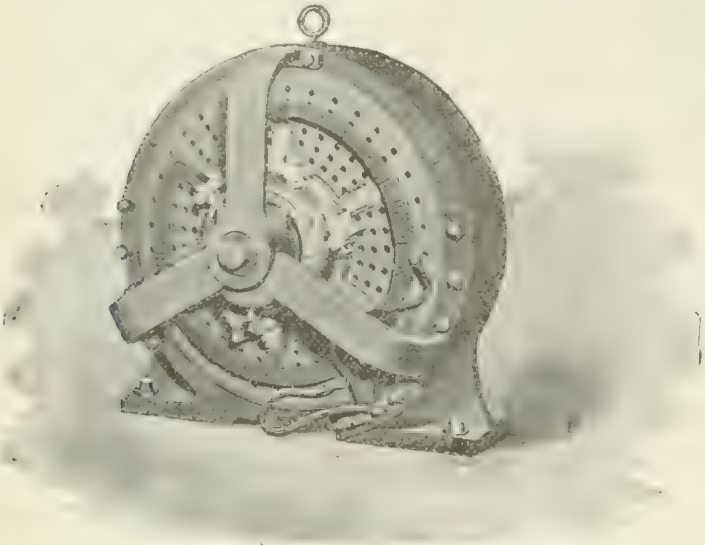
Mechanism of Lamp.

The 220-volt lamp is weatherproof, and may be used without a hood. It is especially suitable for lighting vestibules, doorways, window fronts, etc. It may be used with the closed outside globe or with the single globe and flared reflector. The casings are of several designs, the standard weatherproof casing being finished in black enamel.

A New Motor for Direct Connection.

The motor illustrated on the next page is built for direct connection to machine tools, printing presses, line or countershafts, etc., by the Triumph Electric Company, Cincinnati, Ohio. It embodies the Triumph standard construction throughout, and its design is exceptionally compact. Both armature and pole pieces are of laminated steel, the armature and commutator being mounted on an independent spider, which is bored to fit the shaft of the tool to be driven. Ample room between spider and core is left for ventilation, and radial apertures are provided running from centre to circumference for the same purpose. It is stated that the temperature rise of one of these machines under ten hours' continuous run loaded was less than 10 degrees. Cast-iron perforated plates are fitted on each side of the frame, protecting both the fields and the armature.

The brushes are of carbon and are clamped positively in the holder, the construction of which is such that the tension can readily be adjusted. This type of holder is claimed to be superior to that of any depending on a sliding contact between carbon and holder. The bearings are of bronze of the ring-oiling self-aligning type, and are carried on three-arm spiders attached to the frame, making an entirely self-contained and very compact machine. Oil wells of ample capacity are provided. The machine is built inverted, as a ceiling motor, and is made in six sizes, all based on 100 r. p. m.



MOTOR FOR DIRECT CONNECTION.

Steam Separator and Oil Eliminator.

In designing this apparatus the object sought was to secure the highest possible efficiency with the least possible obstruction to the flow of the stream. To attain this result the interior of the separator was kept as smooth as possible, and all sharp corners and depending ledges avoided. These obstructions, it is asserted, not only add friction, but every angle from which the water of entrainment is sprayed by the current of steam will increase the saturation.

The cut in the next column shows the vertical and horizontal separators manufactured on these lines by the Hoppes Manufacturing Company, Springfield, Ohio. The steam inlet in both gradually enlarges into a chamber ten times the area of the pipe, and the outlet is gradually reduced to the original area. The principal feature of the separator is the interception of the entertainment by gutters which are kept partially filled with water. These gutters or channels, it is stated, have the effect of cutting off all the entrained water or oil, and are arranged to guard both the inlet and outlet. The entrainment caught by these gutters is carried to the bottom of the separator by small pipes.

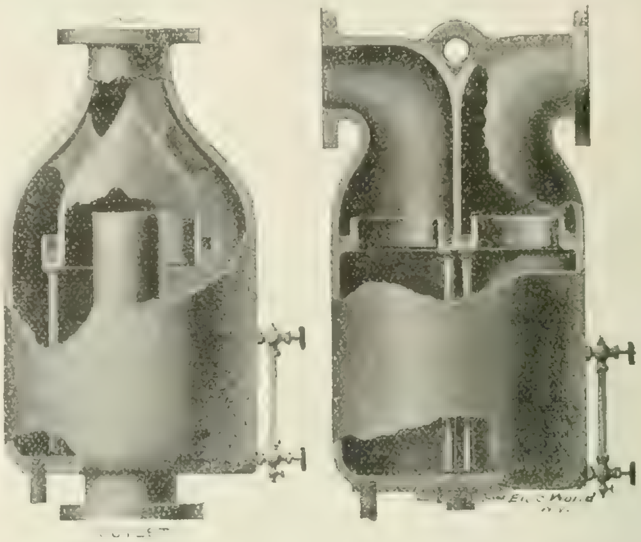
In the vertical separator the steam enters the top and all entrainment following the inside surface [illegible] which does [illegible]

[illegible]

The I-T-E Rheostat.

The letters I-T-E, which have become so well known to the electrical trade in connection with the circuit breaker manufactured by the Cutter Electrical & Manufacturing Company, of Philadelphia, have been adopted in designating a new rheostat just brought out by the same concern.

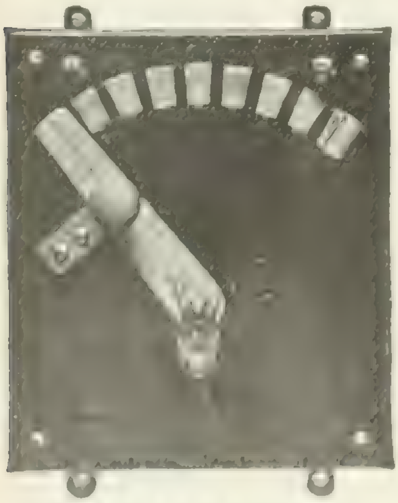
In entering the field already occupied the company kept in mind the devices at present on the market, and remembered that only by producing a better instrument, at the same or lower in price, ultimate success could be attained. For this reason a few words as to the important features of the new rheostat will not be out of place. There are several points of design and construction which tend to render its breakdown impossible except through willful neglect. The design of the contact segments affords a large contact surface, and these segments are kept from turning on the base of the rheostat by means of small detents, which also prevent their working loose, as they are otherwise apt to do. The contact arm and the arm to which the handle is attached are in two separate independent pieces, so that the movement of the handle does not affect the pressure of the contact arm up the resistance segments. An entirely new feature is noted in that the arm and the base plate on which it is mounted can be removed by simply taking off a cap screw. This admits of the removal of parts for any adjustment which may be required.



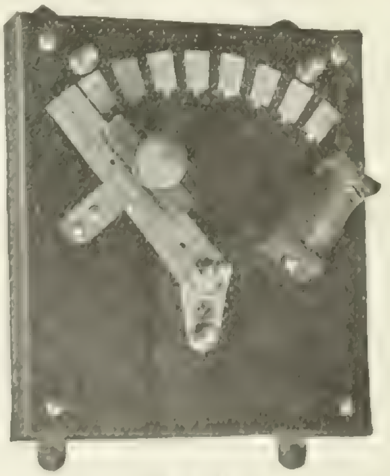
VERTICAL AND HORIZONTAL STEAM ELIMINATORS.

The tension of the spring holding the rheostat arm normally open is of sufficient strength to prevent it being left, either by accident or design, upon any segment excepting those which are not in circuit or those on the side of the rheostat where all the resistance is cut out.

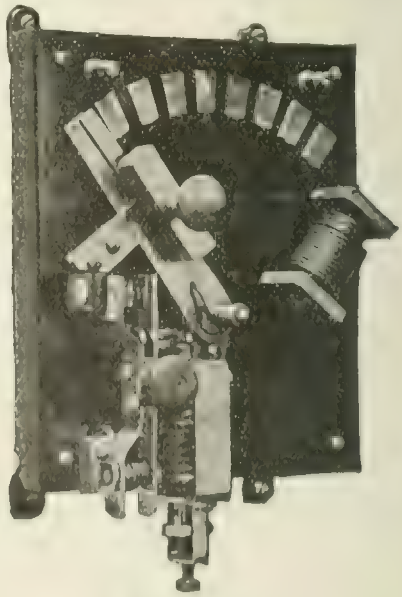
The face is made of enameled slate, the advantages of which are obvious. The resistance is intended to meet the severe conditions of abuse, rather than the strain of ordinary use, and is attached to the back of the slate front. A chambered iron back is filled with a granular, vitreous, heat-absorbing material, which not only holds the resistance in proper position but absorbs and transmits whatever heat may be generated. By this construction an expansion of the resistance coils is allowed free movement in this heat-absorbing material.



TYPE A. I-T-E RHEOSTAT.



TYPE B.



TYPE C.

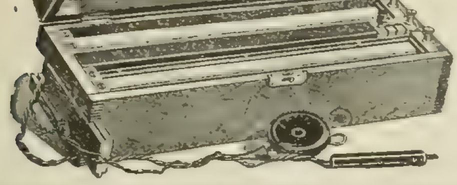
The resistance is so proportioned that [illegible] the full torque current flows the moment the motor is thrown into circuit, and the heating is so carefully distributed that the resistance itself can be hung in the air without any surrounding material whatever to absorb or radiate the heat, and not burn out.

Three types of instruments are now ready for delivery: Type "A," having a [illegible]; type "B," having in addition to the spring action a no-load release, thus protecting the motor in case of interruption of circuit from any cause, and type "C," having in addition to the spring action and no-load release an overload function, which combines the essential features of an I-T-E circuit breaker, protecting the motor in case of interruption or of an overload.

A Direct-Reading Ohmmeter.

Those who have had experience in making electrical measurements and in testing with regular testing sets understand the importance and necessity of keeping the galvanometer away from extraneous magnetic influences. The operation is a delicate one under the most favorable circumstances.

There has been a demand for a reliable instrument for the direct measurement of resistance and free from the objections that are inseparable from the use of a galvanometer, particularly in places where there are stray magnetic fields—in a dynamo room, for instance. The direct-reading ohmmeter illustrated herewith is manufactured by the American Electric Specialty Company, 123 Liberty Street, New York, and is recommended as fulfilling every requirement in an instrument of this class, and as being free from the objections above noted as applying to galvanometer sets. This instrument is extremely simple to operate, and has a wide range of measurement. Instead of a galvanometer a telephone receiver is used in the bridge.


INSTRUMENT FOR THE MEASUREMENT OF RESISTANCES.

A peculiar feature of the instrument is the stylus which is used for the purpose of varying the balancing resistance by touching at different points the wire stretched over the scale until a point is reached where no sound is given out by the telephone receiver. This point represents the balance of the unknown resistance against the known resistance, the value of which is indicated on the scale.

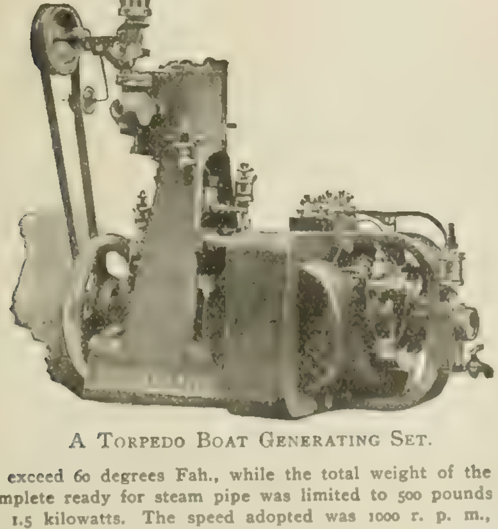
The rapidity with which a measurement can be made is one of the principal features of this instrument, and this merit, in addition to the many others which the instrument possesses, is one that will appeal to manufacturers and others who are required to make large numbers of measurements, such as the measuring of the resistance of incandescent lamps, testing telephone jacks, telegraphic apparatus, etc.

The instrument is compact and portable, and its dimensions are 17 inches long, 5 wide and 4½ high, and its weight is 7½ pounds. The battery, which is contained in the case, is guaranteed to last six months with continuous use and for several years with occasional use. The instrument needs no leveling, and its readings are unaffected by vibrations or stray magnetism.

A "Midget" Generating Set.

The "Midget" generating set, illustrated herewith, is claimed to be one of the smallest and most perfectly designed direct-connected machines ever constructed. The illustration was made from one of a number of sets recently built by the B. F. Sturtevant Company, of Boston, Mass., for the United States Navy, to be used in torpedo-boat service. The salient features of the design are reliability, low temperature, good regulation, ability to stand continuous overloads, minimum of attendance, high weight efficiency and great compactness.

This generating set was designed to be able to develop its rated output continuously with absolutely no sparking at the brushes and with a temperature rise not to exceed 60 degrees Fah., while the total weight of the engine and dynamo complete ready for steam pipe was limited to 500 pounds for a rated capacity of 1.5 kilowatts. The speed adopted was 1000 r. p. m., and as the engine weighed 150 pounds complete, the weight of the dynamo could not exceed 350 pounds. In the finished design of the generator this weight was reduced to 250 pounds, of which 75 pounds was the weight of the armature complete, making the entire weight of the set only 400 pounds; that is, 100 pounds within the limit. This brought the weight efficiency of the output complete to 0.266 pound per watt output at rated capacity.


A TORPEDO BOAT GENERATING SET.

In order to insure steadiness in running as well as to economize in head room the centre of gravity was kept as low as possible by the adoption of the consequent pole type of magnetic circuit, giving a four-pole field with only two field coils, which coils being placed on the horizontal pole pieces reduce the height of the frame and consequent height of the shaft centre to a minimum, and at the same time render a sub-base unnecessary.

The field magnet consists of a wrought-iron forging to which are bolted the horizontal pole pieces. The armature is of exceptionally large diameter in order to facilitate ventilation and present as great a radiating surface as possible. The core discs are mounted on a brass spider having a flange support for the armature coils on the back end and an extended sleeve for support of commutator on the front. The ventilation of the core is facilitated by means of air ducts placed in the centre and at each of its ends. The air ducts consist of a series of radial vanes which, when rotated, act as a centrifugal blower. As the back end of the spider is completely closed and oil proof, all the air is drawn through the commutator, which is of skeleton construction.

The brush holders are of the reaction type, two only being used, as the armature is of the two-circuit, four-pole, barrel-wound type without cross connections. The brush yoke is supported by a projection from the out-board bearing.

The generator is compound wound for a constant e. m. f. (at constant speed) at all changes of load, from no load to 50 per cent. overload, and can stand this variation without sparking at commutators or any movement of brushes. It is stated that a continuous overload of 25 per cent. can be carried with safety.

The engine upon which the effectiveness of the combination depends is of special construction, designed to form a symmetrical part of the whole machine. Its single cylinder is 2-inch diameter by 2-inch stroke, all parts are provided with continuous oiling devices, the bearing surfaces are large and carefully finished, and every feature essential to sustained operation at 1000 r. p. m. has been introduced.

The "Straight Line" Iron Frame Bell.

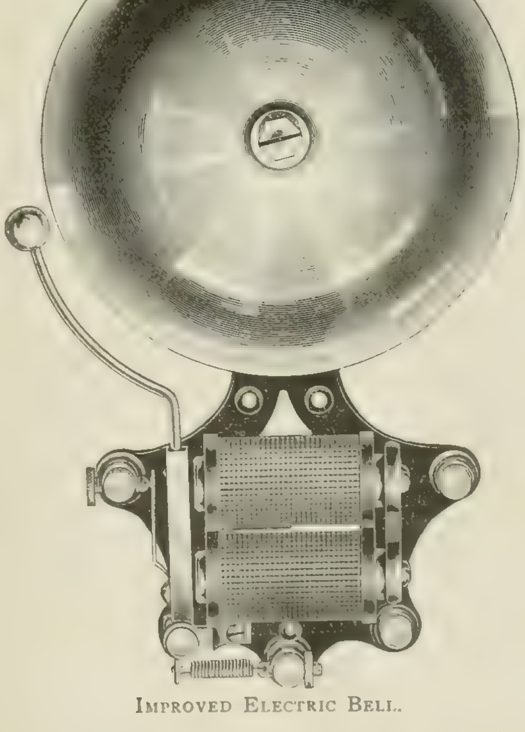
This bell possesses all the good features of the best bell on the market, such as cast bell-metal gong, platinum contact, etc., and, besides, it has been improved in design and construction.

The gong is cast with a square hole and forced on to a square standard and fastened in place by a heavy screw cap, which method of attachment prevents the gong from working loose.

The frame is so designed that it is unnecessary to remove the gong to install the bell, the screw holes being always exposed. The back of the frame is dished so that the frame bears on the edge, thus adapting itself to any slight irregularity on the wall; at the same time it cannot become loosened.

The magnet cores, instead of being screwed to the yoke, have a shoulder cut on them and are forced into a countersunk seat in the yoke. This gives a much better magnetic circuit than the old style and a stronger structure.

The armature is pivoted in adjustable brass-cone bearings, with steel trunnions, giving a wearing surface which lasts indefinitely without readjustment. The contact spring is so attached to the armature that it cannot become loose, and it is possible to renew the platinum contact rivet without removing the bell from the wall. All the other parts of this bell, which is made by the Proctor-Raymond Manufacturing Company, 444 Niagara Street, Buffalo, N. Y., are brought to the same degree of perfection.


IMPROVED ELECTRIC BELL.

The full line of bells will consist of forty sizes, with ten movements, each movement being made by its own special tools, jigs, etc., the use of which enables the company to furnish the "Straight Line" bell at the same price now asked for much inferior bells.

ELEC. WORLD, N. Y.

NEWS OF THE WEEK

Financial Intelligence.

THE EDISON ELECTRIC ILLUMINATING COMPANY OF NEW YORK reports gross earnings during the month of October of $253,897.91, an increase of $39,317.31 over last year; net earnings, $100,800.10, an increase of $9409.45. For the ten months ending with October the gross earnings were $2,424,661.41, an increase of $466,326,29; net earnings, $1,009,185.85, an increase of $151,931.97.

Special Correspondence.

NEW YORK NOTES.

THE THIRD AVENUE RAILROAD COMPANY and the Metropolitan Street Railway Company on Tuesday of last week petitioned the municipal council and the board of aldermen for railroad extensions and connections. The simultaneous petitions are supposed to indicate that an amicable agreement exists between the two companies, and that there will be a division of the streets over which their tracks are to run which will be satisfactory to both. On the Boulevard, from Manhattan Street to One Hundred and Eighty-second Street, the cars of both companies are to run over the same tracks, but each company will have its own conduit. A public hearing will be held on December 22 on the petitions.

TO HOLD AN ELECTRICAL EXHIBITION NEXT YEAR.—The stockholders of the Electrical Exhibition Company, of this city, held their annual meeting on the evening of November 22. Among the business transacted was the unanimous decision to hold an electrical exhibition in this city in 1899. The exhibition during May this year at Madison Square Garden was successful in all respects, and no doubt next year's affair will surpass that of this year. The following named gentlemen were elected officers and directors of the company for the year: C. O. Baker, Jr., president; F. W. Roebling, vice-president; George F. Porter, secretary and treasurer; Marcus Nathan, general manager; H. H. Harrison, L. F. Requa, J. W. Godfrey and C. A. Lieb. It has not yet been decided when the exhibition shall be held.

THE AMERICAN GRAPHOPHONE COMPANY on the afternoon of November 23 gave, at its offices in the Bowling Green Building, a private demonstration of the latest development in the talking machine art to a few invited guests. The power of the new machine as compared with the modern standard phonograph is remarkable, and in most instances the reproductions were as clear and even louder than the originals. This was demonstrated by making records and reproducing them in the presence of the audience. The improvements embodied in the new machine mark a very distinct advance in the development of the art. Usually the evolution of apparatus and processes is by slow degrees, but in this instance a very long stride forward seems to have been made at one stroke.

THE APPOINTMENT OF TWO ELECTRICAL INSPECTORS.—Deputy Commissioner Walton, of the Department of Public Buildings, Lighting and Supplies for the Borough of Brooklyn, has increased the force of the Bureau of Electricity by the appointment of Messrs. Harry Byrne and Edward Sullivan as electrical inspectors. These two gentlemen were upon the eligible list certified to the commissioner by the Civil Service Commission, and the salary of each is at the rate of $1200 a year. Mr. Byrne is well known in the electrical fraternity, having been superintendent of installation in the Electricity Building at the World's Fair, and afterward electrical inspector in the Chicago City Electrical Bureau. For the past few years he has been prominently identified with important construction work in the East. Mr. Sullivan is also well known among electrical people, having been formerly superintendent [illegible] Company and previously to that electrician for the Brush Electric Company.

THE EFFECT OF THE HEAVY STORM ON THE ELECTRICAL SERVICE.—The severe snowstorm which visited the Atlantic coast on Saturday, November 26, and which was particularly violent in this city, found the various traction companies quite unprepared. The fall amounted to about 10 [illegible] into high drifts. The combination was more than the electric, cable, horse and [illegible] interest attaches to the working of the many miles of open-conduit electric lines in Manhattan Borough which have been put in service during the past [illegible] the electrical conditions of the underground conductors, especially at switches and crossings where salt was freely used. Salty snow and water pushed into the slot by the plows formed short circuits across their contacts and burned out many equipments, the dead cars being only a hindrance to those that followed. Such a storm, however, very rarely visits New York City, so that the experience is not likely to be repeated. With a sufficient battery of sweepers to keep the tracks free of snow as it falls such a general tie-up will probably never occur again. The electric conduit can, however, hardly be blamed, as the overhead trolley lines in the neighboring districts suffered just as badly.

AT THE MEETING of the American Institute of Electrical Engineers held on the evening of November 23 a paper by F. W. Carter, of London, England, entitled "The Design of Transformers," was read by Prof. W. S. Franklin, of Lehigh University, in the absence of the author. Mr. Carter's paper discussed the design of transformers solely from the point of view of minimum loss with one or another of several conditions, such as dimensions, etc., fixed. The discussion was entirely mathematical in character, and did not take into account the many circumstances of transformer design which cannot be expressed in formulæ, such as insulation, ease of rewinding, circulation of air and oil, etc. The discussion, owing to the difficulty of following the mathematical reasoning during the brief time devoted to the reading, degenerated into an argument as to whether scientific principles are or are not followed in practical transformer design. At the meeting of the executive committee of the Institute which was held in the afternoon the following named gentlemen were elected associate members: Cleveland Abbe, professor of meteorology, the weather bureau, Washington, D. C.; John Cassidy, superintendent Mutual Telephone Company, Honolulu, Hawaiian Islands, U. S. A.; James Francis Cosgrove, locomotive engineering department International Correspondence School, Scranton, Pa.; Donald Hume Fry, San Francisco, Cal.; James Hamilton, patent attorney, Boston, Mass.; Bernhard Hoffmann, New York Telephone Company, New York city; Harry D. James, draughtsman, Otis Brothers & Co., Yonkers, N. Y.; S. L. G. Knox, first assistant engineer, Crocker-Wheeler Electric Company, Ampere, N. J.; Howard Wallace Leitch, the Edison Electric Illuminating Company, Brooklyn, N. Y.; R. W. Lohmann, electrical engineer, Oakland, Cal.; C. Stowe Reno, electrical engineer, Triumph Electric Company, Cincinnati, Ohio; R. H. Sperling, assistant engineer, British Columbia Electric Railway Company, Ltd., Victoria, B. C.; James Wilkinson, chief engineer, Consolidated Electric Light Company, Birmingham, Ala.; A. Wilford Zahn, electrical engineer and superintendent, Manhattan Light, Heat & Power Company, St. Paul, Minn. The following named associate members were transferred to full membership: Franklin Robert Anson, secretary and manager, Salem Light & Traction Company, Salem, Ore.; Sidney Hand Browne, consulting electrical engineer, Baltimore, Md., and A. E. Brooke-Ridley, Siemens & Halske Electric Company, San Francisco, Cal. The committee on co-operative research, having completed the first stage of its work, has sent to various collegiate electrical engineering departments an explanatory circular, submitting twenty-seven subjects for their investigation.

NEW ENGLAND NOTES.

THE EDISON ELECTRIC ILLUMINATING COMPANY of Boston is distributing at the Exhibition of the Massachusetts Charitable Mechanic Association a neat little catalogue of its own exhibits. Every type of apparatus is listed and a little description given in each case. In the description of the heating apparatus, the cost per hour for the operation of heating utensils for a great variety of purposes is given. It is an interesting little catalogue and well gotten up.

VENTILATING THE BOSTON SUBWAY.—The thorough ventilation of the Boston Subway as well as the prevention of any possible moisture is receiving the careful attention that it deserves. A thorough circulation of air is necessary, and is to be secured by the operation of four special electric fans recently constructed and installed by the B. F. Sturtevant Company, of Boston. These are of the cone type, two of them 7 feet in diameter and two 8 feet in diameter. Each is driven by a special Sturtevant direct-connected motor, and operating together they have a capacity equivalent to changing the air in that portion of the subway with which they connect once in fifteen minutes.

THANKSGIVING GREETING FROM PROVIDENCE.—The American Electrical Works, Providence, R. I., never forgets its friends on holiday occasions. Their Thanksgiving greeting this year consists of a card in three folds, the central one of which contains a few thoughts appropriate to the occasion, and on the two end folds are illustrations of the ingredients of a Thanksgiving [illegible]. The whole idea has a "point," but the point is hidden in a little wooden tube which contains a needle and thread to sew up the turkey. The needle and thread are real, and the needle point is real, but, alas, the turkey is not quite so substantial. Indeed, it is no turkey at all, but only a picture [illegible]. However, the deficiency in this respect is offset by the warmth of the [illegible].

PHILADELPHIA NOTES.

LIGHTNING AND LIGHTNING ARRESTERS.—Mr. Alexander J. Wurts, of the Westinghouse Electric Company, of Pittsburg, Pa., read a paper on the evening of November [illegible] before the electrical section of the Franklin Institute, on "Lightning and Lightning Arresters." Mr. Wurts said in substance: In earlier days, when people were more superstitious than now, fires were lighted and bells rung to drive away the dreaded lightning, but when Benjamin Franklin established the identity between lightning and electricity people were glad to accept the results of his experiments and adopt so reasonable a device as a lightning rod. The lightning rod was a reasonable device at that time, because the public mind was ripe for it, and Franklin had shown that not only would the rod prove a good conductor, but that points on its upper terminals would in certain circumstances prevent the lightning discharge. (Experiments were then shown illustrating these principles.) But now, after 100 years' experience, and with statistics before us, this means of protection has lost much in popularity. Aside from public buildings and houses of the less intelligent class of people, the rod is rarely seen. Statistics show that in nine years, ending 1895, in the United States, there were 4175 fires, with a loss of $14,000,000. During ten years, ending 1893, there were 2679 barns, 129 churches and 831 dwellings struck by lightning, less than 100 dwellings a year out of the millions in this country. During five years, ending 1894, there was a maximum loss of 336 lives. These figures are certainly not alarming, but do seem to warrant in general the use of the lightning rod. Nevertheless, the speaker recommended this device for costly and prominent buildings, for tall monuments, church spires, brick chimneys, etc., especially in rural districts. Experiments were then shown to illustrate how the lightning stroke gathered into a bolt. It was also shown that the kind of metal of which the rod is constructed is of small importance. Globular lightning was thought to be a fact, and a letter from an eye-witness was read. Some interesting experiments were then shown, illustrating the damage done to electrical apparatus during the thunderstorms. Various devices designed for the protection of dynamos and motors were displayed on the table. In conclusion Mr. Wurts stated that although much has been learned in recent years about lightning and atmospheric electricity, nevertheless there are still mysteries to be solved in this fascinating field of natural science.

BUFFALO AND NIAGARA FALLS NOTES.

THE NIAGARA POWER COMPANY has closed a contract with the Electric Lead Reduction Company, which makes use of an electro-chemical process in its manufactures and will take quite an amount of power. It will occupy the building of the Chemical Construction Company near the power house.

IT IS ANNOUNCED that James Morton, of the firm of Alexander Morton & Co., carpet manufacturers, of Scotland, is at Niagara Falls negotiating for electric power with which to run a large factory which is to be a branch of the home concern. An arrangement has already been made, but the particulars have not yet been made public.

AN EFFORT is being made to consolidate the Ely and Smith trolley lines from Buffalo northward. This will, if accomplished, practically reduce the four competing lines to Tonawanda to one, as the north line has been abandoned and the Kenmore line now belongs to the Ely Company. It was folly to undertake so many roads, for they soon fell to cutting rates and carried passengers for a nickel, at which none of the roads could pay expenses.

THE UNION CARBIDE COMPANY has closed a contract with the Niagara Falls Power Company for 15,000 additional electrical horse-power to be delivered during the next summer. In order to utilize this large amount of power new works on an extensive scale will be constructed at once. The existing works of the Carbide Company will be continued. The new buildings will be located on the power company's land, and one of them will be two stories high and over 800 feet long.

THERE IS some disappointment felt in Buffalo on account of the slow development of demand for Niagara power, and there are capitalists there who claim that the power company does not care to sell much current in Buffalo, preferring to concentrate everything near its works, where it has land in quantity to sell. There may be a grain of truth in this, but at the same time it appears to have been the aim of the company to accommodate all comers, here or there. It may prefer to capture new concerns on its own territory, but an electrical engineer is doubtless right when he says that the company never built a line to Buffalo costing half a million or so, just for a bluff. Business will come in time.

CHICAGO NOTE.

"THE ELECTRIC MOTOR-VEHICLE" was the title of a paper read before the Chicago Electrical Association on November 18, by Mr. C. E. Woods. The speaker took a very enthusiastic view as to the future of electric vehicles, based upon the following facts: Sanitary conditions attending their use; lesser cost of maintenance as compared with horses; rapidity of movement; less space occupied in streets and stables, and freedom from expense when not in use, all of which entirely offsets the objections which first appear as to greater initial cost. He traced the development of the modern electric vehicle, and cited his own experience in this line of work. Three years ago he thought it would never be possible to build one with any mileage capacity at all at a less weight than 1800 or 2000 pounds, yet to-day he has vehicles in operation which weigh 800 pounds, including everything, having a mileage capacity of about 28 miles on one charge of the batteries. This vehicle is equipped with one 2½-hp motor, thirty-six cells of sixteen ampere-hours capacity for two hours, which run the vehicle at a speed of 14 miles an hour, carrying two persons. The batteries weigh 440 pounds, the balance being in the motor and vehicle. He builds equipments of four classes, viz., for two persons; for a top carriage or a heavy buggy; for a trap or brake for four passengers, and for commercial delivery wagons and heavy cabs. These range in weight, complete, from 800 pounds to 2400 pounds. In the first equipment thirty-six cells of battery are used, and in the other three forty cells each. Mr. Woods then gave a condensed compilation of the tests made with one of his large cabs. For this vehicle he designed two motors of 3½ nominal horse-power, each of which was capable of running the vehicle at a slight overload under normal conditions of roadway. The tests of the cab on a macadam and asphalt road showed very little difference, and at a speed of 12 miles an hour took 45 amperes at 72 volts at the motor terminals. The vehicle has a total load capacity of 3200 pounds, including the weight of four persons, and it carries forty cells of battery. He called attention to the very great difference in the amount of power consumed in the use of rubber tires. He tried a new tire on the cab and it consumed 18 per cent. more power than the ones he had been regularly using. He has determined by careful tests that the hard-rubber tire is far preferable to the pneumatic tire for use on electric vehicles, without any reference to first cost, durability or freedom from puncture. The pneumatic tire absorbs more energy by about 20 per cent. when inflated, and by a very considerable increase when it becomes deflated to different points of pressure. He has adopted exclusively the series paralleling of the batteries, and has found three speeds to be sufficient for practical purposes. The matter of allowable speeds was also touched upon, and he considered that 14 miles an hour was about the practical limit for large vehicles, although he has run a light road buggy at a speed of 20 miles an hour with a load of 800 pounds. The vehicle could be handled with a reasonable degree of safety on boulevards and parks. He expressed the hope that those directly interested in the development of the storage battery for motor-vehicle work will impart some information regarding the difficulties they have had to overcome. In his own experience he has found that the storage battery has more than met his expectations, both in capacity, weight and durability, and with such improvements as may be made from this time on there need be no further anxiety regarding the success of the storage battery in such work.

ST. LOUIS NOTES.

THE CENTRAL UNION LONG-DISTANCE TELEPHONE COMPANY has completed its line from Centralia, Ill., to Ashley, Ill., giving Centralia, Richview and Ashley direct communication with St. Louis.

THE ST. LOUIS COUNTY STREET RAILROAD.—The County Court is considering a proposition of the St. Louis County Street Railroad to convert its motive power from horse-power to electric. The court is also considering the right of the company to build west of the Wabash tracks. Preparations are being made to begin work at once on the construction of a double track from the city limits.

THE FIRE ALARM DEPARTMENT continues to have trouble with corporations which have placed their wires underground. George A. Warrance, superintendent of construction for the Missouri Edison Electric Company, was arrested a few days ago on a charge of interfering with the fire-alarm system. He was complying with the ordinance requiring the removal of poles.

PACIFIC COAST NOTES.

MR. W. S. HEGER, of San Francisco, the Pacific Coast district agent of the Westinghouse Electric & Manufacturing Company, recently visited Pittsburg, Pa., and other Eastern cities.

THE MARKET STREET RAILWAY COMPANY, San Francisco, will extend its Folsom Street electric line from its present terminus along the San Bruno road to the Five-Mile House. The company is welding its rail joints on Kearny Street, using the Falk system.

MR. HENRY H. BECK, who was for eleven years manager of the American District Telegraph Company in this city, died in Oakland, on November 13, after an operation for an intestinal trouble. He was a native of Bohemia, Austria. About two months ago he resigned his position to become president and superintendent of the Oakland Burglar & Fire Alarm Company. He leaves a widow and a son.

THE MUTUAL ELECTRIC LIGHT COMPANY, San Francisco, will probably be authorized to erect overhead wires in accordance with a recent decision by Judge Seawell. The decision is in a suit brought by the Mutual Company against the mayor and the board of supervisors. It holds, substantially, that as long as the San Francisco Gas & Electric Company is permitted to maintain posts and poles for the stringing of overhead wires it is the legal duty of the supervisiors to grant the rival corporation a similar privilege.

CANADIAN NOTES.

THE WILSON CARBIDE COMPANY, of St. Catharines, Ont., states that calcium carbide has gone up 30 cents per cwt., and that the demand for it is so great that it is impossible to buy it in quantities of more than 500 pounds.

MR. C. J. BALLANTYNE, of Honolulu, formerly a resident of Ottawa, is now in that city. Recently he organized a company, and bought the franchise to operate an electric railway in Honolulu. He is now on a visit to the leading American and Canadian cities with the object of purchasing a plant, and also studying the systems upon which electric roads are operated.

THE LUNENBURG GAS COMPANY, of Lunenburg, Nova Scotia, is changing its electric plant from steam to water power. It has a 16-foot dam nearly completed on the Mush-Mush River at Mahone, 8 miles from Lunenburg. The water wheel is from the works of the S. Morgan Smith Company, York, Pa., and is one of its "New Success" turbines. The company will light the town of Mahone, in addition to supplying light and power to Lunenburg.

ON NOVEMBER 18 the shareholders of the Royal Electric Company, of Montreal, met to consider the proposal of the directors to increase the capital stock of the company, which stock is now $1,500,000, by the issuance of 2500 shares for the nominal value of $100 each, to be offered to shareholders; and also to effect loans by the issuance of mortgage or hypothecary bonds or debentures to an amount not exceeding in the aggregate 75 per cent. of the paid up capital stock. The proposal, however, did not meet with the favor of the shareholders, and it was voted down by a majority of 932 shares.

THE METROPOLITAN ELECTRIC COMPANY will be supplying electric light, power and heat to the city of Ottawa probably by the end of March next. The survey of the company's water power at the Britannia Rapids, about ten miles from Ottawa, has been completed, and everything is now ready for the work of constructing the power-house and arranging for the transmission of electricity. Tenders have been called for, and about the 1st of December operations will be started. The Metropolitan company has two lines under construction for the transmission of the electric power. Only one of these, however, will be operated at present. Through a point of land on the Ontario shore of the Ottawa River which juts out into the Britannia Rapids a canal of about 125 yards long and 20 feet wide will be made. At the foot of this canal will be built the power-house, and the water from the rapids will be concentrated in the canal.

THE ONTARIO GOVERNMENT will probably ask the courts to determine whether or not the Niagara Power Company has forfeited the charter which it obtained from the provincial authorities. The agreement between the Government and the company called for the development of 10,000 horse-power by the first of November last, and 25,000 horse-power at a later period. The Government takes the view that the company has not fulfilled the first of these conditions, and that it has therefore no further right to the charter. The company on the other hand points out that under another section of the agreement the charter was only to be forfeited in the event of a failure to transmit electricity. It claims that it has been impossible to comply with the latter condition, as up to a very recent period the problem of long-distance transmission had not been solved. Furthermore, the company says it cannot fulfill the contract to supply electrical energy, because there is no demand for it.

FRENCH NOTES.

ELECTRIC CABS IN PARIS.—The Compagnie Générale des Voitures has placed twenty electric cabs on the streets of Paris. To this contingent should be added Cab No. 16,000, belonging to the Compagnie des Transports Automobiles, which has been on the streets for some time, taking fares at usual rates.

ELECTRICITY IN THE DEPARTMENT DE L'AIN.—The townships of Dortan, Arbent and Marchon and the canton of Oyonnax will shortly have an electric light and power service. The energy will be furnished by the River Ain. The works are already under way near Condes, a few miles from Dortan, above the junction of the Bienne with the Ain. The power developed will be very large, the figure running up into thousands of horse-power. The dam, which is the largest part of the work, is nearly done. Overhead lines will be used to transmit the current to the towns, where it will be transformed and distributed for light and power. The industries of these towns will be greatly benefited. The Falls of the Ain will supply energy to a number of other places besides those mentioned, notably to Saint-Claude.

MEETING OF THE NATIONAL SOCIETY OF ELECTRICIANS.—The regular meeting of the National Society of Electricians was held on November 9, with President M. R. V. Picou in the chair. The first subject presented was that of charging for electrical energy, M. Pellissier calling attention to the fact that profits mav be increased by reduced rates owing to the increased load obtainable and consequent reduced cost per kw-hour, which may be greater than the reduction in the tariff. After a discussion of day loads, motor rates, etc., he described the Wright demand system. M. de Marchena followed with a description of the new electric traction system installed by the French Thomson-Houston Company in Paris between Aubervilliers, Pantin and la Place de la République. This is supplied with the overhead trolley outside the city limits and accumulators on the urban lines. Each car carries a battery of 224 cells, with a capacity of 35-ampere hours, made by la Société Pour la Travail Electrique des Métiers. The cars have seats for fifty-six passengers, twenty-eight outside and twenty-eight inside. The generating station at Aubervilliers contains three Roser boilers of 300 horse-power each, three horizontal Corliss-type engines of 250 horse-power each and three compound-wound, six-pole, 150-kw Thomson-Houston dynamos, arranged to give 575 volts for charging the accumulators in the station. At the end of the meeting M. Maurice Le Blanc described a new method of compounding alternating dynamos for [illegible]

THE ELECTRIC LIGHTING OF THE CHAMBER OF DEPUTIES.—The electric light plant installed in the Palais Bourbon for lighting the Chamber of Deputies and the Presidential Mansion is chiefly notable for its use of gas engines. These machines were used to avoid building a high chimney and also the escape of smoke and the introduction of a large [illegible] There are two gas engines of 30 horse-power running at 150 r. p. m., and four engines of 50 horse-power running at 165 r. p. m. The present capacity of 260 horse-power is sufficient only for present needs, and it is expected that the capacity will be increased by the substitu[illegible], and by the addition of two [illegible] and a larger battery. The plant [illegible] Palais Bourbon. The engines are [illegible] Water tanks located [illegible] to keep the plant running [illegible] negative plates each. Its present capacity is 1250 ampere hours for a five-hour [illegible] deliberating hall, the electrical illumination of which will be much more ex[illegible]

COMPETITION IN LYONS.—[illegible] be distributed by underground conduits to customers. The necessary apparatus is subject to patents owned by the company. The Gas Company objected on the ground that the Electric Power Company intended to tap the overhead wires, and it memorialized the city government on this subject. The Electric Power Company, however, agreed not to do this, for the present at least, confining its taps to the underground system. The Municipal Council, believing that no one could possibly find any grounds for legitimate objection to tapping the underground conduits, granted the desired permission with the following conditions: 1. All taps must be made from the underground feeders where such exist. 2. No tap will be allowed from the trolley without special permission for each case, obtained from the City Council. It would seem, then, that a railway franchise may carry with it the right to furnish light and power if the sole right to do this has not already been granted. In consequence Lyons is full of railway promoters; but it will not always be possible to utilize the surplus power easily. Customers will not always be found on the line of the railway. First, the excess of power must be available, and next, a special permission must be obtained to sell it. The cost is also a factor, if the current has got to be stored and transformed in the manner in which the Lyons Electric Power Company proposes to go about it. It is true that the company expects to obtain special permission to supply power directly from the trolley in the suburban districts. Another trouble which will come up is the low price which the inhabitants of Lyons will be able to force on the supply of current owing to the presence of three competitors. The Jouage Canal Company may be expected to reason as follows: "My chief profit comes from the supply of power; I can afford to sell light cheap." The Street Railway Company will say: "My profits are made in my cars; I can afford to sell light cheap." And the Gas Company also has good reason to say to itself that it is the new improvements which have been introduced in the utilization of gas which will show the greatest margin of profit, especially considering the almost daily increase in the use of gas for heating and power. The Electric Power Company has already offered to furnish lighting at a maximum price of 16 cents per kilowatt, accompanied by a sliding scale to reduce the price, according to the amount consumed. To the municipality a price of 12 cents per kilowatt hour has been made.

A SWISS INSPECTION BUREAU FOR ELECTRIC CENTRAL STATIONS.—The Swiss Society of Electricians has organized an inspection bureau for central stations, which provides a useful and effective service. It is to be hoped that other countries will soon be supplied with similar institutions. The traiff, which seems reasonable, is arranged as follows: (A) For central stations which sell current (these stations must be members of the Swiss Society of Electricians); yearly dues, 1½ per cent. of the capital chargeable to the electrical portion of the installation, accumulators being put in at one-fifth of their cost; minimum charge, $20; maximum, $300. (B) For central and isolated plants generating current for their own consumption only: (a) generating stations with switchboards and interior wiring. For a single machine the charge is $2 per year. For each additional machine $1; (b), motor stations with switchboard and interior wiring. For a single machine the charge is $2 per year. Motors rated at less than 1 horse-power are charged for as lamps on a basis of ten lamps per horse-power; (c) for incandescent lamps and wiring; the charges are as follows:

Lamps Connected.	Yearly Cost of Inspection.	Lamps Connected.	Yearly Cost of Inspection.
50 or less	$3.00	701 to 800	$17.00
51 to 75	4.00	801 to 900	18.50
76 to 100	5.00	901 to 1000	20.00
101 to 150	6.00	1001 to 1100	21.00
151 to 200	7.50	1101 to 1200	22.00
201 to 300	9.00	1201 to 1300	23.00
301 to 400	11.00	1301 to 1400	24.00
401 to 500	12.50	1401 to 1600	25.00
501 to 600	14.00	1601 to 1800	26.00
601 to 700	15.50	1801 to 2000	27.00

No distinction is made for difference in candle power of lamps. One arc lamp is rated equal to ten incandescents; (d) transformer stations, with switchboards and interior wiring. The yearly charge is $2 for each station; (e) underground and overhead distributing systems: Overhead lines, for the first 2 kilometres the charge is $4 per year per kilometre. Additional lines are $2 per year per kilometre. Underground wires are $2 per year per kilometre. (f) accumulators: Batteries up to 50 kilowatts at $2 per year; batteries of 100 kilowatts or above, $6 per year. Notes.—The classes under (b), (c) and (d) include all wiring within 100 metres of the generator. Both tariffs apply throughout Switzerland. Tariff A includes traveling expenses, tariff B applies only to such stations as can be reached by railway lines giving reduction on mileage. If it becomes necessary to travel over other roads or to go by boat, stage or special conveyance, the extra expense is charged up.

ELECTRIC CRANES FOR THE EXPOSITION OF 1900.—French manufacturers have been invited to submit proposals for the erection and operation of two electric traveling cranes for use in the Hall of Motive Machinery at the Exposition of 1900. The transmission of energy by electricity will receive a very interesting application in these machines, which are to play a very important part in the location and erection of the machinery to be exhibited at the Exposition. The details of the competition were drawn up by M. Gugenet, chief engineer in charge of maintenance and erection apparatus, and presented by M. Delaunay-Belleville, director general of operation, to M. Alfred Picard, commissioner general, who approved it. The requirements include the construction, erection, operation and the final removal of the cranes and their supports and ways. The apparatus, which is installed, will be entered in the catalogue and passed upon by the international jury, and will therefore be in competition for prizes. The capacity of these machines will be 25 tons each, with a span of [illegible] feet, and a height above the ground of 48½ feet. The travel will be [illegible] feet, and the machines must be capable of operating at the following rates for slow speed and double these rates for high speed: Rate of lifting, 4½ feet per minute; rate of travel of the carriage, [illegible] feet per minute; rate of travel of the whole machine, 58 feet per minute. The whole structure is to be composed of sheet metal rods and angle irons all of steel, and must be built so that no part of the structure will receive a strain exceeding 14,000 pounds per square inch. The motive power will be electricity, supplied in such a way that the conductors will be out of reach of the general public. The question of location of the motor, whether it is to be stationary and at the end of the travel or mounted on the crane itself, is optional with each designer. The crane is to be supported on eight-wheeled trucks, running on double rails laid on oak sleepers. The rails will be held together by rods sufficiently numerous to form practically a toothed rack, upon which will act cog-wheels which move the crane. Friction clutches will be used wherever possible to avoid sudden shocks. The proposal sets forth all the conditions of the competition. The machines must be built and set up in their shops within six months, painted and transported to the exposition grounds within seven months, erected and ready for testing within nine months. They will have to stand a test under a load of 30 tons. Special requests of the competitors and their guarantees and the lists of similar machines erected by them will be examined by a commission presided over by the director-general of operation, and composed of the financial director of the exposition, the secretary-general and the chief engineer of maintenance and erecting machinery. The designs selected by these men will be examined and classified by a jury whose chairman will be the director-general of operation, and on which will serve the chiefs of the architectural department, the chief engineer of maintenance and erecting machinery, the engineer in charge of all metal constructions, the engineer in charge of the mechanical and electrical exhibits, the president of the technical committee on machines, with the president of the third sub-division of this committee, and finally the president, vice-president and secretary of the committee on the admission of Class 21 (general mechanical apparatus). Manufacturers who wish to enter this competition must send written notice of their intentions to the general commissioner of the Exposition of 1900. The two successful cranes will be ready for use by exhibitors by October 1, 1899, and will remain in service until February 1, 1901. It seems unlikely that the public will be allowed to ride on these machines. Nevertheless, it should be remembered that at the Exposition of 1889 two similar electric traveling cranes in Machinery Hall were very successful as exhibits. It is true that they were somewhat differently arranged from those which will be used in 1900. They spanned 70 feet and traveled a distance of nearly 1600 feet on rails, carrying 150 passengers at each trip. The carrying of passengers was, of course, simply an afterthought, the object of their existence being to facilitate the setting up and removal of the mechanical exhibits.

General News.

THE TELEGRAPH AND TELEPHONE.

LONDON, ONT.—The People's Telephone Company, according to reports, intends to install a plant here at once.

DALLAS, TEX.—The new long-distance telephone service between Dallas, Memphis, New York, Chicago and St. Louis will, it is expected, be inaugurated early in December.

KANSAS CITY, MO.—The recent blizzard wrought considerable damage to telephone and telegraph wires in this city and surrounding towns. Street railway traffic was also interfered with.

SPENCER, IA.—The Citizens' Telephone Company, of Spencer, has filed articles of incorporation. The capital is $10,000. The incorporators and directors are: O. E. Sully, William Flindt, Ackley Hubbard, C. J. Mikish and J. F. Green.

LANSING, MICH.—As the result of the refusal of the Bell Telephone Company to use poles jointly with the Lansing Telephone Company, every Bell telephone has been removed from the city offices and departments by order of the common council.

PASSAIC, N. J.—The New York & New Jersey Telephone Company is making plans to erect a building in this city for its own use. The exchange will be a modern fireproof structure of stone and two or three stories high, and will be similar to those in Elizabeth and Morristown.

COLUMBUS, OHIO.—The Interstate Telephone Company, of Cleveland, has been incorporated by J. A. Rutherford, Scott R. Hayes, C. B. Arthur, R. M. Fuller, and O. C. Evans. The company proposes to construct and operate a line from Cleveland to Cincinnati, with branches. The capital stock is $25,000.

BOSTON, MASS.—It is stated that it is proposed to reorganize the companies in the Western Electric Telephone system by combining them in one company, with a capital stock of $500,000. Companies owning nearly 4000 miles of toll lines have virtually consented to come into the new arrangement. These companies, it is stated, all use the Bell instruments, and have contracts with the Northwestern Exchange Telephone Company and the Iowa Telephone Company.

BOSTON, MASS.—The Erie Telegraph & Telephone Company has recently introduced in Texas a new class of service that is known as the "one way five-party service." That is, one may have a telephone in his residence from which he can communicate with all the subscribers connected with the exchange at the rate of $12 per annum, but no one is allowed to call this subscriber, and his name is not listed on the books. This same class of service is furnished for business purposes at $15 per annum.

ALBANY, N. Y.—The New Rochelle & Westchester Telephone Company has been incorporated here to operate in New York, Massachusetts, Connecticut and Rhode Island. The capital stock of the company is $150,000, and the directors are Heinrich Mayer, New York; H. A. Connor and F. H. Kellog, Brooklyn, and others. It is stated to be the purpose of this company to establish exchanges in the smaller cities and eventually to connect different cities. For the present the business will be confined to a system between New Rochelle and Mamaroneck. It is stated that the company will use the Phœnix electric telephone appliances.

NORFOLK, VA.—The Southern States Telephone Company has just completed a modern private telephone system for the Norfolk & Portsmouth Belt Line Railroad. In addition to the telephones a switchboard has been installed in the superintendent's office, which enables the connection of any station on the belt line with any line of the Southern States Telephone Company. A telephone has also been installed in the keeper's tower on the drawbridge. The wires are so arranged that the opening of the draw does not interfere with the service. Superintendent Pannill and his assistants, Messrs. Cole and Miller, designed and installed this plant.

NEW BEDFORD, MASS.—The Automatic Telephone Company, which was recently organized here, will, as soon as 500 subscribers have been obtained, begin the construction of a first-class underground telephone system, with a private metallic circuit and long-distance instruments for each subscriber. It is stated that 400 subscribers have already been obtained. The company has a capital stock of $100,000, and its incorporators are prominent business men of New Bedford. The officers and directors of the company are: President, John W. Macomber; vice-president, F. T. Akin; treasurer, Frederick Taber; clerk, Arthur E. Perry. Directors, the above-named gentlemen and B. F. Brownell, Lot B. Bates, Frank R. Kirby, Joseph Poisson and J. L. Gillingham.

NEWARK, N. J.—During the past year or two great improvements have been made in apparatus for central telephone exchange offices. The Newark Telephone Company, of Newark, N. J., has just installed a new central office equipment that is said to possess novel features of an extraordinary nature never before introduced in a central office exchange. It does its work so rapidly that a great deal of time and money is saved, requiring fewer operators and at the same time giving better service. The Newark Telephone Company is an opposition to the Bell, and the success of this exchange equipment is said to be highly successful. This exchange is connected directly with 2100 local subscribers, and also has connections with sub-stations, giving it a total of over 3100 connections.

ELECTRIC LIGHT AND POWER.

INGERSOLL, ONT.—The Town Council has appointed a committee to negotiate the purchase of the waterworks and electric light plant.

LINCOLN, ILL.—The receiver of the Lincoln Water, Light & Power Company has placed an order for a 120-kw alternator with the Royal Electric Company, of Peoria, Ill.

LANCASTER, PA.—The Lancaster Light, Heat & Power Company has executed a mortgage for $100,000, the proceeds to be applied to increasing the capacity of the plant.

ELWOOD, PA.—A special election will be held on December 20 to secure the consent of voters for an issue of bonds in the sum of $8000 for the purpose of building an electric light plant.

PITTSBURG, PA.—Mr. G. H. Winslow, a consulting electrical engineer of this city, is preparing plans and specifications for an electric light plant for a manufacturing company in this vicinity.

HAMILTON, ONT.—Mr. Percy Domville has been instructed by the special electric light committee to prepare an estimate for an electric lighting plant of 300 arc and 3000 incandescent lights capacity.

HAZLEHURST, MISS.—The material has arrived for the electric light plant, but as there exists some misunderstanding between the city and the electric light company, further proceedings have been postponed for the present.

AVOCA, PA.—The Standard Electric Light, Heat & Power Company of this place has been reorganized, and extensive improvements have been made in the arc and incandescent services. Mr. Howard, late electrician for the Weston Engine Company, Painted Post, N. Y., has been appointed superintendent.

DURING THE QUARTER ended March 31 last the value of carbons exported from Vienna for the United States was $5,924, and similar goods to the value of $10,115 were exported to the United States from Nuremberg, Germany, during the same period. From Rheims, France, came "electric machinery" to the value of $51.43, and from St. Catharines, Ont., calcium carbide valued at $1764 was brought into the country.

PHILADELPHIA, PA.—It is stated that a deal is being engineered in this city having for its object the consolidation of the three electric light plants in Baltimore, namely, the Brush, Edison and Northern companies. It is stated that a banking house has secured options on the bonds and stocks of the Baltimore companies. The three concerns are capitalized jointly at $2,899,000, and their total issue of bonds amounts to $1,874,000. The plan is to deposit these securities in trust as security for an issue of $4,000,000 5 per cent. thirty-year collateral trust and mortgage bonds of the consolidated company, to be additionally secured by a mortgage on all the property and plants.

BATESVILLE, MISS.—An electric light plant is to be established in this place, the Hon. L. L. Pearson, through his agent, Mr. D. L. Rush, having contracted with R. S. Stearn, of New Orleans, agent for the Fort Wayne Electric Corporation, for all the necessary equipment for 300 lights. The plant is to be in operation within sixty days. It will consist of one 660-light Fort Wayne alternator, with all the necessary station instruments; Fort Wayne transformers, one 65-hp high-speed automatic engine and two 40-hp boilers. Mr Pearson will equip his new opera house with a number of modern electrical appliances, and will light it with 100 16-cp lamps, or their equivalent. Mr. D. L. Rush will superintend the construction of the plant. White cedar poles will be used throughout, and everything will be first-class and up to date.

THE ELECTRIC RAILWAY.

OMAHA, NEB.—An anti-car-crowding society is the latest organization in Omaha. The society is the outgrowth of long suffering from crowded cars. The organization was effected at a mass-meeting a few days ago.

BRIDGETOWN, ONT.—A meeting of gentlemen interested in securing an electric railway between Thamesville, Bridgetown and Rondeau Park was held here, and it was decided to apply for a charter as soon as the necessary funds could be secured.

KENOSHA, WIS.—President Calkins of the City Council, who is acting mayor, has vetoed the ordinance passed October 24 granting the Milwaukee, Racine & Kenosha Electric Railway Company a franchise to construct its road through the city of Kenosha.

VICTORIA, B. C.—On behalf of a Victoria syndicate Messrs. W. Jensen and S. Goodacre give notice of application for incorporation of the Hardy Tramway Company to build an electric railway from Hardy Bay to Cold Bay, Yuatsino Sound, a distance of 8 miles.

BOSTON, MASS.—The railroad commissioners have authorized an additional issue of $100,000 stock and $50,000 5 per cent. twenty-year bonds by the West Roxbury & Roslindale Street Railway Company for the purpose of funding the floating debt and for extensions and equipment.

BALTIMORE, MD.—The Baltimore Traction Company has declared a final dividend of about 1½ per cent. This winds up the affairs of the company and distributes what was left of its assets after the absorption of the property by the Consolidated Railway, formed by merging the City & Suburban and the Traction companies. The dividend is payable on stock of record of June 30, 1897.

NEW YORK, N. Y.—A Brooklyn newspaper is authority for the statement that the deal between the Brooklyn Rapid Transit Company and the Nassau Electric Railroad Company, which has been talked of a great deal recently, was consummated on the afternoon of November 22, and that the formal papers in the matter were signed in Manhattan that same afternoon. Under this arrangement the Rapid Transit Company acquires the control of the Nassau system.

EAST LIVERPOOL, OHIO.—A syndicate of New York, Philadelphia and Chicago men will build an electric freight road over the Ohio River hills from this city, 18 miles to Lisbon, the county seat. This city is to raise $60,000 bonus, the subscribers to be reimbursed by freight traffic certificates. Already $10,000 has been subscribed. In Madison township lies the largest undeveloped coal fields in the State. The syndicate has obtained options on 12,000 acres of coal, and will mine coal by electricity.

WEST CHESTER, PA.—The Pennsylvania Railroad Company has served an injunction on the Philadelphia, Castle Rock & West Chester Trolley Line Company, to restrain the latter from crossing its road by using a bridge on Gay Street, the bridge having been built by the Pennsylvania Railroad Company several years ago. The tracks of the trolley line are now at the eastern line of the town, and but for this legal procedure would have been laid in the town inside of a few days. The borough council has been appealed to by the defendant, and the matter is resting there for the present.

NEW YORK, N. Y.—The Fort George & Eleventh Avenue Railroad Company has been incorporated with a capital stock of $3,000,000. The directors are John T. Little, Jr., Ambrose F. McCabe, Fred C. Garrick, Frank F. Ogston and Sharon Graham, of New York City; Clement McCumming, of Yonkers; Charles A. Gilbert, of White Plains; William A. Dibbs, of Brooklyn, and D. C. Moorehead, of Jamaica. This company represents the consolidated interests of the North End Street Railway Company, the Fort George & Eleventh Avenue Railroad Company and the Fort George Extension Railway Company.

LANSDALE, PA.—A plan is on foot to connect Doylestown with the upper end of Bucks County by means of a trolley road from the county seat to Perkasie, Sellersville and Quakertown. At the latter place it is proposed to connect with the Quakertown and Richlandtown trolley. The borough council of Perkasie has passed an ordinance on first reading granting a franchise for the laying of tracks in the borough. The Sellersville officials have done likewise. The distance from Quakertown to Doylestown is about eighteen miles. The cost of the line is estimated at $8000 per mile.

NEW ORLEANS, LA.—The Street Railway Employees' Association is planning for an innovation in connection with the carnival that promises to add a very interesting feature. It is intended to give a carnival parade of street cars. The various car barns are taking up the matter, and a committee has been appointed from each of the seven stations. There will probably be two cars from each station and one gotten up by the traction management. These cars will be lighted with about 1000 lights, which will make a magnificent display, as the largest number ever put on a car here is 350. The seats will be taken out of summer cars and they will be made into floats.

WILKESBARRE, PA.—A trolley from Philadelphia to Delaware Water Gap, and [illegible] Capitalists are [illegible] Nazareth, a distance of 8 miles, [illegible] it is understood the road [illegible] Pen Argyl and Bangor, and from there [illegible] Water Gap. [illegible] therefore, [illegible]

NEW YORK, N. Y.—Borough President Edward M. Grout, of Brooklyn, [illegible]

[illegible]

AUGUSTA, ME.—The electric railroads of this State have not all prospered, as the reports of the various companies indicate. The Bangor, Camden & Winterport Company reports a deficit of $96.40, after paying operating expenses, interest and other charges. The Bangor Street Railway shows a net income from operation of $11,127. After paying interest and taxes a deficit of $1660 remains. The deficit last year was over $11,000. The Bath Street Railway shows a net income from operation of $71,132. A dividend of 2½ per cent. on the preferred stock was paid during the year. On June 30 a surplus of $1893 remained. The Calais Street Railway reports a net income from operation of $4743, and after paying interest charges and taxes a deficit of $1786 remains. This, however, was a reduction of nearly $8000 as compared with last year's deficit. The Portland Railroad shows a net income from operation of $94,568. After paying interest charges there remained a net divisible income of $63,049, and after paying 6 per cent. dividend on the common stock there remains a surplus of $33,391, which, added to that carried from last year, makes the total amount $54,397. Deducted from this, however, is $29,334 for profit and loss, construction, equipment, etc., leaving the surplus June 30, $25,053.

EDUCATIONAL NOTES.

ANNUAL INSPECTION TRIP.—During the week ending November 19 the annual inspection trip was made by the senior classes in electrical and mechanical engineering of the University of Wisconsin, Madison, Wis. The places visited were Cleveland, Pittsburg and Wheeling, and the plants of the following named concerns were visited: The Walker Company, the National Carbon Company, the Cleveland City Illuminating Company, the Cleveland & Painesville Electric Railway, the Cleveland Twist Drill Company, Warner & Swasey, Westinghouse Electric & Manufacturing Company, the Westinghouse Air Brake Company, Jones & Laughlin, the Homestead Mills and the Crescent Steel Company.

THE ELECTRICAL COURSES of the United Correspondence Schools, 156 Fifth Avenue, New York, it is stated, are giving satisfaction and are winning much popularity. There are two electric station engineering courses. It is stated that large numbers of station engineers, dynamo tenders, oilers, winders, draughtsmen, etc., have taken advantage of these courses, and as a result have secured more satisfactory positions and increased salaries. These schools also offer the following electrical courses: complete electrical engineering, electric lighting, electric railways, telegraph, telephone and electroplating, besides courses in mechanical, steam, civil and sanitary engineering. The schools will be pleased to send free a copy of their Circular F to any one on application.

LEGAL NOTE.

METER PATENTS.—Some two years ago suit was begun by the Westinghouse Electric & Manufacturing Company against the Citizens Lighting Company, of Brooklyn, N. Y., under two of the Shallenberger meter patents issued August 14, 1888, and numbered 388,003 and 388,004. The suit was directed specifically against the Scheeffer meter put upon the market by the Diamond Electric Company, of Peoria, Ill. Later—that is to say in June, 1897—other suits were brought against the same apparatus by the Tesla Electric Company and the Thomson-Houston Electric Company, respectively, under Tesla's transmission patents No. 511,559 and 511,560, December 26, 1893, and also under Elihu Thomson's electric meter patent No. 448,894, March 24, 1891. On November 28 decrees were entered in all the above mentioned suits, and the defendants were enjoined from further infringement of the said patents.

PERSONAL NOTES.

PROF. S. H. SHORT on December 1 resigned his position as second vice-president of the Walker Company. It is stated that he contemplates taking a trip abroad.

MR. E. F. PECK, who has been secretary of the Kings County Electric Light & Power Company, of Brooklyn, has been appointed assistant general superintendent of the same company.

MR. W. S. BARSTOW, who was general superintendent of the Edison Electric Illuminating Company, of Brooklyn, has received the appointment of general manager of the Kings County Electric Light & Power Company, which recently absorbed the Edison Company.

MR. A. A. THRESHER, of the Thresher Electric Company, Dayton, Ohio, visited New York on November 23, and hurried back again to Dayton to attend to the large line of work now being carried on by the company in power distributing plants, especially motor-driven printing establishments

Trade and Industrial Notes.

THE [illegible] ELECTRIC COMPANY, [illegible] has just issued [illegible] generators and trans[illegible]

THE CLEVELAND [illegible] COMPANY, Cleveland, Ohio, [illegible] Gold Medal at the [illegible] held at Omaha.

THE [illegible] ELECTRICAL MANUFACTURING & SUPPLY COMPANY, [illegible] wiring, etc.

THE ELECTRIC [illegible] COMPANY, Philadelphia, Pa., [illegible] plant in the Commercial [illegible] The plant [illegible]

"THE REEVES" WOOD-SPLIT PULLEY.—Messrs. Patterson, Gottfried & Hunter, Ltd., 146-150 Centre Street, New York, have just issued an illustrated catalogue and price-list of "The Reeves" wood-split pulley. Some valuable information is given in this small pamphlet, and all those interested in such matters should obtain a copy.

A HIGH-TENSION STORAGE BATTERY.—Improvements in the continuous pole of storage-battery plates, the negative of one cell being on its other side the positive of the next cell, designed by N. H. Edgerton, have been covered in a patent No. 614,539, issued November 22. An illustrated description of this battery appeared in THE ELECTRICAL WORLD of April 23, 1898.

THE TRIUMPH ELECTRIC COMPANY, Cincinnati, Ohio, reports meeting with a satisfactory demand for its new motor for direct connection to machine tools, printing presses, etc., which is described and illustrated elsewhere in this issue. A number of important orders have been filled for these machines for such uses, among the tools thus driven being some heavy punches.

THE BERLIN IRON BRIDGE COMPANY, East Berlin, Conn., is erecting for the Waterbury Manufacturing Company, Waterbury, Conn., a new blacksmith shop, which will be of fireproof construction throughout. The roof has steel trusses supporting the covering of corrugated iron lined with the Berlin Company's patent anti-condensation lining. The building is about 40 feet square.

MR. HENRY B. CUTTER, president and general manager of the Cutter Electrical & Manufacturing Company, Philadelphia, Pa., was in New York during the past week. In addition to its well-known specialties, "I-T-E" circuit breakers and "C. S." flush switches, this company has just begun the manufacture of rheostats, an illustrated description of which is published elsewhere in this issue.

MR. HERBERT B. COHO, manager of the New York office of the Eddy Electric Manufacturing Company, reports sales to the International Manufacturing Company, Electric Vehicle Company, Benjamin Eastwood, Paterson, N. J., and the Watson Machine Works, Paterson, N. J.; also a number of small equipments. The Eddy standard for excellence is maintained. Friends of the company will be welcomed at its new office, No. 143 Liberty Street.

AN IMPROVED TRANSFORMER STAMPING.—A method of bending plain rectangular plates into L-shaped and U-shaped stampings which may be readily stacked up to form the magnetic circuits of core-type transformers has been patented by Dugald C. and William B. Jackson, in patent No. 614,474, issued November 22, 1898. One-half of the rights has been assigned to William D. and James W. Packard, of Warren, Ohio.

THE CHAPMAN VOLTAGE REGULATOR.—Patent No. 613,853 was issued to Mr. W. H. Chapman, November 8, 1898, and assigned to the Belknap Motor Company, Portland, Me., covering improvements on the Chapman regulator. The improvements provide a more direct application of the power of the working solenoid to the contact slider of the rheostat, and arrange the retarding device so that it may be adjusted while the regulator is in service.

THE ELECTRIC APPLIANCE COMPANY'S new catalogue of telephone apparatus and telephone construction material, No. 14, the company reports, is being very well received by the telephone trade, and, judging from the orders for telephone material that are coming in, is being very extensively used. The Electric Appliance Company claims that this is the most complete catalogue of telephone supplies that has yet been issued. It will be pleased to supply copies free of charge to the telephone trade.

THE JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J., has during the past summer made an extension to its pencil factory, 40x90 feet and three stories high. The machinery is driven by electric power from the generator in the main factory. No expense has been spared in the equipment of this addition in the way of up-to-date elevators, furnaces, etc., and some time during 1899 various other additions to the extensive plant of the company will be built. This concern was established in 1827, and its products go into every known field of industry.

THE KRAJEWSKI-PESANT COMPANY announces that it has opened its wholesale and retail store in Havana, Cuba, at Calle O'Reilly 150, and is handling all kinds of machinery, especially electrical appliances. The company is represented in Havana by Mr. Norman H. Schneider, who was with the export department of the Western Electric Company, New York, for a number of years. The company is sole agent for a number of American firms and also for the British General Electric Company. Mr. Schneider reports having several plants to overhaul and put into running order.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, of St. Louis, Mo., has recently completed and is ready to furnish a device by means of which large church organs can be operated satisfactorily with the use of alternating current motors. This special adaptation of alternating current motors has been developed in response to numerous inquiries extending over a number of years, and the company believes that it is the only device on the market by which churches, placed beyond the reach of direct current, can operate their organ bellows with an electric motor. The Emerson Company would be glad to receive inquiries from interested parties.

"ENCLOSED ARC LAMPS" is the title of the latest pamphlet issued from the General Electric press. It deals with the different types of enclosed arc lamps manufactured by the General Electric Company for direct and alternating current circuits, indoor and outdoor lamps, marine lamps, miniature lamps, power circuit lamps, series enclosed lamps and single globe and double globe lamps. Each type is well illustrated, and the object of its design and its advantages set forth in language unhampered by abstruse technical expressions. It is written for the information of the general consumer as well as the electrician. The pamphlet will be sent to persons interested on application to any of the sales offices of the General Electric Company.

THE VICTOR TELEPHONE & MANUFACTURING COMPANY, Chicago, Ill., now has orders in its factory for about 1200 drops, the filling of which requires overtime work. The company reports that its goods are meeting with unpredecented favor. Among the exchanges installed during the past month was one of 100 capacity at Bunceton, Mo. The company has just issued its 1899 catalogue, which will be found of great interest to telephone people. It is a unique production of its kind, and gives a description and illustrations of the various styles of instruments made by this enterprising company. A copy will be sent to any one interested in telephone exchange work upon application to the company, whose headquarters are at 166-174 South Clinton Street.

A NEW OPEN-CIRCUIT BATTERY.—An improvement in batteries of the Leclanché type was the subject of patent No. 614,759, issued to Mr. Charles T. Richmond, November 22, 1898, and assigned to the National Carbon Company, of Cleveland, Ohio. The improvement consists in a porcelain cover with downwardly extending screw-threaded projection, on which may be screwed an internally threaded porous cup containing the usual carbon pole and depolarizing material. The purpose of the construction is to make the depolarizer readily renewable by the user, so that the only depreciating parts of the battery are the zinc, the sal ammoniac and the depolarizer, the porous cup and carbon not being wasted at every renewal of the depolarizer.

"A BIRD'S-EYE VIEW" of the business of the Westinghouse Machine Company, Pittsburg, Pa., is presented to human eyes in a little circular just issued by that concern. The object of the circular is to furnish a brief but comprehensive index to the character and extent of this company's business. The various types of Westinghouse engines are artistically illustrated, the principal features of each being briefly described. Among them may be especially noted the Metropolitan type, which are built in sizes of 1000 horsepower and upward, and the Westinghouse gas engine. The latter type of engine is fully described and illustrated on another page in this issue. The Roney mechanical stoker, mechanical draft, economizers, the steam loop and ice-making and refrigerating machinery also constitute subjects that are also described and illustrated.

THE WESTERN ELECTRIC COMPANY has recently issued Bulletin No. 11,001, in which are illustrated the S. K. C. transformers for lighting and power. This company is the exclusive Western agent for all the apparatus manufactured by the Stanley Electric Manufacturing Company, and carries a full stock of transformers in Chicago for immediate shipment. The S. K. C. transformers are built for any purpose and any voltage. There is said to be no aging of iron. In regard to the lighting transformers, the primaries and secondaries are interchangeable and fuse boxes may be used on the transformers or elsewhere. The larger transformers are made of the following types: Self-ventilating, air blast, oil insulated and oil-insulated water-cooled. Regulating transformers are manufactured for the independent control of the voltage of circuits involving the introduction of low resistance. A copy of the bulletin will be mailed to anyone who has not received a copy.

MESSRS. THOMPSON, SON & CO., 107 Liberty Street, New York City, who are well known in the machinery trade, have recently embarked in the business of dealing in second-hand electrical apparatus. The November bargain sheet of this firm includes various lots of standard high-grade and special lamps, 110-125-volt incandescent dynamos of all makes, a long line of motors of various makes, alternating generators and arc dynamos. The firm also has arc motors, power generators, incandescent arc lamps, carbons, transformers, armatures and commutators, switchboards, etc., etc. It is continually buying dynamos, railway generators, railway motors, transformers, arc lamps, motor and trail cars, engines and other equipment, and anyone interested who desires to secure bargains in these lines will do well to communicate with the house. The firm also makes repairs of all kinds, including rewinding armatures, fields, the rebuilding of commutators, railway motors, etc., etc.

THE AMERICAN ELECTRIC HEATING CORPORATION, Cambridgeport, Mass., has been doing an excellent business for some time past, and all indications are that these conditions will continue, as orders are constantly increasing. The larger central stations and supply houses are the company's best customers. The Consolidated Traction Company, of Baltimore, Md., has recently awarded to this company, after severe competitive tests, the order for the equipment of its cars with "American" heaters. All the Boston Subway ticket offices are equipped with "American" air heaters, as are also the ticket offices of Keith's Theatre. The Hudson River State Hospital, at Poughkeepsie, N. Y., has equipped its laundry department with fifty "American" irons; the New York hospital ship "Bay State" is equipped with air heaters, and also with kitchen heating specialties of the "American" type, and last, but by no means least, an order has just been received from abroad for the electric heating equipment of the large steamer "Oceanic," now being built on the Clyde. This order was secured after most exhaustive tests with foreign and other electric heating apparatus, a model stateroom having been specially built for the test. These are but a few of the many recent orders received by the company.

CHRISTENING A NEW LAMP.—It will be remembered that the Warren Electric & Specialty Company, Warren, Ohio, some time ago organized a contest for the naming of its new incandescent lamp, which the company thought was none too good for the best name that bright minds could conceive. It offered prizes for the names that should be decided by the judges to be the best for the new lamp. The judges have rendered their decision, and the following is a list of the successful contestants, with the names for the lamp and the value of the prizes: First prize, $50, "Peerless," Joe E. Calloway, Pueblo, Col.; John C. Watson, Charlotte, N. C.; J. W. Freeman, Joplin, Mo. Second prize, $30, "Wesco," K. W. Mansfield, South Norwalk, Conn.; Gugler Electric Company, Minneapolis, Minn.; J. E. Calloway, Pueblo, Col.; H. P. Ayer, Portland, Me.; J. S. Daily, Chillicoothe, Ill.; New Orleans Electric Company, New Orleans, L.; C. J. Wetsel, Chicopee Falls, Mass. Third prize, $20, "Liberty," W. H. Schott, Chicago, Ill.; J. E. Calloway, Pueblo, Col.; A. D. Scatcherd, Batavia, N. Y.; C. Frankish, Ontario, Cal.; Phillip Hickley, Chicago, Ill. Fourth prize, $10, "Aladdin," "Aurora," "Eclipse," "Encore," Thos. Day Company, San Francisco, Cal.; D. A. Gill, Kansas City, Mo.; Lemuel K. Cushing, Chicago, Ill.; H. L. Brintnall, Saginaw, Mich.

Business Notice.

THE ILLUSTRATIONS in this issue were made by the Photo-Engraving Company, 9-15 Murray Street, New York City.

ILLUSTRATED RECORD OF ELECTRICAL PATENTS

UNITED STATES PATENTS ISSUED NOVEMBER 22, 1898.

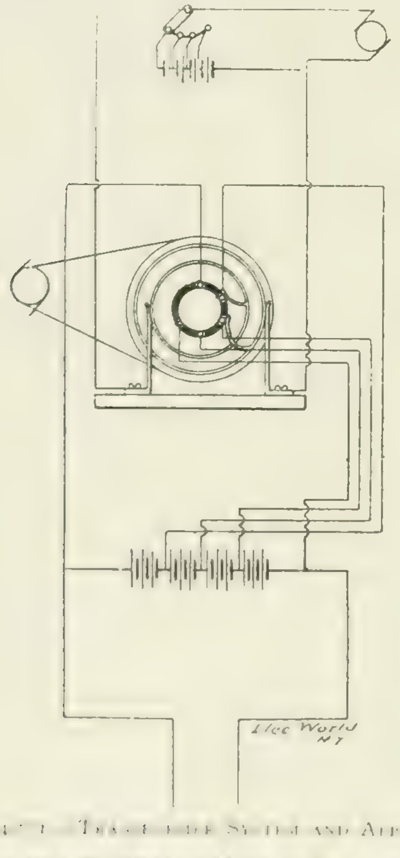
[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

614,453. METHOD OF MANUFACTURING ELECTRIC CABLES; S. Z. de Ferranti, of Hollinwood, England. App. filed Dec. 28, 1897. The method of manufacturing electric cables, which consists in first forming a circular stranded conductor to the shape of a part of a circle in cross section, insulating said conductors, and lastly laying a number of such conductors together spirally forming an approximately cylindrical cable.

614,462. COMMUTATOR; J. R. Grindrod, of Lynn, Mass. App. filed Feb. 6, 1897. As an article of manufacture, a commutator composed of a number of segments separated from each other by insulation, and provided with means whereby they may be secured to the shell; a finished or partly finished outer periphery for making contact with brushes, and means for securing the segments in place during transit and mounting, but which is removed before the commutator is used.

614,472. POTENTIAL SWITCH; J. D. Ihlder, of Yonkers, N. Y. App. filed Aug. 5, 1897. A potential switch the coils of which are wound in opposition, having an adjustable core piece, substantially as described.

614,474. TRANSFORMER STAMPING; D. C. Jackson, of Madison, Wis., and W. B. Jackson, of Grand Rapids, Mich. App. filed Sept. 27, 1897. A transformer stamping composed of a strip of metal folded on itself at an angle, substantially as described.



No. [illegible].—Transformer System and Apparatus.

[illegible] HANGER FOR ELECTRIC LAMPS; J. [illegible], of Belvidere, Ill. In a hanger for electric lamps, in combination, a [illegible] socket [illegible], a [illegible] circuit, a [illegible] through a transverse opening in the socket [illegible], and a [illegible] adapted to [illegible] upon the [illegible], open the [illegible] substantially as described.

[illegible] ELECTRIC LIGHTING GAS BURNER; [illegible]. App. filed [illegible]. In an electric lighting gas burner, [illegible] stem, a lever also mounted thereon, insulation interposed between said [illegible] lever into contact with the first-mentioned lever.

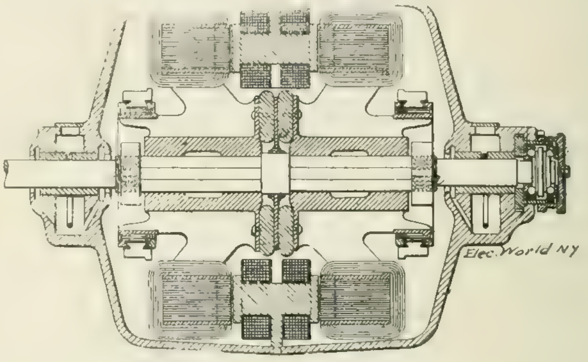
[illegible]

[illegible] groups of storage cells connected with the commutator to [illegible] supplying current to said commutator; of a storage battery and a spark arrester always in circuit with the low-tension circuit, and connected through the commutator with the group of storage cells.

614,597. MEANS FOR CONVEYING CABLES, WIRES OR THE LIKE THROUGH UNDERGROUND CONDUITS; J. Wrigley, of Elmira, N. Y. App. filed June 14, 1898. A flexible shafting, consisting of two coils wound closely upon each other, but in opposite direction, in combination with one or more guide carriages removably arranged on the outer coil, substantially as described.

614,608. DYNAMO-ELECTRIC MACHINE OR ELECTROMOTOR; E. Cantono, of Pavie, Italy. App. filed Dec. 16, 1897. The combination with an electromagnet, consisting of cores and ring, and a shell of casing consisting of opposite cups between which said ring is clamped.

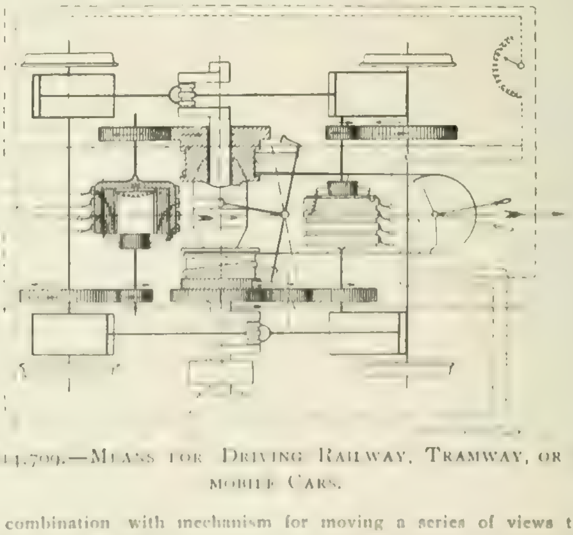
614,686. MAGNETIC CUT-OUT; L. Andrews, of Hastings, England. App. filed Nov. 29, 1897. A magnetic cut-out for each of two or more electric-current generators, consisting of a core surrounded by a continuous winding in series with the generator, a shunt-winding part of which is in the same direction as the series of winding and the other part in the reverse direction, and a switch controlled by said core, substantially as described.



No. 614,608.—Dynamo-Electric Machine or Electromotor.

614,709. MEANS FOR DRIVING RAILWAY, TRAMWAY OR AUTOMOBILE CARS; G. Dupont and M. Johannet, of Paris, France. App. filed Oct. 29, 1896. In a motor vehicle, the combination with a front and a rear axle of two countershafts, one geared to each axle, a main shaft geared to the two countershafts, a field magnet on each countershaft, a single circuit including the field coils of both dynamos, a single circuit, including the two armature windings, and a variable resistance included in the armature circuit, substantially as described.

614,738. CONSECUTIVE VIEW APPARATUS; H. N. Marvin, of New York, N. Y. App. filed April 21, 1897. In a consecutive view apparatus, the combination with mechanism for moving a series of views through the field of the apparatus, of a driving device for said mechanism adapted to be operated by an observer, means for illuminating the views, and an automatic cut-off device, operated when said driving device is released by [illegible] for stopping [illegible] of the apparatus, substantially as described.



No. 614,709.—Means for Driving Railway, Tramway, or Automobile Cars.

[illegible] GALVANIC BATTERY; C. [illegible] Richmond, of Cleveland, Ohio. App. filed [illegible]. In a [illegible] battery, the combination of a jar, and a cover therefor made of insulating material, and having an integral threaded boss on its under side and a hole through said boss and cover, with a clay porous cup internally threaded at its open upper end, which cup is screwed [illegible] electrode in said cup having a stem which extends [illegible] and a [illegible] electrode having a stem which projects through a hole in the cover, and is supported by said cover, and depolarizing [illegible] described.

The Electrical World.

Vol. XXXII. NEW YORK, DECEMBER 10, 1898. No. 24.

PUBLISHED EVERY SATURDAY BY

THE W. J. JOHNSTON COMPANY,

9 Murray Street, New York.

Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York.

New England Office, 620 Atlantic Ave., Boston.
Western Office, 936 Monadnock Block, Chicago.
Philadelphia Office, 929 Chestnut Street.

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THE ELECTRICAL WORLD,

9 Murray Street, New York.

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FREQUENCY CHANGERS VS. ALTERNATING MOTOR GENERATORS.

In large alternating-current systems with the various styles of duties and loads which they are now called upon to perform and carry, it seems to be considered impracticable to settle upon any one frequency for all parts of the system, and better to utilize at least two frequencies, with transforming devices connecting the two parts of the system. The advantages of a comparatively high frequency—sixty cycles or more—are briefly the comparative cheapness of transformation in small distributed units and the improved working of arc lights. For long-distance power transmission and for rotary-converter work lower frequencies—from 25 to 50 cycles—are better, owing to the reduced inductive drop and the lower peripheral speed of the rotaries. Comprehensive systems, therefore, occasionally adopt twenty-five cycles, for example, for part of their work and sixty cycles for the rest of it, and interconnect the two divisions either by means of alternating motor-generators or frequency changers.

The latter machines are not very widely known as yet and hence a brief description of their principle may not be out of place here. They consist essentially of multiphase primary and secondary windings on the opposite sides of an air gap, practically identical with those of an induction motor. With the movable portion of the machine stationary this gives a transformation of the same frequency with any desired voltage or phase changes, dependent on the winding and connections. By rotating the movable part in a direction the reverse of the motion of the rotating field the frequency of the induced secondary e. m. f. is increased by a percentage equal to the ratio of the mechanical speed to that of the primary rotating field. Rotation in the other direction reduces the frequency impressed upon the secondary. In one direction the mechanical rotation requires power and in the other generates power. By coupling such a machine to an alternating-current motor, either of the synchronous or induction type, the total power transformation is accomplished partially by magnetic and partially by mechanical means.

To illustrate the division of the load between the magnetic and mechanical transformation, and to show the necessary size of machines for a given output, the concrete example of the transformation of 120 kilowatts from 25 to 60 cycles will be assumed. This would require a generator constructed essentially like a 25-cycle 50-kw induction motor with a wound secondary and collector rings, the ratio of the secondary number of turns to the primary number of turns, if no change of the voltage is desired, being 5 to 12. This must be driven by a 70-kw motor, and if the primary of the induction generator has a 10-pole winding, giving its field a speed of 300 r. p. m., the motor must have fourteen poles, giving the shaft a speed of 214 r. p. m. It is interesting to note that it is impossible to use any smaller number of poles for this particular change of frequency. The change from 25 to 62½ is, on account of its more adaptable speed ratio, likely to be more frequently used, the minimum number of poles in this case being 4 and 6 for the motor and generator, respectively.

The same transformation can, of course, be effected by an alternating motor driving an alternating generator, in which case all the power transformed is by the one machine turned into mechanical power, and by the other restored into electrical power, requiring, therefore, in the particular instance of transformation from 25 to 60 cycles, machines with a capacity 70 per cent. greater than by the other method. In certain instances the motor-generator method has a great advantage in that the voltage of the output is practically independent of that of the input. In the case of a synchronous motor the speed is independent of the voltage of power delivered to it within considerable limits, and the pressure of the generator which it drives is, of course, affected from the driving circuit only by variations in speed. If the motor of the transforming set is of the inductive type practically the same condition exists, as the speed of an induction motor is not greatly affected by changes of voltage within the limits ordinarily found in commercial work.

In a frequency generator, however, the voltage of the output is not only dependent upon the speed, and, therefore, upon the frequency of the input, but is directly proportional to the voltage of the latter, in that the intensity of the rotating field of the induction machine is exactly proportional thereto. In cases of long-distance power transmission where the line drop is likely to be a variable quantity owing to fluctuating loads, and where a steady voltage is desired for lighting service, the motor generator is preferable in spite of its increased cost and losses. Where, on the other hand, the regulation of the power delivered to the transforming set is as good as that desired at the lamps, or where line drop does not vary too rapidly to be followed by the switchboard attendant, the frequency changer is preferable owing to its lower cost and lower losses.

The frequency changer, however, introduces into the system a transformation across an air gap which requires lagging or alternating currents for its magnetization. With the use of a synchronous motor leading wattless currents can be introduced to counterbalance these, although this requires the use of an exciter. The frequency changer driven by an induction motor requires no direct-current apparatus whatever, while a motor generator requires, of course, direct-current excitation for at least one of the machines.

THE RATIO OF DYNAMO TO TURBINE POWER RATINGS.

In the selection of sizes of dynamos to be driven by water wheels the considerations are quite different from those involved in engine-driven combinations. The essential difference rises from the fact that water wheels will never much exceed their rated loads, being rated at practically wide open gate in order to have a high efficiency at their rated load. A slight margin, about 10 per cent., is allowed to make sure that the wheel will always carry its load with slight variations of head, etc. On this account turbines must always be chosen with a rated power equal to the maximum load they may be called upon to carry. Very brief overloads, that is, with a duration of a few seconds, may be carried by fly-wheel retardation, but for more protracted overloads there is no available source of energy.

[illegible]

[illegible]

only by the regulation, commutator sparking, etc. Thus, in choosing the size of a generator to carry fluctuating loads when steam-driven, the common practice of picking one with an output in kilowatts equal to three-quarters of the rated horse-power of the engine minus a few per cent. for internal losses is correct. But in the case of a generator to be turbine-driven on a variable load, the turbine must be chosen with a rated output sufficient to carry the maximum peaks, and the generator may well be of a much lower rating, since it can stand an overload which its driving power cannot. To take a concrete example, a water wheel rated at 1000 effective horse-power might well be expected to carry a 700-kw dynamo, but with a fluctuating load with peaks requiring 1000 horse-power at the shaft, a 600, or if a modern machine of high overload capacity, a 500-kw generator would do the same work at a lower cost and—in case the peaks were the exception and low loads the rule—with a greater efficiency.

Exactly the same consideration applies in gas-engine work. Gas engines, whether of the "hit-or-miss" or variable-charge style of governing, give their greatest efficiency with their greatest loads and are therefore rated very close to their maximum output, with a slight margin to assure their ability to carry their rating with slight changes of quality of fuel, etc. With perfectly steady loads driven either by turbines or gas engines, the common practice of rating is quite justifiable, but steady loads are the exception and variable loads the rule in electrical work, and the limitations of the driving source should be taken into account in the choice of sizes.

WHAT IS GOOD GOVERNING?

In the recently published catalogue of a prominent make of engine there are given some views on the subject of governing which, on account of the care and scientific comprehension of the subject evidenced in the get-up of the catalogue, merit notice. The catalogue compares the modern types of inertia governor, which, as it happens, were designed by Mr. Rites in the shops of this company, with the older double-weight types as follows:

"The new design has the features of greater simplicity and accessibility, and is capable of giving that ultra close regulation which is just now a somewhat popular fad. It is possible to adjust this governor so that there is no apparent difference in speed, whether the engine be running empty or fully loaded, and it is even possible to adjust it so that the speed with the engine fully loaded is 1 or 2 per cent. greater than when running empty. Being able to demonstrate that we can produce this sort of regulation, we may be relieved of any suspicion of unfairness or envy when we say it is a freak and of no commercial value. Perfect steadiness is the first requisite of a good governor, and a slight falling off in speed with increase of load contributes to that quality. We regularly adjust all governors to regulate within from 1 to 2 per cent. In the midst of so much clamor about 'marvelous governors' and 'perfect isochronism' the purchaser must be careful that his attention is not diverted from the features that are of real importance. We do not know of a single manufacturer with any claims to prominence who builds an engine that does not regulate sufficiently well for any commercial purpose."

So long as governing is effected by the variations of centrifugal force, close speed regulation will necessarily involve considerable unsteadiness, since the slight drop of speed which is bound to occur with load variations before the governor can correct it is enough to throw the governor through the whole range of action. To the statement that a slight falling off in speed with increase of load contributes to steadiness might be added the fact that a greater falling off in speed contributes still more to that quality. Where [illegible] gives considerable trouble, as it does in isolated plant work with electric elevators, it might be well to look into the merits of governing [illegible] poor regulation balanced by generator with [illegible] compounding.

The Effect of Silicon on the Magnetic Permeability of Cast Iron.

BY F. C. CALDWELL.

The tests from which these results were obtained were made under the direction of the writer, as material for a thesis by J. M. Hipple and S. R. Hewitt, students of the Ohio State University. The opportunity was offered by a series of tests made by C. W. Weick, of the university, on the effect of silicon on the mechanical properties. These tests were made upon castings poured from a small cupola, the variation in silicon being obtained by the addition of silvery iron. Three different grades of iron were tested, but enough results to draw curves from were obtained from only two; the points obtained on the third, however, agreed fairly well with the curves here given.

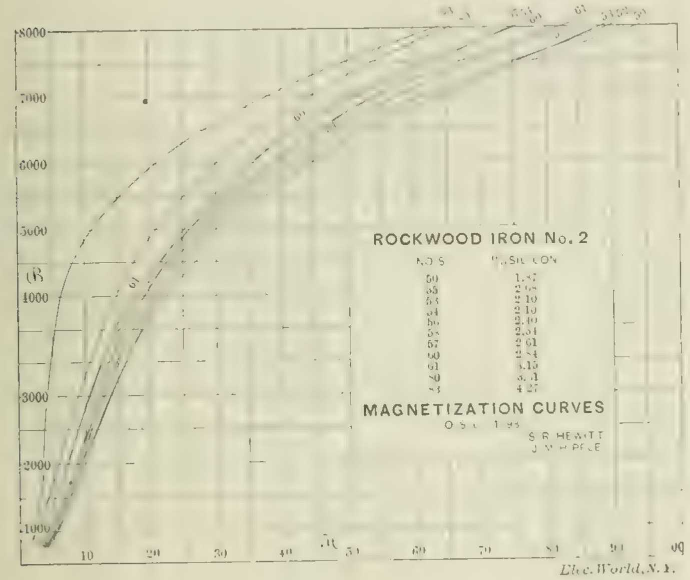

Fig. 1.

The two irons of which the tests are given were "Rockford" No. 2, and "Bessemer" cast irons. The tests were made by the double yoke method, eliminating the error due to the yokes by the arrangement suggested by Ewing.* The bars were about 6½ inches long, and were set 3½ inches apart in yokes 1¾ inches by one-half inch. The maximum distance between the yokes was 12.56 cm. The bars were turned from ⅝-inch castings accurately to ⅜-inch diameter.

The iron of each heat was analyzed under the direction of Prof. N. W. Lord, of the university, and the percentages of silicon given are from his report. The complete curves for all the samples were drawn, and are shown together in Figs. 1 and 2 for the two samples. From these curves the magnetizing forces necessary to give densities of 2000, 5000, 7000 and 8000 were obtained and plotted with percentages of silicon and are given in Figs. 3 and 4. These show that, at least in the irons tested, and in samples of the size used, the specific reluctance is decreased by the increase of silicon between 1.8 per cent. and 4.6 per cent., and that for low densities this decrease follows approximately a straight line law. Also that the same holds up to about 3.5 per cent. for densities up to 8000. Above this point with the higher densities the increase of silicon probably produces much less effect, the curves seeming to become nearly horizontal; indeed, comparison with the mechanical properties would indicate that further increase of silicon would probably produce a decrease in the permeability. It is also to be noted that the change in units of $\mathcal{H}$ for each per cent. of silicon increases as the density increases, and that they are approximately the same in both irons tested, as seen in the following table:

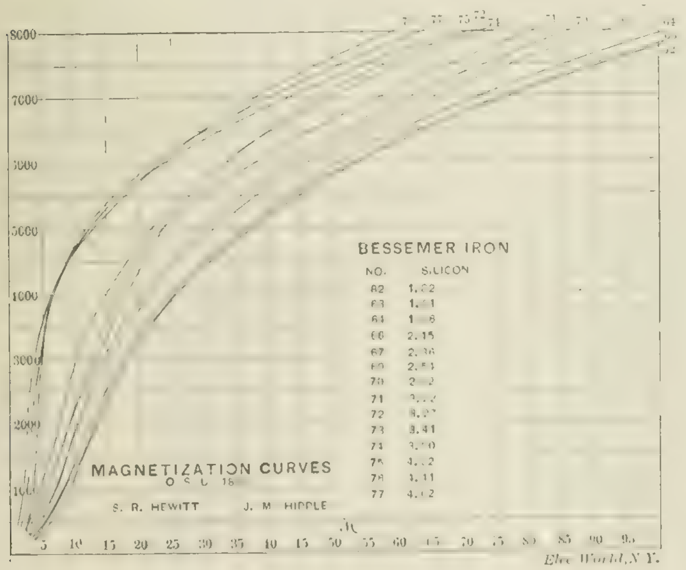

Fig. 2.

	Density, 2000	5000	7000	8000
Rockford No. 2	3.5	7.3	13.2	19.0
Bessemer	3.7	9.3	14.1	20.8

As would be expected from these results, the curves of permeability with percentages of silicon approximate to hyperbolas, the increase of permeability with addition of silicon being very marked at the lower densities.

It is interesting for comparison to note that according to Mr. Weick's tests the addition of silicon up to about 2½ or 3 per cent. softens the iron by change of combined carbon into graphite, but that further increase of silicon results in an increase of hardness. It would seem, therefore, that the maximum permeability requires more silicon than that which gives the greatest softness. This, however, is a point that should be further investigated.

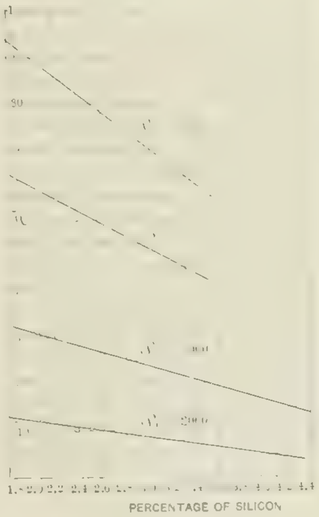

Fig. 3.

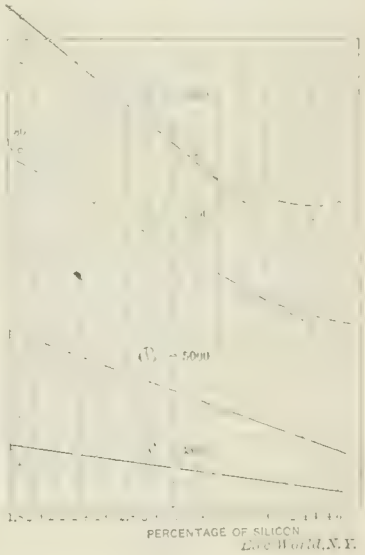

Fig. 4.

With regard to the irons tested, the Bessemer is a mixture of Lake Superior ores, and is made especially for use in the Bessemer process. The Rockford iron comes from Tennessee and is intended for grey castings.

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[*] See The Electrical World, Vol. 28, page 695.

X-Ray Experiments.

An odd line of investigation to determine whether X-ray effects are or are not, as has been suggested, caused by the actual projection of material particles through the glass walls of a Crookes tube, and also through other substances, has been carried out by Prof. F. E. Nipher, of the Washington University, of St. Louis. A projection of molecules at a velocity as nearly as possible comparable with that in Crookes tubes was effected by rifle discharges, and the rather crude experiment of firing 3000 blank charges of smokeless powder at a sensitive photographic plate protected by a sheet aluminum and wooden shield was tried with no evidence of action on the plate. Professor Nipher now proposes to get a rapid-fire gun to imitate Crookes-tube conditions a little more closely by such a succession of charges as to keep the aluminum target red-hot.

What Shall Conduits Under Rivers Be Called?

The London "Electrician," in speaking of some draw-in conduits under rivers, carried the application of the Latin to the terminology of conduit work, as exemplified in the terms submarine and subterranean, one step further by the use of the adjective "subfluvial."

The Transmission Plant of the Cataract Power Company, Limited, of Hamilton, Ontario.

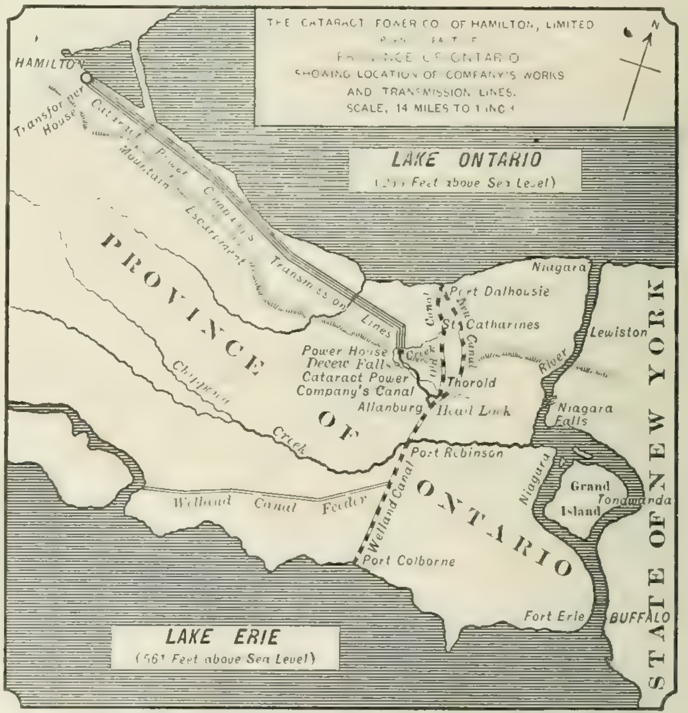
THE longest transmission of power and the highest voltage in regular service east of the Rocky Mountains is that of the transmission plant of the Cataract Power Company, of Hamilton. The generating plant is located at Decew Falls, about 12 miles west of Niagara Falls and a few miles south of the shore of Lake Ontario. (See map on this page. This point is 35 miles distant from Hamilton, to which place the power is transmitted. The system has been in service since the 1st of November, and was officially opened on November 12.

The power is really a part of that of Niagara Falls, the water being taken from Lake Erie and discharged into Lake Ontario, the immediate source being a feeder of the Lake Erie level of the Welland Canal, from which the water is taken at Allanburg. The power-house stands at the foot of a high escarpment, which can be traced for many miles east and west, and which forms the edge of the tableland that serves, so to speak, as a dam for the waters of Lake Erie, and through which the Niagara stream has cut its famous gorge.

THE HYDRAULIC EQUIPMENT.

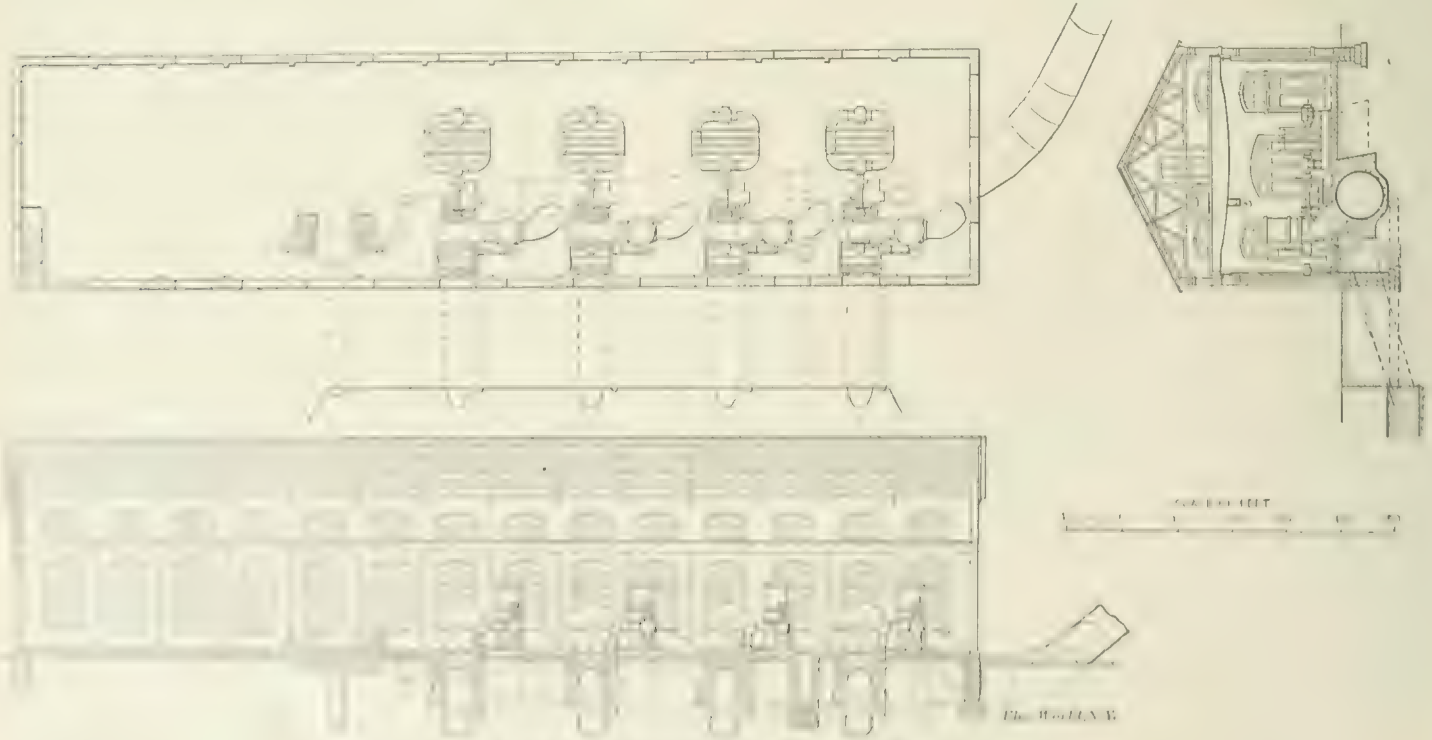
The water is brought from Allanburg to the edge of the escarpment by a canal about 4⅓ miles in length, cut in the clay, with a minimum cross-section of about 97½ square feet below the water level, the canal being 13 feet wide at the base, the sides having a 1½ slope and the normal depth being 5 feet of water. At one point a valley is crossed by a trestle-work carrying a rectangular, closed, wooden flume, which is maintained under a slight head to keep the whole of the flume wet. At the lower end of the canal there are three storage reservoirs, one natural and two artificial, giving an [illegible] feet area.

[illegible] of the escarpment to the power-house in a steel penstock 750 feet in length; the diameter of this pipe varies from 7½ to 8½ feet, and on account of its great size and weight the solutions of the various problems involved in its construction are interesting. It is supported entirely from the upper end, where it is securely anchored in a rock cut by means of having flanges built in concrete. This arrangement was made necessary by the lack of proper anchorage points at the bottom of the slope. About two-thirds of the way down the hill there is a horizontal shelf, and at this point there is placed a slip joint to allow for temperature changes. This joint, in addition to taking care of the expansion and contraction, is so designed as to support that portion of the pipe below it, so that the whole pipe [illegible], joint and all, is hung from the top. The pipe is not [illegible], but is supported on a concrete bed, about one third of its diameter being below the surface, and will be covered



Elec. World, N.Y.

THE LAKE ERIE-LAKE ONTARIO HYDRAULIC POWER DISTRICT.



PLAN AND ELEVATION OF POWER HOUSE.

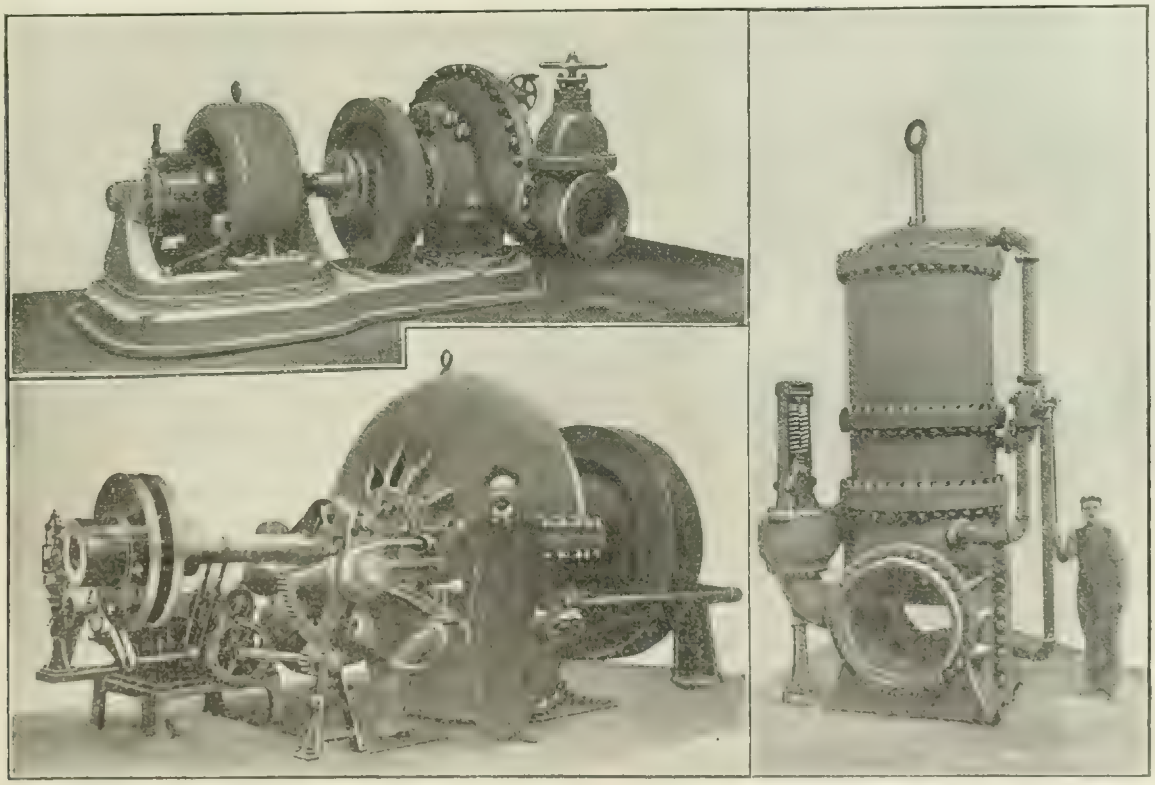
with a wooden sheath to prevent the formation of ice at times of light load.

THE POWER HOUSE.

The power-house, nestling in the valley of Twelve-Mile Creek, into which the tail-water discharges, is a plain brick structure, 174 feet long and 42 feet wide, covered, with a roof supported on steel trusses. The penstock receiver runs under the floor with four vertical branches curving over in quarter turns to the main wheels, and beyond them two similar branches for the exciters. (See plan and elevations on opposite page). Two of the main wheels and the two exciters are already in place.

The Slip-Joint, Penstock and Power House.

The main gates, one of which is shown in the accompanying illustration, are 36 inches in diameter, and were built, as were the wheels, by the Stilwell-Bierce & Smith-Vaile Company, of Dayton, Ohio. They are each operated by a hydraulic ram under penstock pressure, and are not fitted with by-passes. The four-way valve for operating the ram is moved by a long handle, as shown in the illustration. On the other side of the ram is a 12-inch spring-closed relief valve, there being no air chambers on the penstock.



One of the Exciter Sets.
One of the Main Wheels with Governor, Fly-wheel and Coupling.

A View of One of the Main Gates, Showing Ram and Relief Valve.

The wheels are of a different style from those generally put out by this company, and may be described as an inward-flow, radial type. One of the interesting engineering features of this plant is that it is the highest head on this continent employing the reaction type of turbines. The high-head plants in the Rockies all use impulse wheels. The intake pipe is horizontal, and the draft tube passes vertically down through the floor and is sealed in the tail-race to give the added head of 14 feet by suction. The governing gate is a ring of the register type, between the guide chutes and the buckets of the runner, and is moved axially by two rods connected with the governor mechanism. The governor is of the Giesler electro-mechanical type, the centrifugal balls operating electrical contacts, the currents from which in turn energize clutches which are driven by belting from the main shaft. The wheels are rated at 1950 horse-power each at 400 r. p. m., under the normal head, which is about 260 feet.

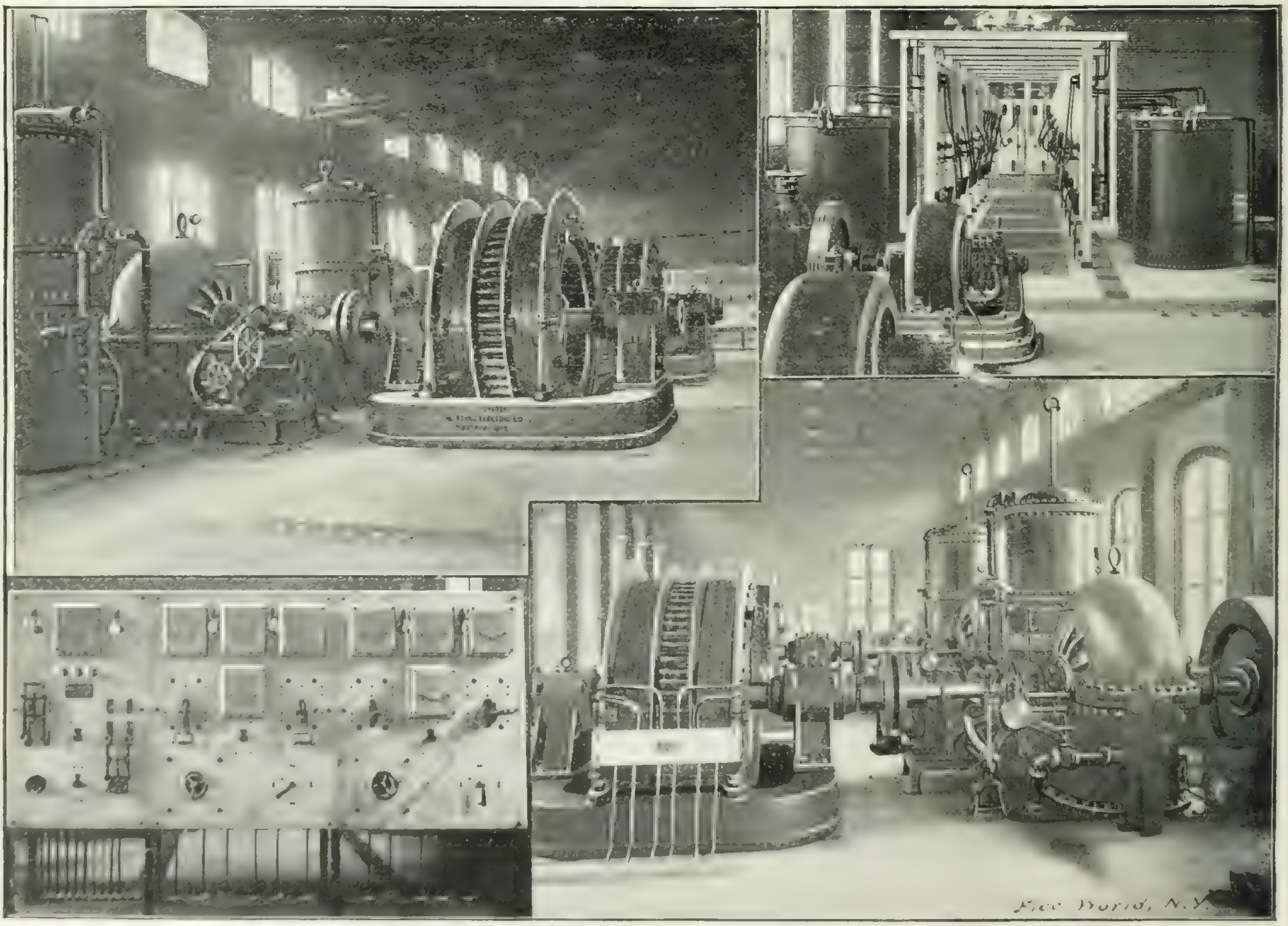
On one of the shafts is a 7½-ton fly-wheel, with an outboard bearing, and the other end is attached through an insulating coupling with the electrical generator. The latter are of the inductor type of the S. K. C. design, and were supplied, as was all the electrical equipment, by the Royal Electric Company, of Montreal. The inductor weighs 15 tons, and is fitted with ten poles on each ring, and therefore, at the speed of 400 r. p. m., generates 66 cycles per second, or 8000 alternations per minute. The machines generate two phases at 2000 to 2400 volts, the windings being, as is customary with these machines, of the coil type not distributed. These coils are wound of bare copper strip with mica insulation between the turns, which construction will stand long-continued over-heating without deteriorating.

The machine switchboard is a handsome piece of work, with three panels of white marble, one for the exciters and one for each of the generators now in place. The generator panels have no live contacts on the face of the board, and are each equipped with one voltmeter and switch by which it may be thrown onto either phase, two main ammeters, one for each phase, and one direct-current ammeter in the field circuit. Switching is accomplished by two double-pole, double-throw slide switches, one for each phase, the double throw being from one set of bus bars to the other. Beside these instruments there are the usual field rheostats. There are no fuses on the generator-board, a short circuit being considered less dangerous with these machines than a sudden throwing off of the load by a fuse blowing with the turbine-gate full open. The exciter panel contains the usual instruments and switches for operating two direct-current shunt machines in parallel on the exciting buses.

The exciters themselves consist of two 30-kw, four-pole, 70-volt machines, built by the Crocker-Wheeler Company, driven at 1000 r. p. m. by individual turbines to which they are direct-coupled, each exciter unit being of sufficient capacity to excite the full equipment of four generators. These turbines are hand-governed.

One of the most interesting parts of the station is that devoted to the step-up transformers for obtaining the 20,000 to 24,000 volts delivered to the line. Two-phase currents are used on the line, so that no transformation of the phase relation is necessary, and a plain battery of single-phase transformers is used on each phase. Each battery consists of five 200-kw Stanley transformers, immersed in mineral-seal oil in heavy boiler-iron cylindrical cases about 4 feet in diameter and 6 feet in height. The transformers are water-cooled, the water, which is taken from the penstock, being circulated through pipes inside the transformer cases themselves.

Each transformer is fitted with a marble switchboard supplied with switches on both the high and the low tension sides; the latter are the ordinary slide type, double-throw from one set of bus bars to the other, and mounted on the backs of the panels. The 20,000-[illegible] This type of switch is called the stick type, consisting of a wooden pole about four feet long, carrying at the end of it a [illegible] which may be pushed up around a downwardly projecting contact finger on the board. The current to the stick is conveyed by a heavily insulated flexible cable [illegible] which is permanently attached [illegible] receptacle. The [illegible] hard rubber slide [illegible] from the finger. The tips of both fingers and contacts are made of non-arcing metal. It is not intended that these switches shall be opened with the load on, but the load will first be removed by the low-tension switches. The others will then only open the magnetizing current of the transformers and the capacity current of the line. Each high tension stick may be attached to either one of two fingers, connecting to either one or the other of the duplicate lines which will eventually be established. Between the two poles of the switchboard for each transformer there is a heavy marble barrier. Non-arcing fuses are placed on both primary and secondary sides of each step-up transformer.


Elec. World, N.Y.

The Interior of the Power House.
The Machine Switchboard.

The Transformers and High-Tension Switchboard Alley.
Another View of the Main Sets.

THE LINE.

The line, as noted above, is of a rather unusual type for such long transmissions—namely, two-phase. The 25 per cent. economy of copper which could have been obtained by a three-phase line with the same potential difference between wires is sacrificed for the reduced interference of unbalanced loads which will be obtained by the arrangement adopted. The four No. 1 medium-drawn, bare copper wires are supported on a single cross-arm, the two phases being respectively on the two sides of the poles, the wires being 18 inches apart. The poles vary from 40 to 50 feet in length, have tops with a minimum diameter of 8 inches, and are spaced 90 feet apart.

Protection against lightning is obtained by a barbed wire the whole length of the line stapled to the tops of the poles and grounded at each pole. At the terminals banks of Stanley lightning arresters and choke coils are used, there being thirty gaps in series between each wire and ground. The insulators are triple petticoat porcelain, made by the Imperial Porcelain Works, and tested in the ordinary way to 65,000 volts before use. The pins are of locust prepared in oil and are fastened into the cross-arm with a wooden peg, the object being to avoid all unnecessary metal near the wires. A two-wire telephone line is mounted on a lower cross-arm and is frequently transposed, the power wires not being transposed or spiraled. For a large part of the distance the line follows the route of the Grand Trunk Railway, and electrical engineers traveling over this road between the East and the West will be interested to see this visible evidence of high-voltage transmission.

THE TRANSFORMER SUB-STATION.

At Hamilton the line runs into a specially constructed brick transformer station on Victoria Avenue. After passing through the arresters each wire terminates in a panel of the line board provided with stick switches as at the other end. One-half of the room is occupied by two batteries of five 175-kw transformers, similar to those at the power station, except that they are air instead of water cooled. The boiler iron cases are fitted with a ring of vertical tubes open at either end, and the transformers set over a duct into which air is blown by a Sturtevant blower coupled to an S. K. C. two-phase motor. The air rises through the tubes and discharges from the tops of the cases, cooling the oil, which in turn cools the copper and iron of the transformer. Each transformer is fitted, as are those at the power station, with switchboard panels having high-tension and low-tension switches. The high-tension side is also fused at this point with D. & W. enclosed, 20,000-volt, 13-ampere fuses 15 inches in length.

The company is now supplying power to the incandescent service of the Hamilton Electric Light & Power Company, and for the outgoing 2000-volt feeders still another switchboard is in use at the transformer sub-station. These feeders are provided with two independent wires on each phase, except those which will be devoted exclusively to power service, which will have three-wire, two-phase lines. The lighting loads are balanced and boosted at the Electric Light Company's station. The old house-to-house 1000 to 50 volt, 16,000-alternation transformers of the lighting company have been replaced by 2000 to 100 volt, 8000-alternation transformers in larger units, with a better grouping of the secondary loads. The company expects later to carry a considerable power load to drive the arc-light machines and also several, if not all, of the street railway lines of Hamilton, and certainly deserves a full measure of success for the boldness and skill with which it has met the difficulties that have stood in its way.

THE 20,000-VOLT TWO-PHASE POLE LINE.

THE STEP-DOWN TRANSFORMER SUB-STATION.

The officers of the company are Hon. J. M. Gibson, president; John Moodie, treasurer; John Patterson, secretary, and H. R. Leyden, general manager, the latter having had general charge of all the construction operations.

The canal and hydraulic work has been performed under the direction of William Kennedy, Jr., consulting hydraulic engineer, and Thomas E. Hillman, engineer in charge of canal construction. The principal contractors were A. A. McDonald & Co., earthwork, canal, etc.; Lowe & Farrell, pole lines; the Stilwell-Bierce & Smith-Vaile Company, hydraulic machinery and pipe, and the Royal Electric Company, electrical equipment.

Electric Railways Here and Abroad.

In a recent address, Mr. W. H. Preece, of London, said: "When I visited America in 1884 there was only one experimental line at work in Cleveland, Ohio. Now there are more miles of line so worked in Cleveland alone than in the whole of the United Kingdom."

The Mechanical Plant of a Modern Commercial Building.

A complete description of the design—with a discussion of various reasons for each detail—of an isolated plant in a modern office building is given by Mr. William H. Bryan in a paper presented at the recent meeting of the American Society of Mechanical Engineers in New York. From this paper the following facts have been abstracted:

The building is that of the Commerce Realty Company, St. Louis, Mo., eight stories in height besides the basement, and occupying a ground space 109 x 225 feet. It is occupied by a large drygoods house, the floors being divided by partitions. After discussing the considerations involved in the planning of different parts of the equipment, the author takes up the subject of contracts and prices, which is quoted as follows:

In view of the central location and general character of the building and its tenants, and the fact that the installation was intended to be a model one, there was great competition for the work. Furthermore, as all bidders were figuring on practically identical specifications there was no chance to claim advantages due to superiority of apparatus or methods. The figures, therefore, were strictly comparative.

On account of this competition the work was let at exceedingly low figures, as will be seen below, the usual profits being cut out, and, in some instances, losses sustained. These figures should, therefore, be used with caution, and from 10 to 20 per cent. added when estimating the cost of new work. Due allowance should also be made for differences in the character of buildings and the service rendered as determined by the peculiarities of the business carried on in it. This is wholly a question of experience and judgment.

The owners of the building under consideration did not feel warranted in supplying their tenants with a high-grade plant, claiming that the lease did not require it. As the tenants had made a ten years' lease, however, and would have to meet the fuel bills, they agreed to pay part of the extra expense.

It was not definitely decided to put in a complete plant until final bids were in, and estimates of cost of operation, repairs, and maintenance had been made. Up to that time the securing of all electrical—and even steam—service from a central station was under serious consideration. The figures, however, showed a material saving by operating their own plant, due principally to the use of exhaust for heating.

Compound engines and electric elevators having been selected, requiring 303 boiler horse-power, it was thought safe to reduce the boiler capacity to three units of 150 horse-power each, two to do the ordinary maximum service. This was equivalent to 4955 pounds of water per hour per boiler, from feed of 212° Fahr. into steam of

125 pounds gauge pressure. Water-tube boilers proving not as high in price as expected, that type was selected, the boiler being the "O'Brien," made in St. Louis. This boiler is similar to the Heine, except that the steam and water drum is horizontal, and not parallel to the tubes; the front and rear water legs are wider at the top than at the bottom, and the rear leg extends some distance below the lower tubes, as a settling chamber. Each boiler contained 1141 square feet heating surface, including drums and tubes of the Hawley furnace, or 9.4 square feet heating surface per horse-power. The grate surface (upper grates only) was 31.5 square feet; ratio grate to heating surface, 1 to 45. The cost of the three boilers set up, including Hawley furnaces, brickwork, foundations, and smoke flue, was $6288, being $13.97 per horse-power, or $1.48 per square foot of heating surface.

The cubic feet of gross capacity of building—as usually computed by architects from outside lines, and from bottom of footings to top of roof—per rated boiler horse-power is 6771; and 5146 cubic feet of space is heated per boiler horse-power. The space heated included only the actual indoor space, and omitted basement.

This work, as well as the heating system and large pipework, was let to Kupferle Brothers Manufacturing Company, of St. Louis, at the gross price of $16,511.

The lowest bid on ordinary boilers, as per specifications, was $5997, being $3397 for the boilers, and $2100 for the Hawley downdraught furnaces, and $500 for the brickwork. The four boilers ag- [illegible]

The selection of the elevator system presented the greatest difficulties. The bids based strictly on the specifications seemed excessive in price, and the owners directed that the data be revised, with a view of getting more reasonable figures. The capacity of the [illegible] pounds, and the four north machines to 1800 pounds, being required to carry these loads at the speeds specified. They were also to be capable of carrying the larger loads originally specified, at reduced speeds. Wooden guide posts and strips were substituted for the steel T guides. The allowance for passenger cabs was reduced to [illegible]

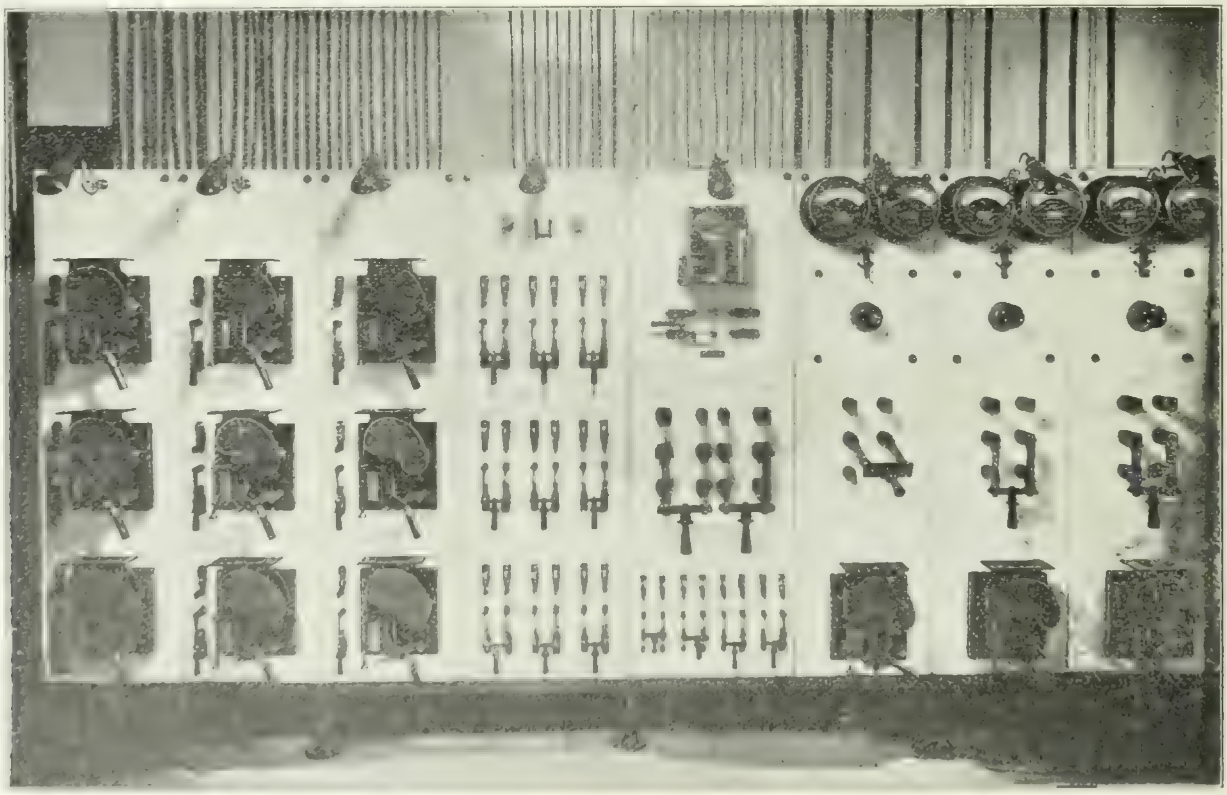
[illegible]

Sprague expert. The four north elevators were to be of the "X 38" type, with solenoid control, and the four south elevators of the "Z" type, with pilot-motor control.

To the above price should be added $3134 for the cost of third engine and dynamo, etc., making a total of $25,204 for the elevator plant complete. The cost per cubic foot of building space (gross) for elevators alone was $0.0072, and for elevators, with engine, dynamo, etc., $0.0083. The cost per square foot of total floor space was: for elevators alone was $0.0072, and for elevators, with engine, dyna-

The selection of the electric elevator for this important installation was decided upon after a thorough investigation. They were found to be more economical in fuel than any other type—even the high-duty hydraulic—on account of the light loads usually carried, and the corresponding saving in power. There was also some saving in first cost. The electrical plant afforded a much more compact arrangement in engine room. As no pumping engines were required, and no tanks or accumulators, one reserve unit answered for both the lighting and elevator plants. The electric elevator has not as yet fully established its reliability and low repair account as well as the hydraulic, but the latest and best types seem to leave but little to be desired in these directions.

The steam elevators were, of course, the lowest in first cost, but were not given serious consideration on account of their large fuel consumption.



A View of the Main Switchboard.

General Electric dynamos were selected, the guaranteed efficiencies being:

At [illegible] load	.	84 per cent.
" [illegible] "	.	89 "
" [illegible] "	.	91.5 "
" [illegible] "	.	91.5 "

The three 75-kw generators, with switchboard,* etc., as specified, cost $5135, or $22.80 per kilowatt. Speed, 260 r. p. m.

[illegible] per kilowatt of dynamo capacity for lighting .. [illegible]
[illegible] per kilowatt of dynamo capacity for all purposes. [illegible]

The three 125-hp engines selected were of the Imperial compound type, built by the Weston Engine Company, of Painted Post, N. Y. Dimensions of cylinders: high pressure, 12 inches diameter; low, 20 inches; stroke, 14 inches; speed, 260. Price, $4268, or $11.38 per indicated horse-power. The same builders [illegible] inches x 14 inches, for the same [illegible] per indicated horse-power. This should [illegible] to be exactly comparable with the cost of the compounds. Computations showed that the horse-power hours of service per year would be sufficient to make the fuel saving of the compound over the simple enough to warrant the additional investment.

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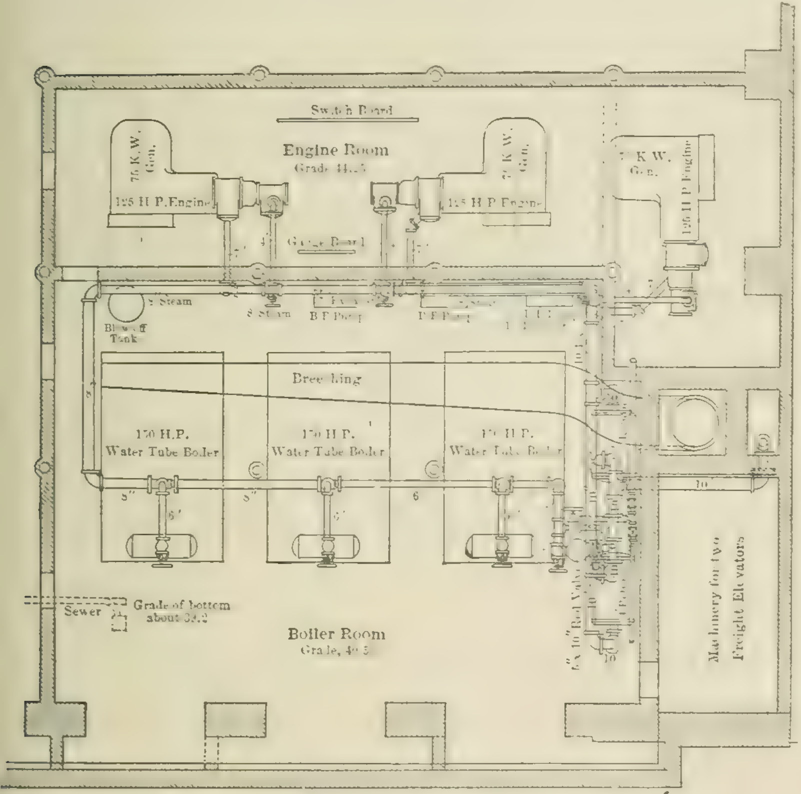
* [illegible]

The cost of engines and dynamos together was $9403, which is $41.80 per kilowatt of dynamo capacity, and $25.07 per indicated horse-power of engine capacity. Gross capacity of building (cubic feet) cared for per horse-power of engine, 8125.

The wiring, lamps, fans and motors were let for $6315, in accordance with the specifications, to the General Electric Company, their 220-volt arc lamp being selected. On the basis of 150-kw capacity the price per kilowatt was $42.10, including the entire work from the switchboard to the lights and fans, exclusive of special fixtures on first floor. Adding to this two-thirds of the contract price for engines and dynamos gives the total cost of the electric lighting plant (exclusive of elevators) as $12,584, or $83.90 per kilowatt, exclusive also of boilers and piping.

The total cost of the mechanical plant ($54,209) may be divided as follows:

Per cubic foot of gross space	$0.0178
Per cubic foot of space heated	0.0234
Per square foot radiating surface contracted for	3.00
Per rated horse-power of boiler capacity	120.66
Per indicated horse-power of engine capacity	144.80
Per kilowatt of generator capacity	241.32



Plan of Boiler and Engine Room.

The total cost of building, including mechanical equipment, ready for the tenant's use, was $301,000, or 9.9 cents per gross cubic foot, and 13 cents per cubic foot heated. The cost named included $20,000 for the use of the party walls of the adjoining buildings, and $10,000 for Luxfer prism glass, and $9000 for a sprinkling system. The value of the ground was $200,000, making the total investment a trifle over $500,000.

TESTS AND PERFORMANCE.

During construction and erection the work was under the supervision of the engineers, and on completion it was submitted to careful inspection and tests to determine whether the contract guarantees had been met. Since going into service the plant has been under the observation of the engineers, so that close track has been kept of its performance.

The boilers were submitted to a number of evaporative trials to determine their capacity and efficiency. The details are not given here, as the methods and results are of no special interest. The boilers, however, give good service, particularly in capacity, dryness of steam, and smokelessness.

An exhaustive detailed test of capacity, speed, and efficiency was made on No. 5 elevator, type "X 38," situated in the northeast shaft. Simultaneous readings at 2½-second intervals were taken of the voltage, speed, and current—the latter being checked by two instruments, two observers reading independently. The live loads upon the platforms were obtained by weighing.

The speed of travel was calculated by dividing the revolutions of the armature by the known ratio between speed of armature and speed of car. The power consumed per trip was obtained by plotting the curves of current readings (see figure), the area of which —multiplied by the voltage—gives the watt hours per trip. This was reduced to mile of travel by multiplying the watt hours per trip by the fraction that one round trip is of one mile. The following table gives the results:

Elevator.	Live Load, Pounds.	Speed Up, Ft. per Min.	Speed Down, Ft. per Min.	Kw. Hours per Car Mile.	Remarks.
Z, No. 1.	147	271	268	3.14	
" ..	908	256	256	3.14	
" ..	2,997	153	157	4.22	Slow speed
" ..	2,997	256	290	4.19	High speed.
" ..	4,000	147	192	4.05	Slow speed.
X 38, No. 5.	147	153	153	3.14	
" ..	1,008	157	155	3.19	
" ..	4,000	152	160	3.34	
" ..	5,012	153	160	3.81	

The observed data from the "X 38" machine are plotted on page 626. It is interesting to note the current of return to the line with light loads ascending, and heavy loads descending. It will be noted that No. 1 elevator has a down speed, with operator only, of 268 feet per minute. With the same counterbalancing it carries a load of 3000 pounds up at 153 feet per minute, with motor operating on slow-speed notch of operating lever. When operated at high speed this elevator lifted 3000 pounds at a speed of 256 feet per minute, and with an economy per round trip slightly better than when operated at slow speed. This elevator carried 4000 pounds up at 147 feet per minute when operated on the slow-speed point of operating lever.

The No. 5 elevator has a down speed of 153 feet per minute when running with operator only, and carries its full rated load of 4000 pounds up at a speed of 152 feet per minute. This elevator carries 5000 pounds up at a speed of 153 feet per minute.

It is particularly interesting to note that the efficiency in kw hours per car-mile increased but slowly with increased loads. The kw hours per car-mile of travel are equal to good average practice, and will probably improve after longer operation of the plant.

The adjustment of the starting devices on the elevators was found to be for a two and a half to three seconds' start. This made the starting current exceed the running current by more than the 50 per cent. specified, which was based on a five seconds' start. When the starting devices were readjusted for a five-second start this condition of the specifications was practically met. It is a question of judgment, therefore, whether the tenants prefer a slow and easy start and a smooth-running electric plant, or a quick start and a correspondingly severe and sudden demand upon the dynamo and engine.

Two dynamos were operated in multiple, running both elevators and lights. With a variation of load from 250 to 600 amperes, the ordinary variation of voltage was from 220 to 226, and the maximum, 218 to 228. With a variation of load from 200 to 500 amperes the average variation of voltage was from 216 to 220, and the maximum, 214 to 222. This variation did not affect the lights sufficiently to be noticeable, unless the observer's attention was called to it, but has been further improved by a more careful adjustment of the elevator-starting devices.

The wattmeter on switchboard shows the electric power used by the eight elevators from July 12 to 27, 1898, inclusive, or 138½ hours' operation, to have been 1920 kw hours, or an average electrical horse-power per hour of 18.6 for the plant, or 2.3 horse-power per elevator.

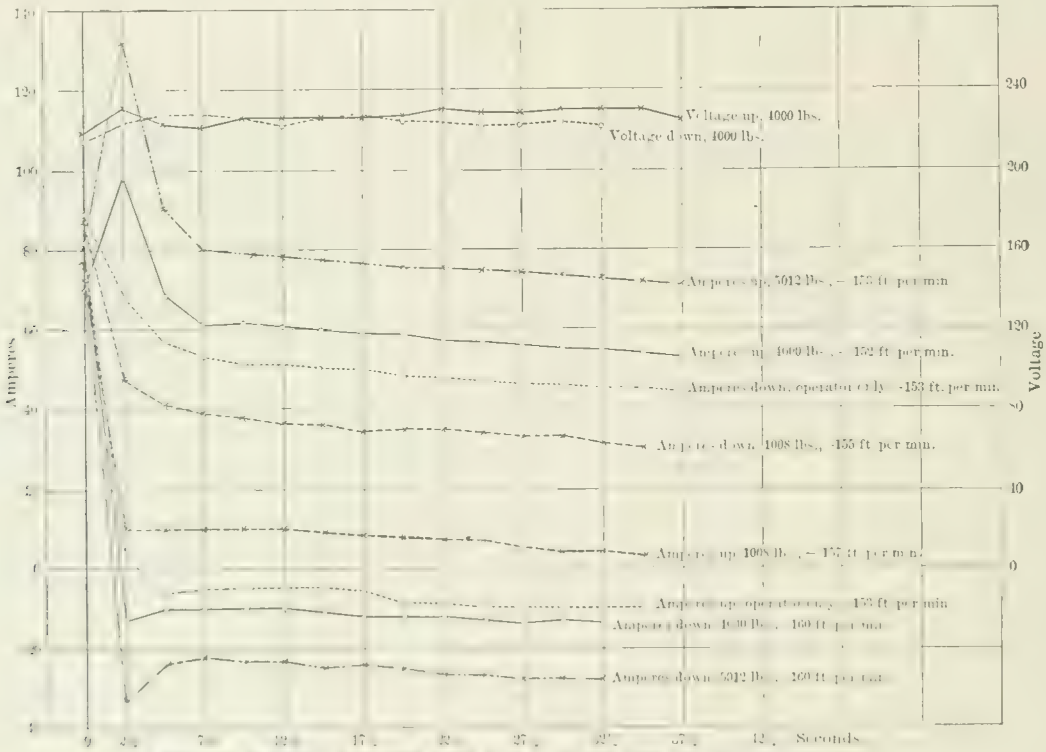
During the month July 12-August 12, 1898, the hours of operation were 283.5, and the average electrical horse-power was 19.2, or 2.4 per elevator. Unfortunately no records were kept of the miles of travel during this time, but they may be roughly approximated as follows, taking the first period mentioned:

Assuming an average efficiency of four kw hours per car-mile, the 1920 kw hours mean a travel of 480 miles. The travel of the eight elevators per round trip is 1608 feet, or 0.304 mile. Dividing 480 by 0.304, the number of round trips is found to be 1579 in 1385 hours, or 11.4 per hour, or five and one-fourth minutes per round trip. As the average travel is about 201 feet, and the average speed about 200 feet per minute, the round trip should have been made in about a minute. This indicates that the elevators averaged about one-fifth the time in motion, instead of one-third to one-half, as originally assumed for maximum service.

It is gratifying to note that the power actually required to operate the elevator plant is considerably less than originally estimated. This is due to the use of apparatus of higher efficiency than assumed, to smaller percentage of time in motion, and to the loads contracted for being less than specified.

The data in the following table, showing the relative performance of three elevator plants in St. Louis, will be found interesting. *A* and *B* are high-pressure hydraulic plants of the most modern type, plant *A* having a high-duty compound crank and fly-wheel pumping engine, and *B* an ordinary direct-acting compound pump. The Hagardine-McKittrick plant is shown in column *C*, and is furnishing arc and incandescent lights from the same bus bars. The fuel and water results are computed from the guaranteed efficiencies of boilers and engines, the elevator data, however, being based on actual test.

	A.	*B.*	*C.*
Cost of coal	$1.35	$1.50	$1.40
Water evaporated per pound of coal	[illegible]	8.00	7.64
Water required per i. h. p. hour	....	54.21	25.00
Coal " " " " "	....	6.78	3.[illegible]7



SPRAGUE ELECTRIC ELEVATOR TYPE X 38, RATED 4000 LBS., 150 FT. PER MINUTE.

RECORD OF ELEVATOR TESTS.

[illegible]			[illegible]
[illegible]			[illegible]
[illegible]			[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]			[illegible]
[illegible]		[illegible]	[illegible]
[illegible]		[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

[illegible] of plant *B* [illegible] wholly to the [illegible] pumping engine. The [illegible] hydraulic plant [illegible] [illegible] and starts at terminals only. The power required will, of course, [illegible]

[illegible] both under and above rating. Very satisfactory performance was [illegible] readings, using carefully calibrated instruments.

[illegible] formance, and were found acceptable. The following results were secured:

Indicated horse-power	126.74
Electrical horse-power at switchboard	102.37
Efficiency of engine and dynamo unit—per cent	80.77
Water rate per indicated horse-power hour—pounds	26.79

The latter was a trifle higher than the guarantee of 25, but the test load was a little too large, and the engine was a trifle out of adjustment. The engine efficiency was determined by a four-hour trial, measuring the water which entered the boiler, and collecting the condensation in pipe system by means of separators, drains and traps, and deducting its weight from that of the water which had been pumped through the measuring tanks.

The Report of the French Railway Engineers.

The report of the committee of engineers sent to this country by the Orleans Railway Company* to determine the status of the art of heavy electric traction, has recently been published, and while most of it is trite to American engineers, there are some examples of fine sarcasm and some interesting conclusions. The London "Electrical Review" quotes the following:

"While we are losing our time on the Heilmann locomotive, the Americans are utilizing, with success, experience gained in exploiting electrical tramways in the development of electrical traction on main-line railways, leaving the generating station at home."

A reference to English conservatism is given as follows: "In ten years electrical traction has almost entirely supplanted horse traction and cable lines in America. New lines have been established at the same time as electric lighting in small towns, in the suburbs of large towns, reaching out to distances impracticable for either horse or cable roads, uniting the principal localities at 40 to 50 kilometres apart, and endeavoring by the junction of suburban networks to raise up traffic between neighboring towns. By the current year 20,000 kilometres have been constructed, and bid fair to [illegible] in the [illegible] future. And London is thinking of experimenting!!!"

After describing the work on the Baltimore tunnel, the Hoboken Shore road, the manufacturers' line at New Haven, the Berlin-Hartford line and the Metropolitan West Side Elevated in Chicago, with a discussion of operation and costs, the report concludes as follows: "No more can the electric locomotive be looked upon as experimental. [illegible] months has demonstrated its superior tractive power over steam, and its reduced weight for equal power. Improvement, it is true, is still possible, but the electrical locomotive no longer requires inventing. It is there and has come to [illegible]

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* [illegible]

Alternating-Current Machinery.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

CHAPTER XXVI.

REGULATION AND OUTPUT OF SINGLE-PHASE ALTERNATORS.

The armature reaction in an alternator has a similar effect upon the apparent drop of pressure in the armature under load, as the real reactance of the armature, so that under their combined influence the alternator behaves as though its real reactance were increased by armature reaction to an amount which may be called the apparent reactance, or synchronous reactance, and which may be measured by observing the drop of pressure in the machine at constant excitation under various loads.

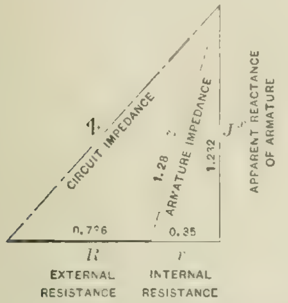


FIG. 149.—APPARENT IMPEDANCE OF CIRCUIT.

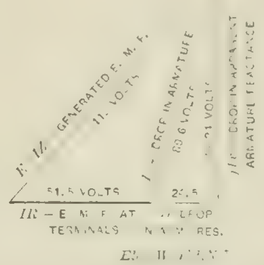


FIG. 150.—DROP OF PRESSURE IN CIRCUIT.

The apparent reactance of an alternator armature is quite large by comparison with its resistance, being, usually, between five times and twenty times its resistance, and commonly about ten times. The simplest way to determine the apparent reactance of an alternator is to operate it under a heavy load and observe the drop of pressure at terminals under constant excitation. Some alternators have so high an armature impedance that they can be operated on short-circuit for a short time without danger of burning out the armature coils, and without requiring any large amount of power. In such cases the apparent impedance of the armature is $Z = \frac{E}{I}$ ohms, where E is the e. m. f. of the armature, as measured under the same excitation at no load, and I is the short-circuit current strength. But in cases where the short-circuit current is too strong to observe, the terminal pressure e volts can be observed at a conveniently large current I amperes at non-inductive load. Then, knowing the internal resistance r ohms, the external resistance $R = \frac{e}{I}$ ohms, and the total apparent impedance of the circuit is (Fig. 149)

$(R + r) + j\,x$, where x is the apparent reactance of the armature. The total drop of pressure

$I\,(R + r) + j\,I\,x = E$, the generated e. m. f., as shown in Fig. 150, so that since $I\,x$, $I\,(R + r)$ and E form a right-angled triangle, we have

$$I\,x = \sqrt{E^2 - I^2\,(R + r)^2}$$

$$\text{and } x = \sqrt{\left(\frac{E}{I}\right)^2 - (R + r)^2}.$$

For example, if we consider an alternator having an e. m. f. at no load of 115 volts, an internal resistance of 0.35 ohm, and a terminal pressure under 70 amperes non-inductive load of 51.5 volts, then the external resistance

$R = \frac{51.5}{70} = 0.736$ ohm, and the apparent reactance is $x = \sqrt{\left(\frac{115}{70}\right)^2 - (0.736 + 0.35)^2}$

$= 1232$ ohms, so that the apparent impedance of the armature is

$$0.35 + j\,1.232 = 1.28\ /74^\circ\ 08'\ \text{ohms}.$$

The drop of pressure in a continuous-current armature of E volts e. m. f., and resistance R ohms, at a current strength of I amperes, is $I\,R$ volts, and the terminal e. m. f. will be $e = E - I\,R$ volts.

The drop of pressure in an alternating-current armature of E volts e. m. f. and Z ohms apparent impedance, at a current strength of I amperes, is $I\,Z$ volts, and the terminal e. m. f. will be $e = E -$ $I\,Z$ volts. The latter equation is, however, a vector equation, and must be interpreted geometrically. It will, therefore, be seen that the value of e depends not only upon the numerical values of E, I and Z, but also upon their phase angles. Thus, taking the generated e. m. f. as 115 volts of standard phase, and assuming that $Z = 1.28/74^\circ\ 08'$, then, for a given current strength $I = 27.8$ amperes, the drop will depend upon the angle of I. If this angle be O°, or in phase with the generated e. m. f.,

$I\,Z = 27.8/0 \times 1.28/74^\circ\ 08' = 35.6/74^\circ\ 08'$ (Fig. 151), and the terminal e. m. f. $= e_0 = E - I\,Z = 115 - 35.6/74^\circ\ 08' = 111$ volts (Fig. 154), representing a terminal drop of 4 volts. If I has a lag of 30° behind the generated e. m. f. then

$I\,Z = 27.8/30 \times 1.28/74^\circ\ 08' = 35.6/44^\circ\ 08'$

Fig. 152. The terminal e. m. f. $= E - 35.6/44^\circ\ 08' = e_{30}$. $= 93$ volts, Fig. 154 representing a terminal drop of 22 volts. With I lagging 60°, the drop is $35.6\ /14^\circ\ 08'$ (Fig. (153) and the terminal e. m. f. e_{60} (Fig. 154) $= 81.5$ volts, representing a terminal drop of 33.5 volts.

On the other hand, if by the action of condensers or equivalent apparatus in the circuit, the current I should lead the generated e. m. f. by, say, 30° or $I = 27.8/30$, the drop $I\,Z = 35.6/104^\circ\ 08'$ and the terminal e. m. f. becomes e'_{30}, Fig. 154, $=128.5$ volts, in which case the terminal pressure is greater than the generated pressure by 13.5 volts, or there is a negative drop in the armature of this amount. Again, if the current leads the generated pressure by 60°, the drop is $I\,Z = 35.6/134^\circ\ 08'$, and the terminal e. m. f. is 142.5 volts e'_{60}, Fig. 154, or is 27.5 volts greater than the generated e. m. f.

These conditions show how much the drop of pressure at armature terminals, and therefore the automatic regulation of the alternating-current generator, depends upon the nature of its load. If it has an inductive load, the drop of pressure will be comparatively great, and the automatic regulation comparatively bad, while if it has a condenser load, the pressure at terminals may rise instead of fall with the load.

By taking successive values of external resistance from $R = \infty$ to $R = O$; i. e., increasing the non-inductive load from open circuit to short-circuit for the alternator considered in the preceding sections, with a generated e. m. f. of 115 volts and an armature impedance of $128/\underline{74^\circ}$ ohms, we obtain the heavy middle curve plotted in Fig. 155. This agrees, with all reasonable precision, with the curve plotted in Fig. 1, p. 278, of THE ELECTRICAL WORLD for March 20, 1897. If z be the apparent internal impedance $(0.35 + j\ 1.232)$ and Z the external impedance $(R + j\,O)$, the current strength in the circuit is $I = \frac{E}{Z + z}$ amperes, and the pressure at terminals is $E - I\,z$, or $I\,Z$ volts.

If the external impedance is inductive with a power factor of 0.8 or 80 per cent., corresponding to an angle of $/\ 36^\circ\ 47'$, so that the current in the external circuit apparently lags behind the terminal pressure by this angle, the reactance in the circuit at any given load is increased, and the pressure at terminals for constant excitation follows the lower dotted curve in Fig. 155. This is nearly a straight line between 115 volts and zero, representing an apparent drop of pressure in the armature nearly proportional to the

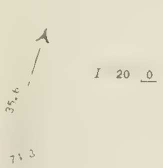


FIG. 151.

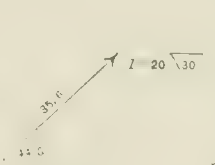


FIG. 152.

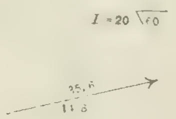
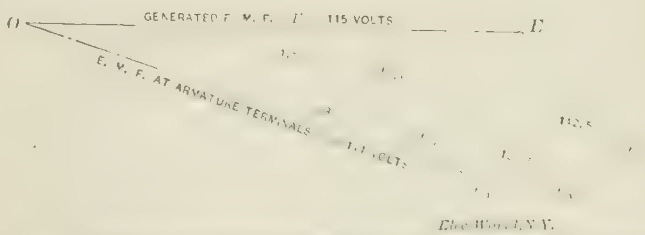


FIG. 153.



O
GENERATED E. M. F. E 115 VOLTS
E
E. M. F. AT ARMATURE TERMINALS
111 VOLTS
142.5
Elec. World, N.Y.

FIG. 154.—DIAGRAM OF DROP OF PRESSURE IN ARMATURE IMPEDANCE.

load current. If, on the other hand, the load contains condensers and has a leading power factor of 0.8, the reactance in the circuit will now be reduced, since the reactance of the condenser load is negative, or neutralizes to a greater or less extent the inductive reactance of the armature. The terminal pressure will now be represented by the upper broken line in Fig. 155, and the pressure at terminals is greater than the generated e. m. f. as far as 63 amperes of load current. If we take 25 amperes, as representing the full load of this machine, the terminal pressure at non-inductive load will be 102, with inductive load of 80 per cent. power factor, 88 volts, and with condenser load of 80 per cent. power factor, 122.5 volts, respectively. A condenser load in alternating-current practice is unusual, but the condition of inductive load of 0.8 power factor may readily happen, and it is evident that such an inductive load may readily double the apparent drop of pressure at armature terminals, which would be produced by a non-inductive load, requiring an increased compounding, if the alternator is compound wound.

If the resistance of an alternator armature is such that the non-inductive full load drop of pressure in this resistance is 2 per cent. of the generated e. m. f., and the apparent reactance of the armature is ten times the resistance, the drop of pressure in this reactance is 20 per cent. of the generated e. m. f. Since these are in quadrature, we have percentage of generated e. m. f. expended in resistance

$$= \sqrt{100^2 - 20^2} = 98 \text{ per cent. approx-}$$

imately, and of this 2 per cent. is in the armature, leaving 96 per cent. at armature terminals. Consequently, such a machine on non-inductive load has a terminal drop of twice its resistance drop, or

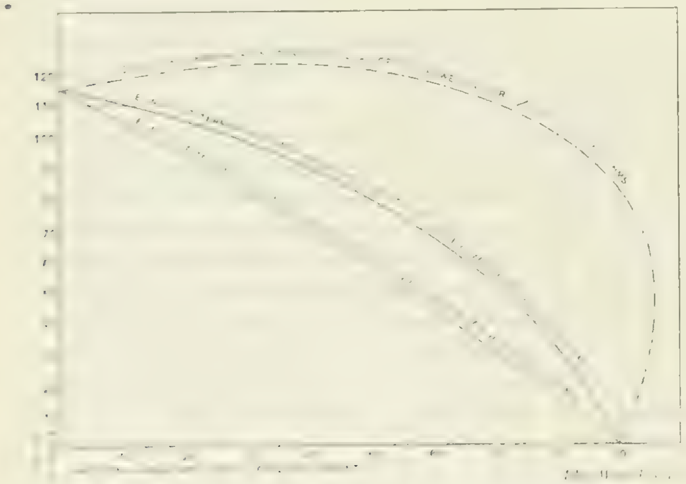


Fig. 155.—Diagram of E. M. F. at Armature Terminals Under Varying Load Current and Constant Excitation.

the apparent drop of pressure [illegible] resistance. This is a common condition in practice.

The power delivered by an alternator at its terminals is [illegible] where e is the terminal [illegible] I the current strength in amperes and k the power factor of the load, or the cosine of the supposed phase angle between e and I. In the case of a non-inductive load [illegible] and [illegible] I watts, as in the case of a continuous-current generator. With constant excitation, [illegible]

[illegible]

The current in the circuit would be

[illegible]

[illegible]

power in the external circuit is $e I$, since the power factor is 100 per cent. $= 72 \times 56.3 = 4054$ watts, and either an increase or decrease of the load current at 56.3 amperes will result in a diminution in the external power. In the case of continuous-current generators, it is known that theoretically the output is a maximum when the external resistance is equal to the internal resistance, or with a drop of 50 per cent. in the armature. In practice, however, except in the very smallest machines, such an output is never reached, owing not only to the low electric efficiency of 50 per cent. so obtained, but also to the large amount of power which would be expended in the armature and which would speedily destroy it. In the case of the alternating-current generator the corresponding rule is, as we have seen, that the output is a maximum on non-inductive load when the external resistance is equal to the internal impedance, and, although in practice this output is not usually reached, yet owing to the reactance of such generators this condition is much more nearly approached than in the case of a continuous-current machine.

Electrolysis of Cast-Iron Water Pipes at Dayton, Ohio.*

BY HAROLD P. BROWN.

The injury of water pipes by electrolysis is at present so well understood that my only excuse for again calling your attention to the subject is found in the peculiar and unusual conditions disclosed at Dayton, Ohio, in an examination made last July.

All of us know that electrolysis may be expected to injure lead and wrought iron pipes on the lines of electric roads within a radius of half a mile from the power house, but we have believed that cast iron mains were safe.

Our faith has been rudely shaken by the condition of these pipes at Dayton. They appeared to be entirely uninjured, and the black paint seemed to be unaffected. But on scraping the pipe with a knife the metal was found so soft that grooves could be cut into it. Therefore sections were removed for mechanical and chemical tests, and the results fully justify your most careful attention, since your own pipes may perhaps be in a similar condition.

The electrical tests showed that the pipes in the business portion of the city, 1½ to 2 miles from the power houses, were positive to the rails and therefore subject to electric corrosion. The highest readings in this part of the city were 4½ volts near Fifth Street Bridge and near Washington Street Bridge. Near the power house on the west side of the river the pipes were 9 volts positive to the rails, and the danger district extended about three-fourths of a mile to the west. In the southern part of the city the highest positive reading was 2 volts in front of the Oakwood Avenue power house.

It was at once evident that the danger district was extremely large in which lead and wrought iron pipes would be injured. This was verified by the records of the water board, which showed a large number of service pipe renewals. These renewals are very expensive in Dayton, because the foundations of pavements are unusually heavy and unusually well constructed.

Cast iron pipe is usually little affected by electrolysis, since the coating of adherent moulding sand and tar paint protects it. In the ordinary soil an iron pipe submitted to electrolytic corrosion is covered with a layer of iron oxide, which is a poor conductor of electricity, so that with a given pressure the deeper is the layer of rust and the slower the rate of corrosion.

But, to my surprise, the soil surrounding pipes in Dayton gives an entirely different reaction when a current passes through it. The tar seems to be no protection whatever, and the surface of the pipe in the danger district is changed into a soft black material resembling graphite and easily cut with a knife. This material is such an excellent conductor that instead of checking it tends to increase the action by reducing the resistance of the path through which the current must flow in order to reach the rail. Moreover, the stones and pebbles near the pipes are actually electro-plated with the metal of the pipe, whether iron or lead. This condition I had never before seen, and as far as I know it has not been previously reported.

Since my Dayton report was published I have received a letter from Mr. Dabney H. Maury, Jr., superintendent of the Peoria Water Company, Peoria, Ill., in which he states that he has encountered the same phenomena.

In order to electrically deposit a layer of metal two things are necessary: first, a liquid which will dissolve the metal; and second, an electrical current exceeding 0.01 of a volt in pressure, flowing away from the metal through the liquid. The fact that the pebbles are electro-plated showed that both these conditions exist, but in order to prove conclusively that the soil itself did not injure the pipes, a pipe surrounded by the same soil was uncovered in another portion of the city, where there was absolutely no trace of an electrical current. This pipe was on Logan Street, near the canal; the records showed that it was put down in 1874, while the pipe taken out at the west end of Fifth Street Bridge had been in use ten years, and exposed to electrolysis for four years. If the damage was caused by the soil itself, this pipe would, of course, have been in a worse condition than the Fifth Street pipe. But the Logan Street pipe was apparently as good as new.

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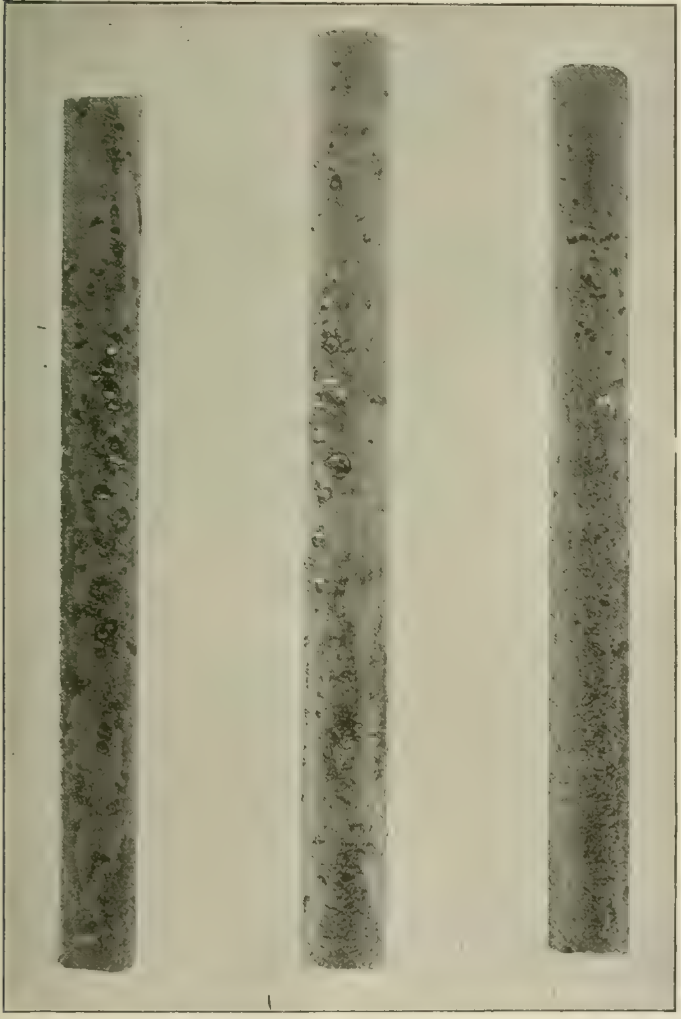
* [illegible] American Society of Municipal Improvements, [illegible]

The chemical analysis of the soil showed that the solvent was produced electrically from carbonates of sodium and chloride of sodium in the soil. Neither of these by itself in the small proportion shown by the analysis would injure a cast iron pipe covered with tar, though, as is well known, a strong solution of chloride of sodium or common salt will rust wrought iron.



Cast Iron Water Pipes Removed from the Streets of Dayton, Ohio.

But the presence of even 0.01 per cent. reduces the electrical resistance to the iron and the passage of the current decomposes these salts and forms muriatic or hydrochloric acid, which dissolves the metals. Having thus determined the cause of the trouble, it remained to fix its extent. Fifteen excavations were made in different parts of the city to determine how much electrical pressure is required to seriously injure the cast iron.

A pressure of 3 volts and less is found to cause a graphite coating not exceeding one thirty-second of an inch in depth; the iron seems to be uninjured. From 3 to 4½ volts the thickness of the layer is increased in a ratio depending upon length of time during which the pipe has sustained this pressure. With a knife or file soft spots from one-sixteenth of an inch to one-quarter of an inch deep can be found in a pipe. With higher electrical pressures the extent of the injury is even greater. In all cases the damage is directly proportional to the pressure and to the length of time during which the current has been flowing, while it is inversely proportional to the distance between the rails and pipes.

In my opinion all mains and service pipes in Dayton are seriously injured where submitted to 3 volts' pressure or more for two or more years when within 4 feet of the rails. This would mean less than 1 mile of mains, but with lead or wrought iron service pipes the pressure limit should be as low as 1 volt. Mr. Chas. E. Rowe, secretary of the waterworks, however, feels that 17,513 feet of mains should be replaced at a cost of $77,000.

To determine what percentage of mechanical injury had been sustained by the pipes it was intended to compare the hydrostatic pressures required to rupture the Logan Street and the Fifth Street pipes, but defects in the apparatus employed prevented a fair test. The Fifth Street pipe, at 150 pounds pressure, leaked through the corroded spots, while the other pipe was able to stand 300 pounds pressure. Test bars were cut from the best portions of both pipes and broken on a Riehle testing machine. The average transverse strength of the Logan Street pipe was 1800 pounds per square inch as against 1085 pounds to the other. The tensile strengths were respectively 16,000 and 11,425 pounds, and the deflections were 0.25 and 0.20 of an inch. Four years of electrolysis had robbed the Fifth Street pipe of about 30 per cent. of its transverse strength and about 45 per cent. of its tensile strength, and had caused it to leak at 150 pounds pressure.

I feel confident that if the railroads would unite in the expenditure of five to seven thousand dollars for the proper electrical apparatus and connections, all the water pipes in Dayton could be maintained negative to the rails. Then the pipes would harden. Moreover, any further electrolysis that might occur would be in the oppositie direction, and would therefore add a layer of metal to the pipes instead of injuring them. I will not here enter into discussion of the electrical methods required in Dayton to obtain this result, but it is evident that no plan heretofore suggested for electrolysis prevention will effect a cure there,owing to the unusual conductivity of the soil and the peculiar division of the city.

The railway manager is as much interested in stopping the trouble as you are ; every pound of metal taken from your pipes means to him a heavy loss of power, increased investment for engines, boilers, dynamos and conductors. And if it is finally established by legal decisions that his current has injured your property he will have to settle the bill. The best course for all concerned, it seems to me, is to take mutual action while that bill is small, and not wait until a bursting main during a fire spreads the loss over the entire community. I would like to offer the following practical suggestions:

1. It will not be a mistake to follow Dayton's example and obtain complete and accurate information concerning the electrical, chemical and mechanical condition of your pipes, especially in the vicinity of the power houses. The trouble may be confined entirely to the lead in the service pipes, and in the calking of joints on your mains; but even here serious damage may result if the matter is neglected for years.

2. Do not put down any more lead or wrought iron service pipes, as these are the first victims of electrolysis and their replacement means ruin to pavements. Use instead wooden pipe, banded with a close spiral of hoop iron and covered heavily with asphaltum. This will stand the heaviest pressure in use, and is not affected by electrolysis, since the hoop iron is low in conductivity and is not electrically connected at the joints. Its cost is said to be reasonable, and it has a successful record of many years' service.

3. Use the same kind of pipe for new mains in any district in which a railway power house is likely to be erected and heavily paint the lead calking of cast iron mains, using asphalt or petroleum wax.

4. In the danger district along the lines of electric roads and on intersecting streets put into your water and gas mains two or more consecutive lengths of these wooden pipes so as to break the electrical continuity of the mains, and thus make their resistance greater than that of the rails. Fill in the space around them with broken stone and connect with drain if possible.

5. Midway between the wooden sections on each main attach insulated pilot wires, leading to a central office. Connect similar wires to the rails nearest the pipe wires and make daily electrical tests at times of heavy load. If any section shows positive to the rails cut it at once into smaller sections and call upon the railway to rebond its line upon that street. This, with the proper electrical management of the railway feeder wires and apparatus, will effectively protect your mains.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE
AMERICAN AND FOREIGN

By Carl Hering

Dynamos, Motors and Transformers.

ROTARY CONVERTERS. S. P. Thompson. Lond. "Elec. Eng.," Nov. 18.—The continuation of his paper (see "Digest" last week); it is also being reprinted in the "Elec." and "Elec. Rev." A number of interesting results, which these diagrams show, are pointed out; when the alternating current is reversing, for instance, the armature is operating simply as a motor and is being accelerated; when the alternating current is at a maximum the armature is operating wholly as a generator and the acceleration is negative; the armature is then adding 100 amperes to the 100 coming from the primary mains. The coils, which are close to the slip-ring, are moreover heated much more than those which lie midway between the connectors, the distribution of the heating being quite different from that when the armature is used for either a motor or a dynamo; this unequally distributed heating effect is in total also somewhat greater in the former than in the two latter, but it is less than the total heating effect if used as a single-phase generator or motor, the ratios being 1 to 1.366 to 2 in the three cases. Some curves show this unequal heating effect for the case of a single-phase converter. He then considers what differences will be made if the magnetic distribution does not follow a sine law; if the poles are narrowed so as to concentrate the fields, even though the continuous voltage remains unchanged, the alternating voltage will be increased and the curve will be more peaked than a sine curve; if used to convert continuous into alternating currents the effect will be to raise the effective alternating voltage and to lower the relative alternating current. If used for the reverse process the converse result takes place. If the machine is used to convert single-phase into continuous currents the form of the curve and the distribution of the flux are of greater importance and the apparatus is less satisfactory than the two-phase or three-phase converter; it has greater variations of armature reactions and greater and more unequal heating, and requires more accurate setting of the brushes; it is not self-starting from the alternate-current side; notwithstanding these disadvantages, such machines are in satisfactory use. He then considers the two-phase converter, showing again a succession of diagrams and the currents flowing at each instant. The inequality of the heating is much less in this case. The armature reactions are more nearly balanced, and there is much less tendency to impart a periodic fluctuation to the continuous current; such machines are self-starting and give little trouble from sparking. Another series of diagrams shows the flow of currents for a three-phase converter.

ROTARY CONVERTERS.—Lond. "Elec. Rev.," Nov. 18.—A short editorial article calling attention to the low efficiency due to multiplicity of conversions. Both at Niagara and for the Central London Railway it is thought doubtful whether the use of rotary converters is of any advantage over direct generating of continuous currents. It is thought that converting apparatus are necessary evils, to be adopted only after all attempts at a direct method have failed.

THEORY OF THE ROTARY TRANSFORMER. Kapp. Lond. "Elec.," Nov. 18.—The beginning of a translation in abstract from the German of the article noticed in the "Digest" Oct. 15 and 22.

BRAKING IN SINGLE-PHASE INDUCTION MOTORS. [illegible] "Zeit. fuer Elek.," Nov. 13.—In such motors there are two fundamentally different methods of braking, first by the insertion of a [illegible] resistance in the armature, and second, by bringing the motor into the condition of over-synchronism. He discusses both these methods, admitting that the results are more of [illegible] interest. He shows that it is possible to [illegible] of this kind by connecting a resistance of a certain particular value in the armature circuit; for other values the [illegible] He suggests that [illegible] The second method is [illegible] and it is shown that with [illegible] the motor until it comes to rest.

[illegible] "L'Eclairage Elec.," Nov. [illegible] He discusses the operation of non-synchronous motors with revolving fields for [illegible]

[illegible]

CALCULATING ARMATURES FOR A CONTINUOUS CURRENT MACHINE. Grassi. "L'Eclairage Elec.," Nov. 12.—A reprint of a short article from an Italian journal in which he shows how to calculate the relation between the diameter and length of an armature, based on the loss by the Joule effect—that is, by the heating due to the resistance. He applies the formula in certain examples.

MAGNETIC FIELDS OF BIPOLAR DYNAMOS. Hess. "Elek. Zeit.," Nov. 17.—Illustrations, accompanied by descriptions, of iron-filing picture, showing the distribution of the lines of force in a ring and drum armature alone, in the field alone, and in both combined; the illustrations were made with iron filings on sensitive paper and by means of open-wound coils, resembling those of an armature, but with no iron in the core, thus showing the field in the interior; they were made for the purpose of instruction, and differ somewhat from those in S. P. Thompson's book. The differences when used as a motor and dynamo are also shown. A small working model is described and illustrated in which the armature consists of a single flat ring around which an open spiral is wound and connected to a commutator as usual, the whole revolving horizontally between two poles; with the aid of iron filings this enables the field to be shown while in action.

PARALLELING ALTERNATORS.—"Elek. Zeit.," Nov. 17.—A communication from Schueler and another from Benischke, both stating that the method recently described by Burch (see ELEC. WORLD, Oct. 8) is not new. The latter, moreover, states that he has used it with 2000-hp, three-phase machines, but found no advantage in it; he describes this particular case. The remnant magnetism is not sufficient, as Burch claims, to bring the machines into step; he had to excite them a little. He considers it very hazardous to connect an excited machine in parallel with a loaded one; even though there would be no short circuit, as with the continuous-current machine the current will be from 3 to 10 times of the normal, and the fuses will therefore blow, or if no fuses exist, the machine is in danger of being burnt out.

Lights and Lighting.

DERY INCANDESCENT LAMP.—"Elek. Anz.," Nov. 17.—A note stating that experiments with this modified form of Nernst lamp have given good results; the lamp is now being made for street lighting purposes, and it is stated that it will soon be on the market.

Power.

ELECTRIC CRANES AT SOUTHAMPTON.—Lond. "Elec.," Nov. 18.—A brief, illustrated description of the new cranes which have just been completed for the work at the harbor. They differ in many respects from the older ones. One of the new departures is an arrangement for automatically ringing a bell in the cabin when the load is too great; one of the bearings rests on springs, and when the pressure is too great a contact for a bell is made. Another feature is the combined crane; there was a necessity for a 12-ton crane as a standby, but instead of making this a separate crane a 12-ton hoisting gear was combined with a 3-ton crane by means of an arrangement of gears; the change from one to the other can be made in about one minute. The 3-ton cranes will lift 30 cwt. at 200 feet per minute, or 3 tons at a proportionately lower speed; the radius of the swinging cranes is 30 feet, and the normal slewing speed 400 feet per minute. There are two separate motors, one for the hoisting and one for the slewing motions, the former a 50-hp and the latter a 10-hp; the lifting motors of the 3-ton cranes are not reversible and have copper brushes, but those for the 12-ton cranes are reversible and have carbon brushes like the slewing motors; the voltage is 200, and the consumption of power from 3.5 to 5 kw-hours per hour, the cost being 6 cents per unit; but even at this comparatively high price the electric cranes are superior for handling cargoes cheaply and quickly, as much more work can be got out of them; they are less likely to get out of commission through breakdowns, and are much more quickly repaired, the cost of repairs being trifling; there is a great saving in standing charges, since the generating plant is also used for lighting. Men unskilled in electrical machinery can handle the cranes very well.

POWER TRANSMISSION FOR MINING. Esson. Lond. "Elec. Eng.," Nov. 18.—An abstract of a paper read before the Institution of Civil Engineers. He points out the advantages due to the fact that the crushing mills can be placed at the mine, if electrical power transmission is used, thus avoiding the serious expense of transporting the ore to the seat of the water power. The question of whether power transmission should be adopted is briefly discussed. The greater part of the paper refers to a description of the plant of the Sheba Gold Mining Company, in which power is transmitted electrically to the crushing mills 5 miles distant, reducing the cost of milling from about $1.50 per ton to about 40 cents per ton, an aerial ropeway transport having formerly been used; the generating plant consists of three alternating current dynamos running at [illegible] volts.

POWER GAS.—"L'Eclairage Elec.," Nov. 12, and "L'Ind. Elec.," Nov. 10.—A long, illustrated description of the Riché gas, which is intermediate between what is known as power gas and lighting gas, and is obtained from the distillation of wood; it can be used as well for power as for heating. The composition and calorific power of the principal commercial gases is given; for city gas the mean value is about 5250 calories per cubic metre; that of Dawson gas is 1346 and that of Riché gas is 3029; the article is a reprint, in part, of a pamphlet.

SHOREDITCH.—Lond. "Elec. Rev." and "Elec. Eng.," Nov. 18.—A reprint of the official report of the first year's working results of this dust-destructor plant; it is followed by the discussion of it by the committee. The report appears to show a net profit of about $13,000. The same journals contain also a communication from Baker, giving his interpretation of the published results.

ELECTRIC ELEVATORS.—Lond. "Elec. Rev.," Nov. 18.—Brief, illustrated descriptions of some of the mechanisms used on the Siemens and Halske elevators, one for rapid and one for slow speeds; worm gearing is used.

SOCIAL INFLUENCE OF ELECTRIC POWER.—Lond. "Elec.," Nov. 18.—A long editorial referring to electric traction and the use of electric motors for industrial purposes.

ELECTRIC MOTORS IN SHOP AND MINE. Barber. "Eng. and Min. Jour.," Nov. 26.—An abstract of a paper read before the Civil Engineers' Club of Cleveland. The advantages of the electric motor are pointed out; the relative loss of power in the two forms of transmission was briefly discussed. The first cost of the electrical installation is said to be greater than that of belt and shaft transmission, but the cost of maintenance is less. The opinion was expressed that an electric percussion drill could be made, but that none has yet been produced that fulfills the requirements, while the pneumatic percussion drills are highly perfected.

ELECTRIC POWER ON SHIPS.—"El'ty," Nov. 30.—Brief quotations from reports to the Navy Department by officers of the Brooklyn concerning the operation of the machinery on that steamer, which was driven electrically. The Brooklyn is said to be the most thoroughly electrically equipped vessel in the United States Navy. The reports refer to the results of experience during the recent war; the operation of the electrically driven machinery is reported to have been very satisfactory.

ELECTRICALLY OPERATED PUMPS. Bunnell. "Eng. Mag.," Dec.—An illustrated article pointing out the conditions under which electricity is the most desirable motive power for pumps and discussing the advantages of some of the types of pumps specially designed to be electrically driven; the latter are illustrated.

POWER FROM COKE OVENS.—"Eng. and Min. Jour.," Nov. 26.—A note stating that a large electric power plant has been proposed, to be run by gas engines from the surplus gases forming the bi-product in coke ovens at Dunbar, Pa.

GRENADA.—"West. Elec.," Nov. 26.—A translation of the article noticed in the "Digest" Oct. 22.

Traction.

CANAL HAULAGE. Allen. Lond. "Elec.," Nov. 18.—A brief reply to the recent communication of Galliot (see "Digest," Nov. 26). He claims that his own remarks were perfectly correct. He states that one horse can haul 120 tons at a speed of 2.25 miles per hour for four hours without difficulty; the pull is about 2 pounds per ton; the pull is increased in proportion to the square of the speed; a pull of 300 pounds at a speed of 2.5 miles per hour is equivalent to 2 horse-power on the tow-rope, but the motor must exert twice this pull when starting. He claims that the prevalent impression that the average horse can perform only two-thirds or three-fourths of a mechanical horse-power is wrong, as a horse can work at the rate of 1.5 mechanical horse-power for four hours a day or 1 horse-power for eight hours a day without injury, and can easily exert a pull of 600 pounds for a short distance. He questions how Galliot's tricycles pass one another, intimating that it involves considerable delay. The pull on the tow-rope equal to 6 horse-power at a running speed of 2 miles per hour is 1125 pounds, which is much greater while getting up speed, so that the weight of the tricycles and the wear on the tow-path must be very great.

HEILMANN LOCOMOTIVE.—"L'Ind. Elec.," Nov. 10.—A short article referring to some recently published data, which, however, is only very brief. It is claimed in the original that the results of these experiments have been satisfactory, and that the trials are to be continued on the line from Rouen to Havre, then from Paris to Cherbourg and finally to Brest.

"L'Elec.," Nov. 12, contains a few notes referring to recent trials, which are said to have been satisfactory; no information of importance is given.

TRAFFIC ON LONDON STREETS. Barry. Lond. "Engineering," Nov. 18.—An abstract of his inaugural address at the Society of Arts. He refers to the more or less distant future; he does not seem to have much faith in the deep-tunnel railways, as cheap fares on surface lines would command most of the traffic; he therefore suggests widening the streets and providing bridges at crossings like the present Holborn viaduct. He does not seem to mention the use of electricity for power.

TRACTION BOOSTER.—Lond. "Elec. Eng.," Nov. 18.—Answers to the question whether it is better to use motor generators or accumulators as boosters at the end of traction feeders. One of the answers, after discussing the question, concludes that in capital outlay, efficiency and maintenance the advantage is in favor of the motor generator, but for smooth working, reliability and a ready standby, adopt accumulators.

LYONS.—"L'Elec.," Nov. 19.—An illustrated description of the electric railways in that city, where the change from horse to electric traction has recently been completed for the whole city; the installation was made by the Thomson-Houston Company.

LIVERPOOL.—Lond. "Elec." and "Elec. Rev.," Nov. 18.—A long, well-illustrated description of the electric trolley line.

GLASGOW.—Lond. "Elec.," Nov. 18.—A well-illustrated description of the electric trolley line in Glasgow.

CHICAGO.—Lond. "Elec.," Nov. 18.—A brief, illustrated description of the West Side Elevated Railroad.

TRAMWAY UNION.—"L'Elec.," Nov. 12.—A brief account of the meeting of the International Tramway Union at Geneva last August; the principal matters which interest electricians are referred to.

AUTOMOBILE ACCESSORIES.—"L'Ind. Elec.," Nov. 10.—A short notice stating that a prize of $80 is offered for a sort of box or enclosed switchboard of a universal nature for electric automobiles and containing such things as a voltmeter, an energy meter, a rheostat, a pair of conductors, with universal terminals for connecting to the battery, etc.

AUTOMOBILE DELIVERY WAGONS.—"L'Energie Elec.," Nov. 1.—A long, illustrated article on the recent competitive exhibition near Paris, in which sixteen such vehicles took part, three of which were electrical. Brief, illustrated descriptions are given.

HEILMANN LOCOMOTIVE.—"Eng. News," Nov. 24; abstracted in the "Elec. Eng.," Dec. 1.—A short article giving a description of both the old and the new locomotive, with an illustration of the new one; the data was received from the Heilmann works, and refers to the construction as distinguished from the operation. Although it can develop considerable power, it does not seem to be capable of hauling very heavy trains or of attaining any exceptional speed. One advantage claimed is an economy in coal consumption, but the information gives no particulars of any work done in hauling heavy trains. A comparison is made between the figures of the first Heilmann locomotive with those of some new steam locomotives. The subject is also commented on editorially; it is stated that a fact which is often overlooked is that a steam locomotive generates power at a much lower cost than any stationary steam plant. The argument often made that the electric locomotive is a future certainty, is also discussed, and it is shown that the electric car or locomotive operates under entirely different conditions from those on steam railways, and that it is used where the steam locomotive could not operate economically; all electric railways thus far built have been for purely local traffic, the Heilmann engine being the only attempt to use electricity for ordinary railway service; the published results give no reason to expect a more extended use of that machine. In conclusion it is stated that there is no reason to expect the application of the electric locomotive to ordinary railway service.

SURFACE CONTACT SYSTEM. Johnson. "Elec. Eng.," Dec. 1.—The continuation of the reprint of his paper noticed last week. A reprint is also begun in "El'ty" and "Elec. Rev.," Nov. 30.

BUDAPEST.—"Eng. News," Dec. 1.—A full-page illustration, with a brief description, of the compound engine at the power-house of the Budapest electric railway.

AUTOMOBILE. Child. "Sc. Am. Sup.," Nov. 26.—A long, illustrated description, including drawings, of an electric tricycle, which is so designed that it can be constructed by an amateur with the resources of a small machine shop. It is intended for one person, for a maximum speed of 12 miles an hour and a capacity of a 20-miles' run with one charge of the battery. The construction of all the parts is described and illustrated. The batteries are of the lead-zinc-cadmium type.

Installations, Systems and Appliances.

BRIGHTON BREAKDOWN.—Lond. "Elec. Rev.," Nov. 18.—An anonymous communication in which it is suggested that a thoroughly good short circuit on one dynamo would necessarily interfere with the excitation of all others in parallel with it; if the machines had shunt excitation only their voltage would immediately fall to zero without waiting for a reduction in speed. This is followed by a communication from Tapper describing the occurrence, with an illustration; he was one of the engineers present at the time. All the dynamos were practically self-exciting, and no battery was in use. The sequence of events was as follows: A series of loud reports, accompanied by showers of sparks and melted copper, with a drop of about 50 per cent. in the voltage; the lights remained steady for five or six seconds, and then gradually died out during forty to sixty seconds. The cut-out of the faulty machine was seen to fall and was badly burned; none of the others showed any signs of burning. The whole shutdown lasted twenty to twenty-five minutes. A band was found loose on the armature of the damaged machine, and a large hole was burnt into the copper bars immediately under it.

GRUYERE.—"L'Eclairage Elec.," Nov. 12.—A brief, illustrated description of a small plant in this part of Switzerland; it is said to be one of the first alternating-current stations in that country, and was installed in 1893.

ZURICH.—"Elek. Zeit.," Nov. 17.—Long extracts from the official report of the operation of this station for last year.

CHICAGO.—"West. Elec.," Nov. 26.—A brief, illustrated description of a plant which has just been installed for running 866 arc lamps for street lighting.

PARIS. Bayly. "Elec. Rev.," Nov. 30.—A short description of the central station at Place Clichy. The method of charging the accumulators by means of a booster is described.

Wires, Wiring and Conduits.

NON-INTERCHANGEABLE FUSES. Erlacher. "Elek. Anz.," Nov. 13.—A brief, illustrated description of a modification of the fuses of the Rittershausen system, which was the one which received the prize from the German society; it has some faults, however, which are claimed to be overcome by the present modification. The object of the system is to make it practically impossible to insert a larger fuse in the block than the one for which it was intended. In the original form a larger fuse could be inserted if the fuse was simply bent a little. In the present modification the screw clamps are so made that the movement of the nut is limited; it would be possible to insert a smaller fuse, but not a larger one, as the thickness would be too great to clamp under the screw. An illustration is given, but it is not very clearly described.

FINDING A SHORT CIRCUIT. Dobbs. "Elec. Eng.," Dec. 1.—A note showing how a short circuit in a lamp socket may be readily found in long strings of incandescent lamps in multiple, such as are used for decorating purposes. An attempt was first made to blow out the short circuit with a large current, but this was not successful. The string of lamps was then connected in series with a circuit of about eight lights, and a compass was then moved along the main wire, to which the lamp sockets were attached; the needle gave a constant deflection until the short-circuited socket was reached when it suddenly swung to a different position. The method is believed to be applicable to many other cases.

LINE INSULATORS. Perrine. "Elec. Eng'ing.," Nov.—A long article which is of the nature of a short treatise on such insulators, describing the various forms and discussing their properties.

HISTORIC INSULATOR.—"Elec. Eng'ing.," Nov.—An illustration of what is thought to be probably the oldest specimen in existence of that type of insulator which is used in places where the permanent fastening of the wire is not desirable; it is the form used originally on the Washington-Baltimore line, and was obtained from one of the first lines built in Wisconsin, in 1848.

Electro-Physics and Magnetism.

HIGH-FREQUENCY CURRENTS AND DISCHARGES. Ebert. "Wied. Ann.," 65, p. 761; abstracted at considerable length in the "Elek. Zeit.," Nov. 10.—He discusses the use of high-frequency currents for studying discharges in gases. A gas cannot be compared directly with a conductor of the first class nor with one of the second class; the gas acts more like a combination of a conductor which conducts like one of the first class, or also like an electrolyte, and a "capacity-resistance" arising from a sort of dielectric action, which resembles a polarization resistance; the discharge tube might be compared to a condenser which has been pierced. In his researches he investigated this condenser action. In the first part of the paper he describes with the aid of illustrations the machines and the apparatus which were used; the former gives currents of a frequency of about 500 per second, which is sufficient for that purpose. He found that a discharge tube acts like a condenser toward the oscillations of the current. When the pressure of the gas in the tube was varied he found that at the high pressure at which the column of gas just breaks down, as also at very low pressures, the voltage at the electrodes is very high and the current small; at a certain intermediate value the voltage becomes a minimum and the current a maximum; with decreasing pressures there [illegible] up [illegible] very low pressures, at which finally no discharge can take place, the [illegible]

[illegible]

[illegible] high-tension discharges; a mirror-like deposit is then produced by the dissipation of the wire by these discharges.

ELECTRO-DYNAMICS. Leray. "Cosmos," Nov. 12 and 19. —The beginning of a long article on the electro-dynamic laws of electric currents and their effect on the surrounding ether; it is of a theoretical nature.

CONTINUOUS CURRENTS IN THE ALTERNATING ARC. Eichberg and Kallir. "Elek. Zeit.," Nov. 17.—An illustrated abstract of the article noticed in the "Digest" Nov. 5.

ACTION OF VARIOUS WAVES ON THE COHERER. Leppin. "Wied. Ann.," 65, p. 885; abstracted briefly in "Elek. Zeit.," Nov. 17.—He showed that the coherer responded to sound waves when these waves act directly on it. If a telephone is connected in the circuit of a coherer, the latter will act as a microphone, the notes from whistles being especially clear. Heat waves will increase the resistance of a coherer which has been made conducting; a simple touch by the hand, for instance, is sufficient to produce an increase of the resistance. With light waves a distinction must be made between broad daylight and the direct light from the sun; the former will decrease the resistance, while the latter will increase it.

OSCILLATIONS ALONG WIRES. Morton. Lond. "Elec. Rev." and "Elec. Eng.," Nov. 18.—A brief abstract of his Physical Society paper on the propagation of damped electrical oscillations along parallel wires; it is discussed by Heaviside.

NATURE OF CATHODE AND ROENTGEN RAYS. Walter. "Wied. Ann.," 66, p. 74; noticed briefly in "Elek. Zeit.," Nov. 17.—If cathode rays are moving particles charged with negative electricity, as now generally accepted, then, according to this author, Roentgen rays are nothing more than the reflected cathode rays which have deposited their charge on the anti-cathode. This explains why X-rays are not deflected by a magnet, as the particles no longer carry an electric charge; that they have a higher penetrating power may be explained by the fact that when the particles carry a charge they are attracted by the body through which they are passing, while particles without a charge pass through them without meeting this opposing force.

CURRENTS PRODUCED BY ROENTGEN RAYS. Winkleman. "Wied. Ann.," 66, p. 1; abstracted at some length in the "Elek. Zeit.," Nov. 17.—He shows how a continuous current may be produced from one metal-plate to another, between which Roentgen rays pass.

REFLECTION OF CATHODE RAYS. Starke. "Elek. Zeit.," Nov. 17; abstracted from a German physical paper.—Description of experiments with the reflection of cathode rays. Platinum was found to reflect 36 per cent., brass 30 per cent., aluminum 21 per cent., and lampblack 17 per cent. of the incident cathode rays; these figures are not changed much when the voltage is increased from 6000 to 9000.

CONSTANT OF EARTH'S MAGNETISM. Eschenhagen. "Wied. Ann.," 65, p. 951; abstracted briefly in the "Elek Zeit.," Nov. 10.—The constants for the year 1897 at Potsdam, Germany.

MAGNETIC IRON ORE. Abt. "Wied. Ann.," No. 9; noticed briefly in Lond. "Elec.," Nov. 4.—He tested specimens of magnetite and found that they had a greater degree of remnant magnetism than steel manufactured by the puddling, the Bessemer or by the Martin processes, but they are surpassed in this respect by certain crucible steels and by tungsten steel.

ROENTGEN-LIGHT NOTES. Rollins. "Elec. Rev.," Nov. 30.—In this continuation of his notes he states that if a piece of insulated, opaque metal with a hole in it is placed very near the tar[illegible] results and sharp definition were obtained even from a highly excited tube. An improved tube of this kind is illustrated.

REFRACTION OF ELECTRIC WAVES. Bose. "Sc Am. Sup.," Dec. 3.—A reprint from "Nature" of an abstract of his two Royal Society papers, one on the determination of the indices of refraction of various substances for the electric ray, and the other on the influence of the thickness of air space on the total reflection of electric radiation.

Electro-Chemistry and Batteries.

CHEMICAL THEORY OF THE LEAD ACCUMULATOR. Dolezalek. "Wied. Ann.," 65, p. 894; abstracted briefly in the "Elek. Zeit.," Nov. 17.—By an application of thermo-dynamic laws, [illegible] by the usual equation in which both the lead and the oxide are converted into [illegible]

THEORY OF THE ACCUMULATOR. Hoppe. Lond.

"Elec. Rev.," Nov. 18.—A translation in abstract of the article which was noticed in the "Digest" Nov. 19.

OSMOTIC THEORY. Nernst and Bose. "Zeit. f. Elektrochemie," Nov. 17.—A short article describing some experimental results which refer to the osmotic theory and prove its application under certain circumstances.

ELECTROLYSIS OF ALKALINE CHLORIDES. Winteler. "Zeit. f. Elektrochemie," Nov. 3.—The conclusion of his long article describing various experiments which he has made (see "Digest," Sept. 10). No general conclusions seem to be drawn.

ELECTRO-DEPOSITION OF GOLD. Andreoli. "L'Elec.," Nov. 19.—The conclusion of his long article describing this process at the Transvaal.

NICKEL. Ulke. "Eng. Mag.," Dec.—An article on the mining, smelting and refining of nickel, at the conclusion of which the electrolytic process of refining is briefly described; this process is in use in Newark. The difficulty in depositing a thick plate of pure nickel is overcome by heating the solution, although he says that thick deposits can also be obtained from cold solutions under proper conditions.

Units, Measurements and Instruments.

AMPERE BALANCE. Ayrton and Jones. Lond. "Elec. Eng.," Nov. 18.—A reprint of a very short Brit. Assn. paper describing briefly an apparatus designed and constructed by them which was used in their preliminary investigation of the redetermination of the electrochemical equivalent of silver—that is, the determination of the ampere in terms of the silver equivalent. This method is the one they used after considering a number of different ones. "On a vertical cylinder about 17 inches high and 6.8 inches in diameter we wound two coils about 5 inches in height, separated by an axial distance of 5 inches. The coils consisted each of a single layer of about 170 convolutions of wire, and were wound in opposite directions. From the beam of a balance there was suspended, inside this cylinder, a light bobbin, about 4 inches in diameter, on which was wound a coil about 10 inches long, consisting of a single layer of 360 convolutions, and the whole apparatus was so adjusted that when the beam of the balance was horizontal the inner and outer coils were co-axial and the top and bottom of the inner suspended coil were respectively in the mean planes of the outer stationary coils." This arrangement was used because the geometric measurements could be accurately determined and convenient formulas could be used. A certain current was determined absolutely by this means, and it was found that the silver value of the true ampere was so nearly equal to the usual value, namely, 1.118 m.g. per second, that it would require an apparatus still more perfectly constructed to enable the error in this value to be ascertained with accuracy. They have made working drawings of such an apparatus which it appears is to be constructed.

MEASURING ELECTRIC QUANTITY. Blondlot. "Jour. de Phys.," Oct.; abstracted briefly in Lond. "Elec.," Nov. 18.—A description of his novel method of measuring the quantity of electricity directly in electromagnetic units, and a meter based on it. The method was described in the "Digest" Aug. 6. There is a movable coil inside of a fixed one, the same current flowing through both; he shows that the quantity passing during one oscillation always remains the same; hence the total quantity is given by the number of oscillations; this quantity in absolute units is equal to the square root of the fraction whose enumerator is the moment of inertia of the movable coil multiplied by 3.1416, divided by the product of the number of turns of the fixed coil per centimetre of length, by the area of the ring. In the meter the oscillations are only in one direction, and the current breaks the current at each oscillation. The apparatus is said to follow any sudden variations of the current strength with the greatest promptness.

MAGNETIC FLUXES IN ELECTRICAL INSTRUMENTS. —Lond. "Elec. Rev." and "Elec. Eng.," Nov. 18.—An abstract of the discussion at the Physical Society of Campbell's paper (see "Digest," Nov. 26). Ayrton, among other things, discussed the effect of the earth's field, which is of the order of 0.2, on the Weston instruments, the field of which is on the order of 1000; it is sometimes erroneously assumed that the readings are practically independent of the earth's field; by putting such a voltmeter in different positions with respect to the compass the errors were far greater than might be predicted from the above ratios; the earth's field was exaggerated by the iron pole pieces; the error was about 0.2 per cent. "in the horizontal field," and 0.8 per cent. when the field of the voltmeter was parallel to the earth's induction; the induction of the gap was 1200. Reeves described a method for measuring the effect of stray fields on ammeters and voltmeters; the instrument is mounted on a stand and is brought under the influence of a large coil carrying a current; fields of known magnitude can thus be superimposed on the working field; from these known values the working field can be deduced. Campbell states that his results with the Weston instruments differed from those of Ayrton; the error which he had observed was below 0.1 per cent. He suggests that the effect may be different in different instruments according to the degree of saturation of the permanent magnet.

TESTS OF SHEET IRON. Kolben. "Elek. Zeit.," Nov. 10.—A short communication referring to the articles by Roehr, noticed in the "Digest" Nov. 26. He refers to some tests made by him in 1896 in which he showed that at the usual magnetic induction of 5000 the loss in a certain English sheet iron for transformers was 8 watts per cb. dm., while in normal soft-charcoal iron sheets it is just twice as great. The chemical analysis of these is also given, and shows that the percentage of manganese was considerably greater in the latter; these show that carbon, silicon and manganese all three (together) tend to make the iron poorer for magnetic purposes. This is followed by a short communication by Niethammer also discussing the same article. In the issue of Nov. 17, Roehr replies to these critics. Regarding the remarks of Kolben he states that conclusions may be drawn regarding the combined action of those ingredients, but not with reference to the effect of each single one. To Niethammer he replies that the original object was to determine whether it will suffice in practice to take a sample of a few strips instead of making a test transformer.

INDUCTION COIL-BREAK. Villard. "L'Eclairage Elec.," Nov. 12.—An abstract of a French Physical Society paper. He states that the apparatus contains no mechanisms, nor does it require an external source of energy. The movements are produced by the vibrations of an elastic strip securely held at the two extremities; it is provided with a point, which dips into mercury; it is placed in the magnetic field, and whenever a field exists the action is to break the contact; the energy required is less than 1 watt. The description is not quite clear.

MEASURING VERY HIGH VOLTAGES.—"L'Elec.," Nov. 19.—A translation in abstract of the article by Peukert, noticed in the "Digest" Oct. 22, describing his method.

PRONY BRAKE. Wetler. "L'Eclairage Elec.," Nov. 12.—A translation, with the illustrations, of the article noticed in the "Digest" Oct. 22.

Telegraphy, Telephony and Signals.

PROTECTING TELEGRAPH AND TELEPHONE LINES. —"L'Eclairage Elec.," Nov. 12.—An illustrated reprint of a circular issued by the Government telegraph department in Switzerland, concerning the protection of such lines against strong electric currents; a number of diagrams are given.

CALCULATION OF A PRIMARY BATTERY FOR CHARGING ACCUMULATORS FOR TELEGRAPHY. Brunelli. "L'Eclairage Elec.," Nov. 5.—A long abstract of his article, which was noticed in the "Digest" July 23.

EARTH PLATES.—"Science Abstracts," Nov.—An abstract of an article describing the experiments made with various forms of earth plates, by the telegraph department of Germany. It is apparently the same article as was noticed in the "Digest" Jan. 1, 1898.

TELEPHONE INDICATOR.—Lond. "Elec. Rev.," Nov. 18.—A brief, illustrated description of the Rabbidge indicator, for which great simplicity is claimed; it is intended to replace the shutter indicator on telephone switchboards.

TELEPHONE SWITCHBOARD. Dubreuil. "L'Elec.," Nov. 12.—In this continuation of his article he discusses the details of multiple switchboards, with special reference to the method of facilitating the action of the annunciators when the attendant calls a subscriber.

MODERN TELEPHONY. Wehrenalp. "Zeit. fuer Elek.," Nov. 13.—In this continuation of his long, illustrated series he discusses telephone centrals and their construction.

BELL SIGNALS.—"Zeit. fuer. Elek.," Nov. 13.—In the issue of September 4 of that journal there was described a system of telephone and bell signals used on the Austrian railways; in the present short, illustrated article a new system of connection for this system is described, which is said to simplify it. It has the advantage that the bell signal will be received at all the stations even when the telephone is in use at the time.

SUB-MARINE TELEGRAPHY. Bright. "Eng. Mag.," Dec. —An article on the extension of sub-marine telegraphy during the past quarter of a century. It includes a map of the world, with all the cable lines. In conclusion he says that far more capital is invested in sub-marine telegraphy than in any other branch of electrical industries, and that it amounts to about $225,000,000.

PARTY LINES. Miller. "Elec. Eng'ing," Nov.—In this continuation of his long serial he discusses what are termed "strength and polarity systems"—that is, those which depend for their operation on changes in strength or in the direction of the current, or both; at present all the party lines successfully using selective signaling are operated on this general plan.

PRIVATE TELEPHONE LINES.—"West. Elec.," Nov. 26.—A short, illustrated article calling attention to the fact that it is false economy to endeavor to use the same battery for a local telephone line that is used for electric gas lighting; it is shown that under certain conditions the battery will be short-circuited through the telephone switches.

PAY STATIONS IN PARIS.—"Elec. Eng.," Dec. 1.—A note stating that the French Government intends to provide for a number of sub-stations in different parts of the city, with waiting rooms attached; the cost is to be 5 cents per message.

TELEPHONE PATENTS.—"Electrical Engineering and Telephone Magazine" publishes a monthly digest of telephone and kindred patents, under the direction of Clement; short, illustrated descriptions are given.

ANCIENT METHODS OF TELEGRAPHING. Irwell. "Elec. Eng'ing," Nov.—A short article describing methods of signaling used by the ancients and up to the beginning of this century.

MINE SIGNALS. Clements. "Eng. and Min. Jour.," Nov. 26. —An abstract of a paper read before the South African Society of

Electrical Engineers. After referring to the various systems of signaling in mines he describes the usual electric system, which he considers to be the best.

Miscellaneous.

ELECTRIC HEATING.—Lond. "Lightning," Nov. 17.—A brief, illustrated description of a bindery in London where electricity is used to a considerable extent for heating, the current being generated by means of a gas engine and used also for lighting. Electricity is used for heating the small tools used in gilt lettering, for heating the glue pots, sealing wax, and ovens for heating the backs of books. The energy used is 20 to 22 units per day (presumably kw hours), but it is steadily being reduced as the workmen learn the importance of turning off the heat. There is an actual saving in the quantity of gas used, as compared with the former output when the heating was done by gas. The lighting plant had to be increased but slightly in order to supply the heating current, thus involving but little increased capital expenditure. The plant also includes a storage battery.

ELECTRIC WORKING OF METALS. Brillie. "Rev. Gen. des Sciences," Nov. 15.—A long article giving illustrated descriptions of the various processes and machines which are in use for electrical heating, welding, brazing, and fusing metals. The article is of the nature of a summary of the various processes.

REGULATING APPARATUS FOR RESERVOIRS. McPherson. Lond. "Elec. Eng.," Nov. 11.—A brief abstract of a recent paper describing an apparatus.

MECHANICAL APPLICATIONS. Richard. "L'Eclairage Elec.," Nov. 12.—An illustrated article giving brief but well-illustrated descriptions of numerous mechanical applications of electricity taken from patent specifications.

ELECTRICITY FOR POPULARIZING HEALTH RESORTS. Hulme. Lond. "Elec. Rev.," Nov. 18.—An article calling attention to the effect which the introduction of electric light and power has had in the development of Blackpool.

PRIZE.—The French Academy of Sciences has this year awarded for the first time the Houllevigue prize of $1000; it was awarded to the French physicist, Branly, for his coherer.

PLATINUM.—"Eng. News," Dec. 1.—A note from the United States consular report stating that 95 per cent. of the entire amount of platinum mined in the world during 1897 came from Russia, the entire amount being about 6 tons. A table gives the distribution among the various mines.

New Books.

ELEMENTS OF SANITARY ENGINEERING. By Mansfield Merriman, Professor of Civil Engineering, Lehigh University. Published by John Wiley & Sons, New York. Octavo, 216 pages. Price, $2.

TWENTIETH CENTURY MAGIC. By Nevil Monroe Hopkins. New York: George Routledge & Sons. [illegible] pages, [illegible] illustrations. Price, $1.

This work contains one chapter devoted to electrical magic as presented already in serial form in the "American Electrician."

PATENTED TELEPHONY. Published by the American Electrical Engineering Association, Chicago, Ill; 102 pages, with illustrations from patent specifications. Price, $1.50.

This work is intended as a reference work for telephone designers and patent [illegible] to the patent situation. It takes up [illegible] patents, these being properly classified, and discusses some of the Supreme Court decisions and their bearings on the present state of the art.

ALTERNATING CURRENT WIRING AND DISTRIBUTION. By William Le Roy Emmet. New York: The Electrical Engineer. Second edition, [illegible]. Price, $1.

Many a station manager who finds the wiring of direct-current circuits plain [illegible] subjects as synchronous and induction motors and rotary converters, the use [illegible]

[illegible] Hartford, [illegible]

[illegible]

HARPER'S SCIENTIFIC MEMOIRS. An opportunity for students not situated within reach of great libraries, in which they may obtain original papers on important points, is to be given in a series of works published by Messrs. Harper & Brothers, entitled "Harper's Scientific Memoirs." These will contain such original documents of value translated and edited by Prof. Joseph S. Ames, of Johns Hopkins University, with the assistance of many other noted scientific scholars. Two volumes are now ready, one entitled "The Free Expansion of Gases," containing memoirs by Gay-Lussac, Joule and Thomson, the other containing Fraunhofer's papers on "Prismatic and Diffraction Spectra." They are printed in thin octavo volumes, the first one mentioned above having 102 pages and sold at 75 cents; the other 65 pages, its price being 60 cents.

COMMERCIAL CUBA. By William J. Clark. New York: Charles Scribner's Sons. 500 pages, with illustrations and maps. Price, $4.

All electrical engineers will take particular interest in this work owing to the relations of its author with the electrical industries, Mr. W. J. Clark being well known as the manager of the electric railway department of the General Electric Company. Where Mr. Clark has found time with his other multitudinous duties to compile this elaborate and complete compendium of useful and valuable information about Cuba is a mystery, but in spite of the author's duties in other lines the work is a very thorough one. Beside being valuable as a work of reference it is eminently readable and almost as entertaining as a work of fiction, the personal and social peculiarities of the Cuban people being dwelt upon, so that those having dealings with them may know how to treat them. To all intending to enter into commercial relations with this new colony of the United States this work is a sine qua non, and anyone interested in the subject of which it treats will find its perusal of value.

MATTER, ENERGY, FORCE AND WORK. By Silas W. Holman, Professor of Physics, Massachusetts Institute of Technology. New York: The Macmillan Company. 257 pages. Price, $2.

Under this broad title there is presented a plain and simple explanation of many of the fundamental ideas and principles of physics. The work does not pretend to present the experimental side of the subject, but to develop in the mind of the reader, who is assumed to have some knowledge of these, a clear idea of many of the fundamental conceptions which the practical man often finds it hard to grasp, and the loss of which seriously embarrasses him often more than he knows in his study of the applications of science in the industries. Only those who personally know Professor Holman can appreciate the great care he has taken in the preparation of this work, the logical simplicity of his explanations of rather intangible subjects, and the interest which the reader will be surprised to find in such a dry subject; all of which are due to the author's almost affectionate enthusiasm for this particular line of work. Those who have struggled with the conceptions involved in the absolute system of units; who have tried to get a mental grasp of the dimensions of the physical quantities; who have tried to understand that electromotive force is dimensionally considered the product of length to the three halves power, mass to the one-half power, and time to the minus second power, will find their ideas most wonderfully clarified by reading this work. The presentation of speculations on matter and energy, discussing such things as the vortex-atom theory and the nature of energy and matter, are as delightful reading to a student of science—even one not versed in the higher mathematics—as is a work of fiction.

ENGINEERING CONTRACTS AND SPECIFICATIONS. By J. B. Johnson, Professor of Civil Engineering, Washington University. Second Edition, Revised. New York: The Engineering News Publishing Company. 450 pages. Price, $3.00.

This work contains a synopsis of the law of contracts and a complete list of descriptive and technical clauses of various kinds of engineering specifications, among them being the following specifications of value to electrical engineers: Specifications for excavations and embankments; for cement, mortar, concrete and masonry; for various classes of iron and steel work; for pile and trestle bridging; for the steam plant of a small electric light station; for leather driving belts; for turbine water wheels; for the installation of an electric lighting station in a small city, and for electrical distribution circuits for light and power. The work has been prepared for the use of students, engineers and contractors, and should be particularly valuable to consulting engineers who wish a general outline of specifications in which they can embody their own individual ideas and needs. The specifications are made complete and carefully worded, and in one part of the work are given illustrative examples of complete contracts and specifications. These are taken from the work of many famous engineers, some of those well known to electrical men being B. J. Arnold, of Chicago; William H. Bryan, St. Louis; Richard McCulloch, St. Louis, and J. T. Fanning, of Minneapolis.

The complete index and the careful marginal side heads of these various specifications make this work a valuable one to the consulting engineer, the contractor or the builder.

LA TRACTION ELECTRIQUE SUR VOIES FERREES. By André Blondel and E. Paul Dubois. Two vols., 1700 pages and 1014 illustrations. Baudry & Cie, Paris. Price in U. S. [illegible]

Perhaps, taken altogether, this is the most notable electrical book of the recent year. It covers the field broadly, not only in the variety of subjects treated, but also in the manner in which the different aspects of each particular subject of development are treated. It is not only new to find embodied in one treatise so many valuable hints concerning modern practice, but it is of exceptional value and interest to the reader to have them presented and [illegible] as illustrative of fundamental principles. From the opening chapter to the end of the book the interest is well sustained, and the treatment of a most important phase of electrical work is handled adequately and accurately; indeed, the range of information which extends, as one may say, from theoretical [illegible] to practical [illegible], is unique.

Heretofore, strange to say, books on electric traction have chiefly treated of the distribution of electric power to the cars, and have neglected traction proper. The present volumes deal exhaustively with electric traction as a topic in itself, and on the following general plan:

A first part, dealing with rolling stock and appliances, and a second part covering the technical details of traction proper.

It will appear to the reader, however, that many desirable additions have been made to the initial plan, which come in due place in the two volumes. Thus Vol. 1 contains a treatment of track construction, electric motors and trucks—with scale drawings of motors and complete data—electric locomotives, etc. The second volume follows with principles and details of the alternating and direct current motors, regulation, braking, etc.

Among so much that is valuable it is difficult to select particular portions, but perhaps Chapter VII. may be taken as fairly illustrative of the completeness of detail of the book upon a given subject. Here we have an exhaustive study of all kinds of electric locomotives. After a reference to historical failures in that line, the authors then trace the rational evolution of the electric locomotive, both in the United States and Europe, it being shown that in practical results American workers took the lead. Then follows a detailed analysis of the logical requirements of locomotive construction, and an elaborate comparison of electric and steam locomotives under all conditions and aspects.

Chapter II. is devoted to alternating polyphase motors, and is a thorough study of all the prominent applications. In a final comparison of alternating and direct current motors, the authors conclude that the most serious difficulties in the use of alternating currents do not arise from the operation of the motor itself, but are due to the awkward nature of the distribution, which fact limits their use to but special cases.

There are two valuable appendices; one referring to general costs and running expenses, the other to a discussion of the conditions of safety of operation. In the second appendix there is a complete exposition of the subject of electrolysis, including an up-to-date consideration of the vital question of electrolytic effect on pipes, bridges, etc., which has attracted so much attention of late.

There are also numerous valuable indices, containing supplementary detail matter in regard to forms, specifications and designs, together with annotations on the text itself. The whole work is profusely illustrated. That the compilation of this book cost an enormous amount of painstaking effort goes without saying, and that the information is so accurate is matter for congratulation as well as surprise, in view of the vastness of the field.

As above mentioned, the distribution of electrical energy as a general subject does not find a place in these books, but this will be treated in a third volume to be written by the same authors, thus completing the treatise.

The Woods Electric Motor-Vehicle.

By the courtesy of the Fischer Equipment Company, of Chicago, Ill., sole manufacturer of the Woods motor-vehicles, The Electrical World is enabled to present to its readers some interesting facts concerning these carriages.

The work of Mr. Woods has been exclusively toward the production of fine artistic carriages in all the various styles known to the carriage makers' trade rather than the mere production of a self-propelled machine. The company is now offering some twenty-five different styles of vehicles covering the same range of diversity in design as is found in any of the large carriage manufacturers' catalogues. The company's factory is well equipped for this class of work, and it manufactures the complete vehicle, including everything that is used in the building up of the carriage, except the rubber tires.

Fig. 2 represents the Fischer Company's victoria hansom cob, which is equipped with two 3½-hp motors, and has sufficient battery capacity to run 30 miles on one charge. It is designed for use on city streets and to run at a maximum speed of 12 miles an hour. In another design of the hansom cab the driver sits back of the passengers instead of at the front of the vehicle, as in the former case. The finish of these vehicles is said to be first class, and their manipulation is reduced to such a degree of simplicity that a driver of ordinary intelligence can readily learn to operate them. The total weight of these cabs is 2600 pounds each.

The lightest road buggy built by the company is illustrated in Fig. 1, the total weight of this vehicle being but 750 pounds. The equipment consists of one 2½-hp motor, with sufficient battery capacity to run the vehicle 25 miles on one charge at a maximum speed of 12 miles an hour. It has a seating capacity for two passengers.

A peculiar feature of the Woods vehicle is that wooden wheels and hard-rubber tires are used almost exclusively. The company has by practical tests demonstrated to its own satisfaction that the latter are far more desirable and durable in many ways than the pneumatic tires. They not only present a more graceful appearance, but consume less power and are free from all the annoyances due to punctures, etc.

In the control and operation of these vehicles it is said to be impossible to apply the brake without first cutting off the power from the motors, and, conversely, it is impossible to apply the power without first releasing the brake. This result is accomplished by an interlocking device between the brake and controller. A separate reversing switch is used by which these vehicles operate in exactly the same manner when running backward as they do in their forward movement. This reversing switch is provided with a lock, so that when the key is removed the vehicle cannot be operated by anyone not in possession of the key. The various speeds are obtained by series paralleling the batteries, and great pains have been taken to secure a uniformity of discharge of the batteries while in parallel. The contacts and connections have nearly four times the cross section ordinarily required. On the light road buggy, but one motor is used with a differential gear. Aside from this one departure all of the Woods vehicles for hard and heavy work are equipped with two motors, one being attached to each rear wheel. Every provision is made for automatic adjustment in the turning of corners or in turning the vehicle around.

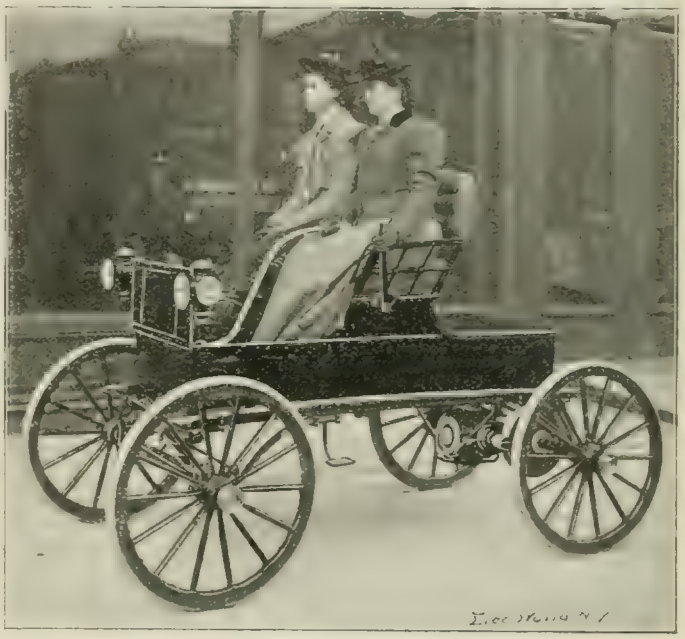


Fig. 1.—Light Road Buggy.

The motors are built with ironclad armatures and special coil windings, which are wound before being placed on the armature. The batteries are so arranged that they may be removed from the vehicle in order to replace them with duplicat sets of they may be charged in situ.

It is stated that an absolutely noiseless gear has been obtained after a long series of experiments, special compositions in rawhide being used for the purpose.

The lightest of the vehicles manufactured by the Fischer Company is the road wagon, which weighs 750 pounds complete. On one charge of the battery it is capable of covering 20 miles at a maximum speed of 14 miles per

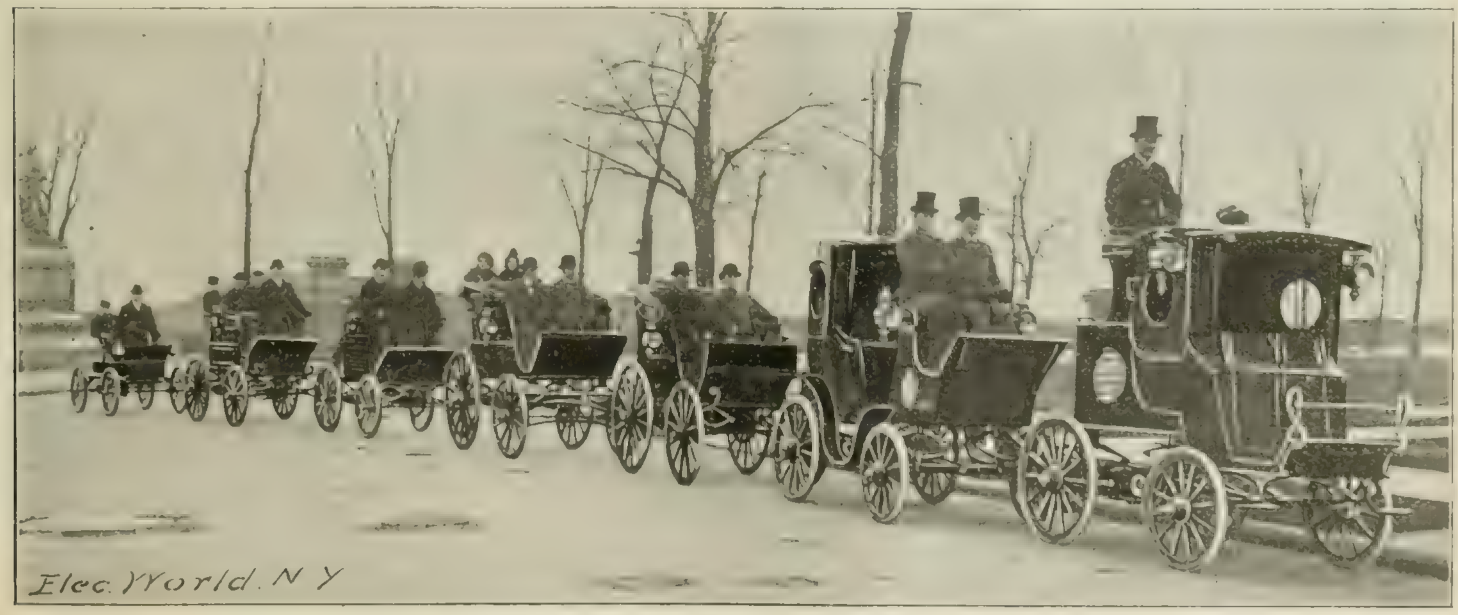


Fig. 4.—Various Types of Woods Electric Motor-Vehicles.

hour. It requires three hours' time to recharge the batteries, of which there are forty cells. The diameter of both the front and back wheels is the same, namely, 32 inches. It is capable of climbing a grade of 5 per cent., and according to data given out by the company it can be operated at a cost of three-quarters of a cent per mile. The heaviest vehicle in the list is a theatre bus, weighing 3500 pounds complete, and is capable of traveling 25 miles on one charge of the forty cells of battery. It has motors of 9½ horse-power capacity, and its maximum speed is 8 miles per hour. It is stated that this vehicle can be operated at a cost of four-tenths of one cent per mile. Between the vehicles above referred to there are many other sizes and classes. The maximum speeds vary between 10 and 16 miles per hour, and the cost of operation ranges between the limits given in connection with the two vehicles above referred to.

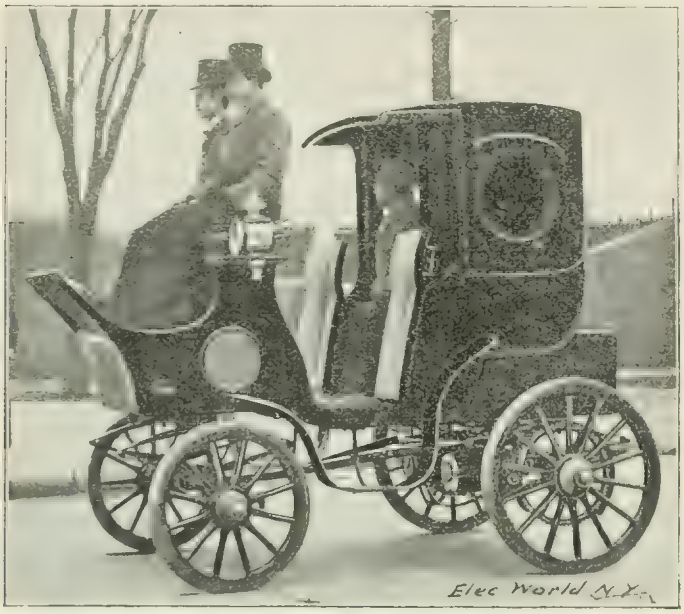


Fig. 2.—Victoria Hansom Cab with Driver's Seat in Front.

An Electric Forge Blower.

The cut in the next column shows an adaptation of small induction motors for use in the operation of forge blowers. This is said to be not only the cheapest, but also the best method of furnishing a blast for all sizes of blacksmith forges. [illegible]

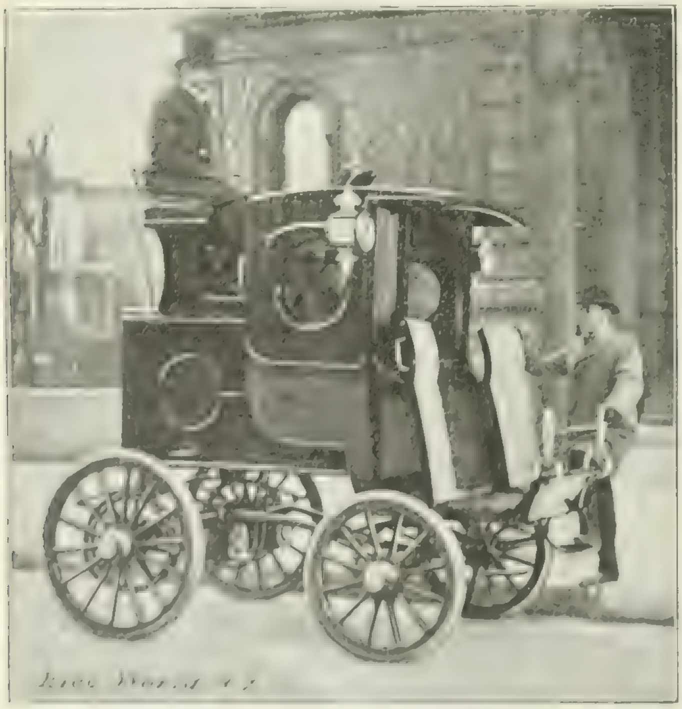
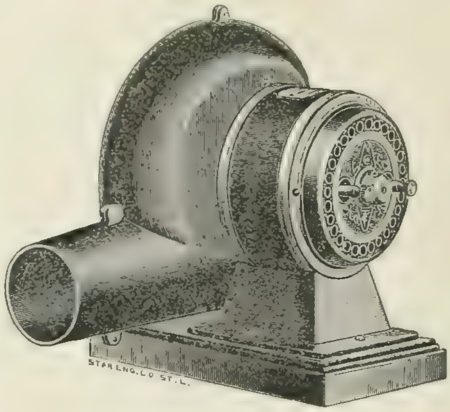


Fig. 3.—Victoria Hansom Cab with Driver at the Back of Passengers.

It is stated that a great many of these machines are being used in some of the largest blacksmith shops in the country, and are giving the best of satisfaction. By the use of this blower it is possible to get an even welding heat much quicker and better than can be done by any other means. The motors furnished with this apparatus are of the induction type, which, having no brushes, commutator or other parts requiring adjustment or repair, are particularly adapted to this class of work. Further information regarding this apparatus will be gladly furnished by the Emerson Electric Manufacturing Company, St. Louis, Mo. This blower is recommended for use in central stations.



Electric Forge Blower.

Instruments and Methods Used in Telluride High-Voltage Power Transmission Measurements.*

APPENDIX A.

[Extract from report of Mr. Mershon.]

At first, all the measurements of power were made in the low-tension circuit. The attempts to measure the power delivered to the line by taking the difference in the readings of the wattmeter in the low-tension circuit of the transformers when the lines were on and when they were off, proved worse than useless. This was due to the fact that throwing on the lines distorted the e. m. f. wave impressed on the transformer. As a result, at low voltages, readings obtained in this way indicated a negative line loss, and it was only when the voltage was raised to such a point that the line loss was greater than the reduction in iron loss, due to the e. m. f. distortion, that positive results could be obtained; such results were of course incorrect. In order to overcome this, it was determined to balance on the wattmeter the effects of the iron loss in one of the power transformers against that of the other in such a manner that both transformers would be subject to the same e. m. f. distortion, and the iron loss would therefore at no time register anything on the wattmeter. The line loss could then be measured directly. This was accomplished as is shown in Fig. 18.

Here the transformer which supplies the line is designated as the "power transformer," while that which is used in balancing the iron loss of the power transformer is called the "balancing transformer." As was stated in the description of the transformers, the power transformer has four of its low-tension coils in multiple for receiving power, while the fifth or middle low-tension coil is independently used in connection with the measuring instruments. This middle coil of each transformer is shown in the sketch, and it is through these coils that the balancing transformer receives its voltage. That is, one-third of the middle coil of the power transformer feeds one-third of the middle coil of the balancing transformer. With such an arrangement, the balancing transformer receives practically the same wave form as that impressed upon the balancing transformer, no matter what the amount of wave form distortion may be. *F* is the field coil of the wattmeter. It has two windings. Through one of them, the primary winding, passes the current to the power transformer; through the other, the secondary winding, passes the balancing current, the current to the balancing transformer. As these currents are in opposite directions in their respective windings, when adjusted to the proper values their effects on the field coil of the wattmeter annul each other. It is evident that if [illegible] were used a balance for iron loss when the lines were off would not necessarily mean a balance when the lines were on, because the change in current due to putting the lines on would cause a change in the [illegible] of the secondary of the wattmeter field coil, and consequently a change in the balancing current through the secondary. The air transformer *B* is [illegible] and *A* is preferably, but not necessarily, exactly similar to the [illegible] and supplies an e. m. f. in its secondary exactly equal to and in [illegible] of the secondary of *A*. These two secondaries are connected in series, so that their e. m. f.'s are opposed, and through them both is sent the balancing current. The secondaries of *A* and *B* are not connected directly in series with the circuit containing the middle coil of the power transformer and balancing transformer, but are included in the circuit through the medium of a [illegible] transformer, *C*. *C* renders possible the adjustment of the balancing current to the value necessary for zero wattmeter reading when the lines are off, and [illegible] device, is necessary because of the impossibility of securing two transformers with exactly the same iron loss. Indeed, in this particular case the ratio of the hysteresis to the Foucault current loss differed so much in the two transformers as to necessitate adding an shunt to one of them an ohmic resistance which made up for the lack of Foucault current loss in it. This method of reading power is, if properly carried out, a most admirable one, and has the advantage that the instruments to be handled are all in the low-tension circuit. The balance may be obtained without difficulty, and when once properly obtained holds through all ranges of voltages and distortions of wave form. Tests of this balance were made repeatedly with the lines off, by varying the impressed e. m. f. through wide ranges and distorting the e. m. f. wave, the distortion being produced by introducing in series with the power transformer large amounts of both resistance and reactance. In every case the balance was perfectly preserved. There is one drawback, though not a serious one, to the method as here employed. The power transformer, because of the load upon it, heats up faster than the balancing transformer, and the balance is in consequence impaired. The amount of unbalancing is, however, small, even for wide difference of temperature, and it can be easily corrected for by means of zero readings taken before and after a set of observations. This unbalancing, due to unequal heating, could be rendered negligible by placing the power transformer and the balancing transformer in the same tank of oil.

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*Continuation of paper by Chas. F. Scott, presented before the American Institute of Electrical Engineers, Omaha, June, 1898. See The Electrical World of November 26 and December 3.

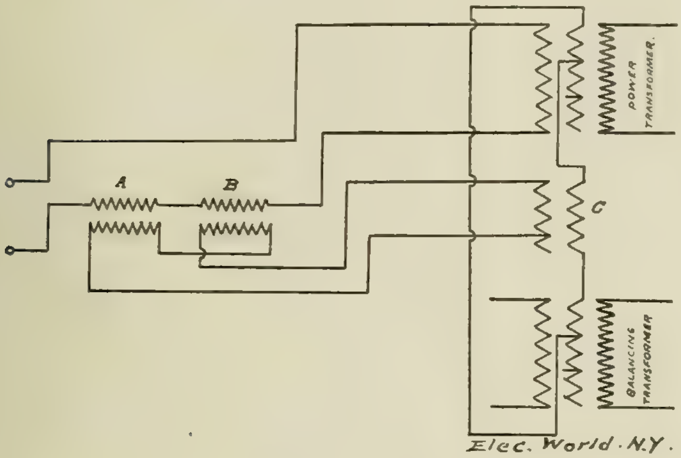


FIG. 18.

Although in this case the balancing transformer was of the same size as the power transformer, it may be much smaller, though both transformers should be worked at the same induction. Of course, it is not necessary that the balancing transformer have a full set of windings. It need only have a coil suitable for receiving e. m. f. impressed upon it.

The wattmeter actually used in this work (shown in Fig. 19) consists of a field coil so mounted that a Weston wattmeter can be slid in and out of it, and different ranges thus obtained. The scale originally on the wattmeter was replaced by one of equal parts. The wattmeter's own field coil is not used at all, the field being supplied wholly by the large external field bobbin. The voltage impressed upon the wattmeter shunt coil was at first obtained from the auto-transformer above mentioned, but later it was obtained directly from one-third of the middle coil of the power transformer by the use of an additional resistance of multiplier. The winding of the field bobbin consists of twenty-seven turns of a cable composed of seven No. 8 double cotton-covered magnet wires which were twisted together after having been separately treated with "P. & B." insulating compound.

The wires are brought out separately to terminals on the top of the bobbin, and can be used singly or in any desired series or multiple combination. They were, for this work, connected up into two sets, forming the primary and secondary of the wattmeter coil. The size of this field coil, necessitated by the size of the wattmeter box, gives it a large reactance, and as this has added to it the equal reactance of the air transformer, the reactance of the combination is considerable. This is objectionable because of the consequent distortion of the generator e. m. f. wave, for though the results obtained under these conditions are accurate, they are in some cases the results of conditions differing widely from those which will ordinarily be met with in practice. The combined reactance of the field coil and the air transformer at a frequency of 60, when passing a current taken by a power transformer supplying the line, is 2.83. The current used in obtaining this figure probably differed somewhat from a sine wave. If the wattmeter were specially constructed with a view to this work, the movement being surrounded as closely as possible by the protecting case, the external field coil into which the movement projected could be made small enough to reduce the reactance to a negligible quality. In designing a wattmeter for this work it should be borne in mind that it must measure under the condition of a very small power-factor.

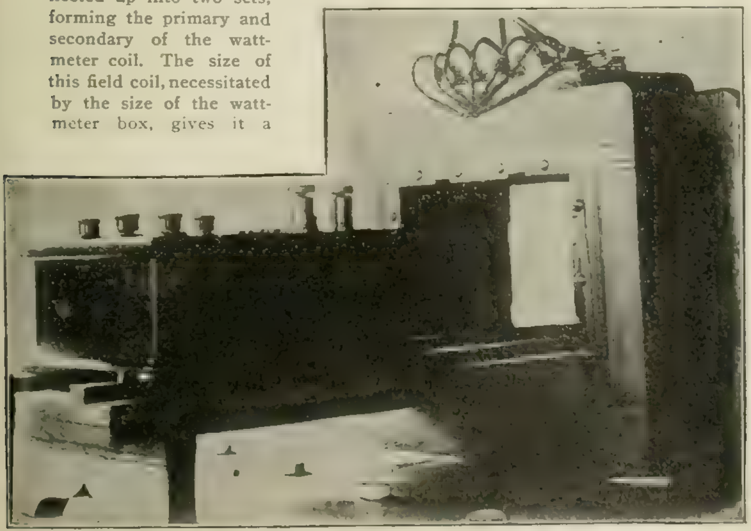


FIG. 19.—WATTMETER WITH EXTERNAL COIL, USED IN TESTS AT TELLURIDE.

In these notes the term "Weston Wattmeter" is meant to include the field bobbin of the wattmeter and the air transformer used in connection with it.

After the above wattmeter had been in use for some time another was obtained for use in the high-tension circuit. It is a Thomson inclined-coil instrument, whose field coil was rewound for this work. In connection with this wattmeter are two external resistances—the one with a resistance of 1,202,300 ohms, for use in series with the shunt circuit of the wattmeter; the other with a resistance of 3495 ohms being equal to that of the wattmeter shunt circuit and intended for use in shunt to the latter, in which case the wattmeter shunt coil receives only one-half of the current in the shunt circuit. When in use, the case of the wattmeter was connected to one of the wattmeter shunt terminals, so that the inside and case of the wattmeter were always at the same potential and the case formed a screen against any external electrostatic effects. This wattmeter was of considerable value as furnishing a means of studying the effect of the distortions due to the Weston wattmeter, and also to the readings at low frequency, since in the latter case it was necessary to use both transformers as power transformers, which left nothing for use as a balancing transformer. In the notes this wattmeter is designated as Thomson wattmeter.

The ammeters used were two Thomson inclined-coil instruments. They had a capacity of one-half and two and one-half amperes respectively. They were put directly into the high-tension circuit, the cases being connected to one terminal of the instrument.

The method of taking wave forms was that devised and published by the writer (Mr. Mershon), in 1891. It is an instantaneous potentiometer method, employing a telephone receiver to indicate a balance. The connections are those shown in Fig. 20.

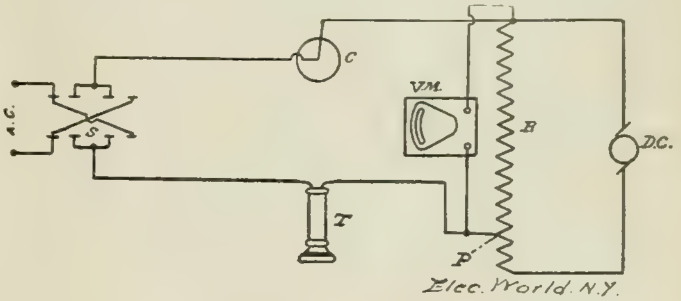


FIG. 20.

A C is the source of the alternating e. m. f., whose wave form is to be plotted, *S* is a double-pole switch for reversing the alternating current terminals, *C* is the usual instantaneous contact device, *T* is a telephone receiver. *V. M* is a d. c. voltmeter—in this case the Weston laboratory standard *R* is a resistance along which the contact *P* can be moved. *D C* is a source of direct current—in this case a direct-current dynamo feeding the resistance *R*. The contact *C* being set at any desired point, the value of the e. m. f. at the instant of contact is determined by moving *P* backward or forward until there is no sound in the telephone *T*. The reading of the direct-current voltmeter *V M* gives the desired value. The e. m. f. *A C* was obtained from the same source as the e. m. f. for the a. c. voltmeter, i. e., from an auto-converter connected across one-third of the middle coil of the power transformer.

The indication of proper speed, or rather frequency, was obtained from the vibration of a weighted steel wire hung in front of the poles of an alternating electro-magnet energized by the machine supplying power. The wire always vibrated at the frequency for which the suspended weight was adjusted, and ceased to vibrate when there was any appreciable deviation from this frequency.

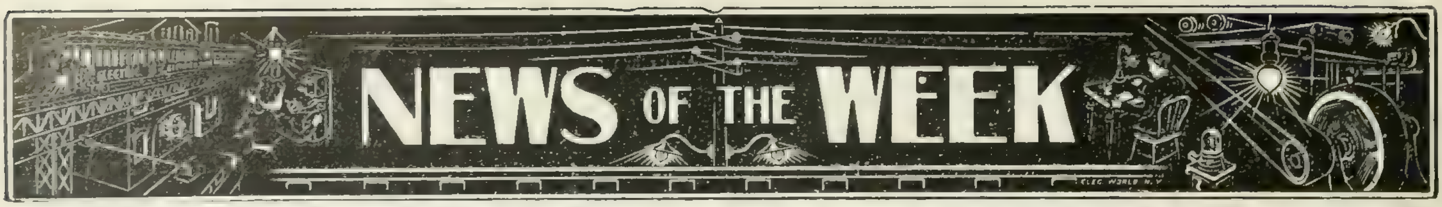
APPENDIX B.

CALCULATED CHARGING CURRENT TO TWO PARALLEL WIRES.

Length, 1 mile; 10,000 Volts; Sine Wave.

The charging current to a single-phase line 1 mile long has been calculated from the formula for capacity between wires and on the assumption that the e. m. f. is a sine wave. The results are given for several cases, and as the variations between the quantities given are not very great, intermediate values can be readily interpolated. The current varies directly as the length of line, the voltage and the frequency.

Size of Wire B. & S.	No. 8.	No. 4	No. 1	[illegible]	[illegible]
Distance between centres of wires.	Amperes at 60 cycles.				
12 inches.	.032	.035	.038	[illegible]	[illegible]
24 "	.0284	[illegible]	.0328	[illegible]	[illegible]
48 "	[illegible]	.0274	[illegible]	[illegible]	[illegible]
	Amperes at 25 cycles.				
12 inches.	.0133	.0146	[illegible]	[illegible]	.0221
24	.0118	[illegible]	.0137	[illegible]	[illegible]
48	.0105	.0118	.0121	[illegible]	[illegible]


ELEC WORLD N.Y.

NEWS OF THE WEEK

Financial Intelligence.

THE BOSSERT ELECTRIC CONSTRUCTION COMPANY, Utica, N. Y., has increased its capital stock from $16,000 to $75,000.

GENERAL ELECTRIC DIVIDEND.—The directors of the General Electric Company on December 2 declared a dividend of $17.50 on the preferred stock. This pays up one-half of the accumulated dividends, leaving yet to be paid up to August, 1898, $29 per share. The unpaid cumulative dividends now aggregate $763,942. On October 24 last the directors declared a distribution of $11.66⅔ per share on the preferred stock as reduced, to be applied on account of the unpaid accumulated dividends. This declaration called for the payment of $297,640, leaving at that date unpaid accumulated dividends standing of $1,230,245. The second dividend is payable December 22.

Special Correspondence.

NEW YORK NOTES.

HONORING COLONEL GRIFFIN.—A complimentary dinner was given for Col. Eugene Griffin at Sherry's on Thursday evening last by the officers of the First Regiment, United States Volunteer Engineers. Several prominent army and navy officers were present.

"WHAT WILL OUR COUNTRY SAY OF US?" (A Reverie of the Army of Santiago) is the title of a song just published, the words and music of which are by Gen. C. H. Barney. General Barney is one of the best-known old-timers in the telephone field. He has for many years been connected with the New York Telephone Company, and was formerly a member of the firm of Alexander, Barney & Chapin. Outside of its merits the song does credit to General Barney's patriotism.

SPECIAL CARS FOR PACKER STUDENTS.—The Packer Institute girls in Brooklyn have received a special distinction at the hands of the Brooklyn Heights Railroad Company, which ordinary mortals do not enjoy. The company has assigned three of its cars for their exclusive use to convey them to school. These cars start in the morning from the Broadway Ferry, Fulton Street and Reid Avenue, and Flatbush Avenue and Clarkson Street. Each car carries a sign reading "Packer Institute Car." It is stated that if the experiment is successful special trolley cars will be assigned for the use of scholars of other large schools.

MR. ALBERT L. JOHNSON, president of the Nassau Electric Railroad Company, Brooklyn Borough, returned home from Europe on Saturday night last on the steamer "Campania." It is stated that Mr. Johnson went to London to interest certain persons in the project of establishing a trolley system in that city. He is encouraged with the results of his trip. He asked the London authorities for a certain privilege to demonstrate what he could do in the matter of bettering the means of intramural travel in London, and states that he has reason to believe that the privilege will be granted. Mr. Johnson declined to make any definite statement regarding the project, but promised to say more on the subject next spring, when he expects to return to London.

THE POSTAL TELEGRAPH BUILDING SCORCHED.—The fire which on Sunday night last destroyed the five-story building at the corner of Broadway and Warren Street, and badly damaged the upper half of the Home Life Insurance Company's building, a modern steel structure, sixteen stories high, [illegible] upper floors of the Postal Telegraph Company's building [illegible] and a slight damage by water [illegible] company's property was not affected. On Monday morning the [illegible]. Some of the reports in the daily [illegible] Postal Telegraph Company and the Commercial Cable Company [illegible] damage, but these were [illegible].

[illegible] FOR THE FIRE ALARM SERVICE.—The Fire Department [illegible]

THE RAPID TRANSIT [illegible]

[illegible] being as to whether such legislation as is desired will be constitutional. The counsel is of the opinion that there is no constitutional limitation upon the power of the County of New York to raise money to build a tunnel railroad, if authorized by appropriate legislation. President Orr in his explanation, states that the present situation with reference to the building of the tunnel railroad is brought about by the inability of the enlarged city of New York to borrow a sufficient sum of money to carry on the work in the manner required by the rapid transit statutes, and the commissioners have reached the conclusion that unless the powers of the board are enlarged by further legislation, it would be impossible now, or for many years to come, to proceed with the construction of the railroad. Two courses only appear to be open to the board in the prosecution of its work. These are a request for legislation making the rapid transit road an asset exclusively in the County of New York (Boroughs of Manhattan and the Bronx), and correspondingly making the debt incurred for its construction a charge exclusively upon the county, and a request for legislation enabling the Rapid Transit Board, in its discretion, and, if for any reason construction by the county is found to be impracticable, to frame and sell to private capitalists a charter for the road. The only resource which is available, it appears, or which will be available for many years to come, is the borrowing capacity of the County of New York. The Legislature could repeal the provision of the Greater New York Charter, making the rapid transit road an asset of and a charge upon the greater city, and restore the road to the position originally intended for it and approved by popular vote, as being an asset of and a charge solely upon the Boroughs of Manhattan and the Bronx. New York County could issue its bonds to provide for the cost of the road. There is reason for relieving the Boroughs of Brooklyn, Queens and Richmond of their share of the burden, just as there is reason why the Boroughs of Manhattan and the Bronx should exclusively own the corresponding asset. Municipal construction was authorized by popular vote of the Boroughs of Manhattan and the Bronx. There has never been a popular assent to such municipal construction by the Boroughs of Brooklyn, Queens or Richmond, and Mr. Orr stated it as his belief that it would never receive such assent. A bill to give the Rapid Transit Board the power to create and sell a franchise would be comparatively simple, he stated. Provisions of that character are already in the rapid transit law, and it will only be necessary for the new bill to permit the Rapid Transit Board to avail itself of those provisions, notwithstanding the vote for municipal construction. This alternative is not open to the board under the law as it stands. If recourse is to be had to private capital to build the railroad it may possibly be necessary to enter once more upon the long and expensive process of obtaining consents of property holders (or the substituted consent of the court) as well as the consent of the municipal authorities. Moreover, the adoption of this latter alternative would involve the abandonment of the entire plan of municipal construction and the relinquishment of the great benefit which would accrue to this county from the ownership of the road. Mr. Orr stated that he was opposed to it personally unless it shall prove impossible to obtain the needed relief in any other manner.

THE FINAL REPORT of the president to the board of directors of the Edison Electric Illuminating Company, of Brooklyn, which was presented on November 8, is an extremely interesting document. It gives the history of the company from its inception down to the recent date when it was absorbed by the Kings County Electric Light & Power Company. The company was incorporated on March 8, 1887. In that year electric lighting had already made some progress. Arc lighting had been introduced for street lighting in Brooklyn for several years, but incandescent lighting had not yet attained a footing in the city, nor generally elsewhere except in a few of the large cities. At the meeting of the directors on November 20, 1888, the executive committee was authorized to proceed with plans for the erection of a power station and begin the laying of conduits in the streets. Work on the Pearl Street station, which was the first one established by the company, was begun at the opening of the spring of 1889. This station had a capacity of 3600 horsepower, its equipment consisting of four boilers and engines, with eight dynamos and complete electrical apparatus therefor, for supplying electrical current for light and power throughout an underground system covering a [illegible] of a mile about the station. This station forms a part of the present Pearl Street station, and at the time of its erection was thought to be almost a model one for the business. But with the new year, 1890, the company, under the supervision of Mr. William S. Barstow, began to install a new arc light which was under the control of the user, and offered advantages over the old pole arc light. During that year [illegible] arc lights were installed by the company as well as [illegible] horsepower of motors, while the incandescent lights were increased in number to [illegible]. The stockholders then authorized an increase of stock to $1,500,000 and of $500,000 in bonds, with the proceeds of which [illegible] engines were installed in the station with the accompanying dynamos and electrical apparatus, while a new district of service was formed. In the year [illegible] a great increase of business and progress was made and the [illegible] Avenue station was built and equipped. It was at this time that the company began paying dividends, beginning with July of that year, at the rate of [illegible] per cent per annum. In [illegible] the lines were extended into the Eastern District of the city, and a power station was erected in Gwinnett Street. This station was equipped with machinery of the latest design, and the mains were [illegible] through the principal streets. At the close of [illegible] the company had connected the equivalent of [illegible] 16-cp lamps. [illegible] increased the rate of dividends to [illegible] per cent. The new [illegible] was notable for the introduction of the [illegible] and the triple-expansion upright engines. Extensions [illegible] and the capital stock was again increased by 1,000,000. The Pearl Street station was enlarged and equipped with the latest machinery, and the Lexington Avenue plant was practically rebuilt. In 1894 the company entered the field of street lighting, which was a new one for a low-tension company. To supply the demand thus increased by the street-lighting service two more vertical engines of 1500 horse-power each were erected in the Pearl Street station. In 1895 the Citizens' Electric Illuminating Company was purchased, its entire capital stock of 5000 shares at $100 each being paid for at the rate of $175, or a total of $875,000. The Citizens' Company was a high-tension overhead-wire system, with a valuable franchise, covering all the city except those wards known as Eastern District wards, which were supplied by the Municipal Electric Light Company. To provide for the purchase of the Citizens' Company the capital stock of the Edison Company was increased $750,000 and the bonds by $500,000. The lamp connections had increased to an equivalent of 154,523 16-cp lamps, and the service, both public and commercial, had been vastly improved. The report then refers to the imposition of "very serious and unreasonable taxes" on its property by the city assessors in 1895, but through the efforts of its counsel a reduction of the assessment for personal tax from $1,070,000 to $375,000 was effected. This contest, the report states, has arisen each year since, but the interests of the company have been very successfully championed. The steps that led to the building of the Union Station at Bay Ridge, which was described and illustrated in THE ELECTRICAL WORLD of December 3, 1898, are recited by the president in his report. This station is represented to be the most advanced electric lighting station on the continent, and is, in the words of the president, "a monument to the genius as well as as the engineering ability of our general superintendent, Mr. William Slocum Barstow." The new station, the report states, is built on a scale likely to fully supply all the electric current needed for light and power within the city for many years. The recent negotiations and final consummation of the consolidation of the Edison Company and the Kings County Electric Light & Power Company are briefly reviewed, and in conclusion the report congratulates the directors on the character of the employees in the service of the company and compliments many of them by name for their ability and faithful devotion to the company's interests.

NEW ENGLAND NOTES.

MR. PERCY HODGES, late of the General Electric Company, is now associated with C. S. Knowles, Boston, in the railway department.

MR. J. HENRY HALLBERG, of Peabody, Mass., was united in marriage at Salem, Mass., November 16 to Miss Mary Ellen Daley, an accomplished young lady of that city. Our congratulations and best wishes attend the happy couple. Mr. Hallberg is well known through his connection with the Standard Thermometer & Electric Company, of Peabody. He is the designer of the Upton Midget enclosed arc lamp.

MR. JOHN S. KEENAN, of the Bibber-White Company, Boston, well known in electrical circles, has resumed active service with the company. Mr. Keenan has long been a member of the First Massachusetts Heavy Artillery, U. S. V., with the rank of lieutenant and quartermaster. At the outbreak of the war with Spain this regiment was the first to respond for active service, and Lieutenant Keenan has, of course, been with it. He was most heartily welcomed on his return to business.

THE K. & W. COMPANY, Pittsfield, Mass., has never been so busy as at the present time, and the increased facilities afforded in its new factory are genuinely appreciated, not only by the company, but also by the electrical trade generally, which accords to the specialties of this company exceptionally liberal recognition. The "Hardy" incandescent lamps continue to grow in popularity and demand, and the numerous repeat orders received are the best possible indorsement of them. Other specialties of the company, such as composite dynamo brushes, hanger boards, spark arresters and commutator compound, are also in great demand. First-class goods and first-class management always bring custom, and this is precisely what the K. & W. Company may honestly claim.

AN IMPROVEMENT IN ELECTRIC SMELTING APPARATUS.—A further detail in the system of heating metals by means of an arc crossing a hydrogen envelope in a liquid bath, the invention of Geo. D. Burton, has been covered in patent No. 615,136, issued November 29, 1898. This describes an arrangement for heating simultaneously two bars which it may be desired to weld or braze together. One piece, as usual, is connected to one terminal of the circuit, its end being immersed in the bath suitably connected with the positive pole of a direct-current source, the other piece being also immersed within the bath and brought sufficiently close to the one that the current passes to it and forms about it a gaseous envelope subject to the arc, heating the two simultaneously.

REPORT OF THE WEST END STREET RAILWAY COMPANY'S BUSINESS.—The Boston Elevated Railway Company, lessee of the West End Street Railway, has made its report of earnings and expenditures of the West End Company. The statement shows for the year ended September 30 a total surplus, after charges and dividends were deducted, of $214,077, compared with the surplus of $431,572 in 1897. The gross receipts were $9,179,096, against $8,719,031 last year; operating expenses, $6,566,584, against $6,213,708 last year; net earnings, $2,690,668, against $2,505,323 last year. During the year there were carried 181,321,295 passengers, an increase of over 9,000,000. The car miles run were 32,209,150, and the average number of persons employed was 5328. The annual meeting of the stockholders of the West End Street Railway Company was held at 101 Milk Street on November 22. President Samuel Little submitted a brief financial statement for the year ended September 30. The stockholders voted to amend the by-laws so as to take from the directors the power of appointing unnecessary operating officials, and also to take from them the power of acting upon and declaring dividends. The old board of directors was re-elected.

BUFFALO AND NIAGARA FALLS NOTES.

NIAGARA ELECTRIC POWER has been in use at the Curtiss malt house in Buffalo some days, and is reported to be entirely satisfactory to all concerned.

THE BUFFALO STREET RAILWAY COMPANY has just laid a long line of subways down Main and out Perry Streets for the accommodation of its feed wires.

THE CITY of North Tonawanda is engaged in exacting from the Niagara Power Company the payment of 2½ per cent. of its gross earnings to the city for the franchise it is seeking there. The company demurs, but will no doubt accept the terms. It is also insisted that less shall be charged for the current than is paid in Buffalo.

THE RAPID extension of the use of Niagara power for lighting Buffalo streets is a good deal handicapped by the lack of cable. As fast as that can be obtained for the conduits the street lights will be changed over to the Niagara system. So far the use of the Niagara current in this capacity has hardly passed the stage of experiment, though no serious hitch has been reported.

THE BUFFALO, TONAWANDA & NIAGARA FALLS trolley line, the oldest one connecting Buffalo and Tonawanda, and usually called the Smith line, is to give up its power house and use the current from Niagara Falls. The contract is made, and it is said that about $25 a horse-power is to be paid. It will be some time before the change can be made, as the unfinished transformer house will be needed. This will not be done till late next month.

INDIANA NOTES.

THE INDEPENDENT TELEPHONE COMPANY of Indianapolis will begin service on January 1, 1899.

THE PEOPLE of Richmond are rejoiced over the proposed line of electric railway to connect that city with Indianapolis. The right of way has been secured.

THE BOARD OF COUNTY COMMISSIONERS of Hancock County has granted Charles L. Henry a franchise to build an electric railroad from Greenfield to Indianapolis.

THE INDIANAPOLIS LONG-DISTANCE TELEPHONE COMPANY has contracted to extend its line to Nashville. This is the first company to penetrate the wilds of Brown County, the only county in Indiana without a railroad.

MR. NATHAN MORRIS and other Indianapolis capitalists are seeking a right of way for an electric railway along the public highway between Anderson and Ingalls, a distance of 12 miles. They say the line will then be continued to Indianapolis, 36 miles. The petition will be granted.

FARMERS of Indiana are generally supplied with telephone service. Their residences are connected with those of their neighbors and with country towns and cities. "I sat under my own vine and fig tree and received the election news," said an old farmer of Montgomery County. "More, I ordered my insurance renewed at 11 o'clock of the day of its expiration. Had I been compelled to make the trip to town I would have been without insurance for several hours," said he.

THE BOARD OF COUNTY COMMISSIONERS of Marion County, sitting at Indianapolis, are kept busy hearing applications from rival companies seeking right of way for electric railroads between Indianapolis and other cities of the State. The interest manifested in this particular indicate that the day is near at hand when nearly all the Indiana cities and towns of any importance will be connected by electric roads. The gas-belt line recently opened between Anderson and Alexandria is being operated with marked success, and a movement is on foot to connect all the cities in the gas belt and then build a connecting line to Indianapolis. There are also lines projected in northern and southern Indiana, and the year 1899 promises to be a red-letter year in the construction of electric railways in this State.

THE NATIONAL MUNICIPAL LEAGUE conference was held at Indianapolis, the first session beginning on November 30. Delegates were in attendance from various parts of the country. A special committee made a report on an ideal American municipal charter. On the subject of franchise grants the report reads as follows: "Careful constitutional provisions have been promulgated as to the method of granting franchises. That such franchises should only be granted for a limited period is a principle that has now received very general acceptance. The application of this principle is of peculiar importance in a country like the United States, where the legislative authority is restricted by the constitutional guarantees to vested rights. With us the grant of a valuable franchise for an indefinite period is, in fact, if not in law, irrevocable. The enormous value of such a franchise makes it practically impossible for a city to repurchase it without seriously impairing its finances. The end which the committee has had in view has been to make the franchise grant in the nature of a lease for a short term, at the expiration of which the city as lessor enters into possession. The limits of the lease have been fixed at twenty-one years, a term amply sufficient to offer all necessary inducement to private corporations." The document provides for compulsory public accounting of all grantees of franchises. The conference and the report of the committee is attracting wide attention. The various provisions of the report are especially interesting and of concern to managers of private corporations, such as electric street railays, water, light and gas companies.

WISCONSIN NOTES.

THE JANESVILLE TELEPHONE COMPANY was recently organized by a number of business men of that city, and a complete exchange is to be put in.

THE MILWAUKEE ELECTRIC RAILWAY & LIGHT COMPANY now has in active operation about 175 miles of electric road in Milwaukee and to its immediate suburbs. By the close of the present year the company will have expended for improvements, completed or arranged for, considerably over $1,000,000.

SOME TIME AGO the Wisconsin Telephone Company made application to the city of Marshfield, Wis., for a franchise to build a long-distance line through the city. It was refused, but went ahead and put up poles, which were cut down under the mayor's orders. The company recently put poles up again, which have also been cut down.

BY THE TIME the Superior Rapid Transit Company, of West Superior, Wis., completes the work of replacing the present narrow-gauge railway system with the new standard gauge and rolling stock it will have expended about $350,000, this including the laying of the tracks, material, labor and new rolling stock. Cars now run from any point in Duluth to West Superior, and the new interstate service will be inaugurated in the near future.

ST. LOUIS NOTES.

THE BOARD OF PUBLIC IMPROVEMENTS will submit another lighting bill to the City Council next week if the city counselor decides that a measure similar to one formerly defeated can be reintroduced. The new bill is to provide for a five-year contract, and is to include public buildings.

THE PEOPLE'S RAILWAY COMPANY was granted an appeal to the Supreme Court this week. The appeal was made as a result of the decision rendered by Judge Wood in the case of L. M. Rumsey against the People's Railway Company. Judge Wood, in his decision, ordered a foreclosure sale of the company.

SUPERINTENDENT OF FIRE AND POLICE TELEGRAPH Silas J. Benedict opened bids for burying the city's wires, on Monday, November 28. Only two bids were received—the Southern Electrical Supply Company, $13,618, and the Western Electric Company, $14,190. The Standard Underground Company submitted an explanation as to why it did not bid. "The specifications are too arduous," it said. The bids will be submitted to the comptroller, who will award the contract to the lowest bidder.

PACIFIC COAST NOTES.

THE FALLEK TELEPHONE & AUTOMATIC SWITCH COMPANY, of San Francisco, was recently incorporated, with a capital stock of $100,000. The directors of the company are A. K. Andriano, W. T. Hess, Jr., Nathan Fallek and I. Harris.

THE SOUTHERN CALIFORNIA POWER COMPANY, after vexatious delays of long duration, is ready to transmit electricity at 33,000 volts a distance of 80 miles to Los Angeles, Cal. This water-power plant, which cost $500,000, has been two years in building. This transmission is said to be the longest in the world. There are 3½ miles of tunnels through granite mountains and 2 miles of flumes. Water is turned into the four water-wheels, directly connected to the generators, at the pressure of 310 pounds to the square inch.

THE UNION IRON WORKS COMPANY, San Francisco, successfully launched the battleship "Wisconsin" on November 26. Electricity will be used to operate incandescent lamps, four large searchlights, two large turrets, the ammunition hoists and the powerful fan blowers for the elaborate ventilating system. It is understood that there will be eight generators, each operated by a Union Iron Works vertical compound engine, directly connected. Four of the generators will be built by the electric department of the Union Iron Works and the remaining four will be supplied by the General Electric Company, in connection with its contract to install the apparatus for electrical operation of the turrets. The "Wisconsin's" displacement is 11,525 tons, [illegible]

THE PELTON WATER WHEEL COMPANY, San Francisco, recently [illegible] Pelton wheel direct connected to dynamo for lighting mill of St. Gothard [illegible]

CANADIAN NOTES.

[illegible]

THE SOUTH SHORE, at the Lachine Rapids, Quebec Province, will soon be able to boast of hydraulic works similar to those on the north shore of the rapids, which belong to the Lachine Hydraulic & Power Company. A company has been formed composed of Canadians and New York capitalists. Work is expected to begin next spring, the promoters of the company intending to study during the coming winter the effect of the frazil ice in the chutes of the Lachine Power Company dam. To obtain the required fall the new company will have to dam Isle du Diable to the mainland, at the head of the rapids, and lower, from the same island to Isle du Paquette.

THE TOWN CLERK of Niagara Falls, in a letter to the press, says that the amount of power developed at Niagara Falls, Ontario, is being misrepresented in the statement that 50,000 horse-power is now developed and available for use, and that there is no demand therefor. The facts are as follows: By an arrangement with the Niagara Falls, Park & River Railway two dynamos of 500 horse-power each are placed in position and driven by a water wheel in the railway company's pit. These two furnish 750 electrical horse-power at the distance of 1½ to 2 miles, where it is being utilized. Of the said amount 250 horse-power or more has already been contracted for by the Niagara Falls Electric Light & Power Company, 200 by the Carborundum Company, and 100 by the Carmelite Monastery, so there is actually a very small amount, if any, now for sale.

FRENCH NOTES.

TRACTION ENGINES AND AUTOMOBILES.—There will be a traction engine and automobile show next year at Ghent in connection with the Provincial Fair. Traction machines will very likely replace horses in the propelling of life-saving machines—fire engines, ladders, reels, fire-escapes, etc.—and they must be built so as to be able to start at a moment's notice. Also the cost of energy for operation must not be excessive. The competition will comprise two classes, one for vehicles having a load capacity of 5500 pounds over and above their own weight, the other having a load capacity of 11,000 pounds. A speed of 12 miles per hour on a level and 2½ miles per hour on an 8 per cent. grade, under full load, will be required. The machines which are exhibited will be put through a series of thorough tests, and the results will be published in detail. This is the first competition of its kind to take place in Belgium.

NATIONAL CONSERVATORY OF ARTS AND CRAFTS.—During 1898-99 the free lecture courses at the National Conservatory of Arts and Crafts will include a course in applied physics, to be conducted by Prof. M. J. Viole, who will treat the following subjects under the head of electricity: Fundamental laws of electrical and magnetic phenomena; measuring instruments; generators, accumulators and transformers; transmission of power; telegraphy; telephony; electrical oscillation; lighting, and electroplating. Prof. M. Marcel Deprez will also lecture on industrial electricity, covering the following subjects: Study of the fundamental laws of electricity considered from the point of view of their industrial applications; laws governing the transmission of electrical energy in all its forms; instruments for measuring electrical quantities; general theory of generating machinery for the conversion of mechanical energy into electrical energy, and vice versa.

ELECTRIC TRACTION IN PARIS.—Tuesday, October 8, saw the completion of the first 2-cent fare electric tramway line of Paris. The Southern Tramways Company or Paris Tramway Company is now operating its Bastille-Charenton line partly by overhead trolley and partly by underground trolley, which was permitted as an experiment by the Municipal Council acting in accord with the General Council of the Seine. Judging from the simplicity and good appearance of the whole construction, there is ground for hoping that the company will soon see its way to changing over its other lines, to the great benefit of the public. Travel will be much more rapid, and the great number of cars which it becomes possible to operate will reduce the time spent in waiting. Moreover, the poles which support the wires can be used in the poorly lighted suburban districts as arc light standards. The Avenue Daumesnil presents a good object lesson in the advantages of the new system. All the construction work on this line [illegible] Houston Company.

ELECTRICITY IN THE NAVY.—The Minister of the Navy has estab[illegible] specially educated in electricity. These men will be drawn from among the non-commissioned of[illegible] Toulon, and who make application for the position, due regard being paid to their relative standing at the time of graduation. The officers selected will take the course given at [illegible] and will be required to pass a [illegible] will be eligible to the following [illegible] have been graduated to per[illegible] all war ships [illegible] attached to newly [illegible] on the depart[illegible] a position [illegible] will have charge of special experiments involving the use of electricity, will serve on the commissions appointed to test new ships and will superintend the lighting plant of the arsenal, etc. Fourth, there will be positions in the central torpedo and electrical service at Paris. Fifth, a position as adjutant to the vice-[illegible] will be open [illegible] of work, [illegible] devoted on special [illegible]

[illegible] United States, [illegible] plants demonstrate con[illegible] clusively that there are no technical difficulties to prevent its use over relatively short distances. Existing stations are producing enormous volumes of electrical energy for railway purposes at very reasonable costs. There are numerous cases of feeders carrying loads quite equal to anything which would be required for a heavy train service, and notably at Buffalo there is a case of transmission of energy over a distance of 22 miles. The practicability of the method of taking current from a continuous conductor, either overhead or on the ground, by means of a sliding contact, is well proven. The elevated railway of Chicago (trains weighing 108 tons and running on two-minute headway) uses a third rail, supported on paraffined wooden blocks, showing that the third rail is all-sufficient for power distribution to trains under the most crowded conditions. Finally, the electric traction machine, whether a locomotive or car fitted with its own motors, has been evolved to standard conditions; motors, and especially controlling apparatus, are built to work under volumes of power greatly in excess of anything needed in the heaviest service in France."

THE HEILMANN LOCOMOTIVE ON THE PARIS-HAVRE LINE.—The Heilmann locomotive recently made the trip from Mantes to Rouen. As is generally known this machine is in two parts, each half being carried on bogy trucks with eight wheels, and each axle being driven by a motor, thus utilizing to the utmost the weight of the machine for traction. It is this arrangement which enables this monster, measuring 60 feet over all and weighing 120 tons, to circulate on the existing railways. One would be tempted to think that such a machine, weighing nearly 40 tons more than the modern locomotive with its tender, would make much more noise than the latter does. The fact, however, is that to anyone riding on it the engine seems to move with a sliding motion; there is no shock perceptible; hardly even a slight vibration. The great weight does, however, shake the ground over which it travels to a depth of nearly 10 feet, and the object of this trip was not a speed test, which was made last winter, when a speed of 75 miles per hour was attained, but a test of the steel bridges and trestles on the line. Every bridge was furnished with a recording deflection indicator, and the engine was stopped when at the further side of the bridge to observe the record made by its passage. The engineers of the Western Company were greatly pleased with the results, which showed no abnormal deflections. Many comments have been made on the peculiar shape of the engine. The rear view differs but little from that of an ordinary engine, but the front view presents the appearance of an armored cruiser or a torpedo boat, armed with a ram, mounted on wheels. The engine-driver stands in this part in front of two large port holes from which he can observe the track. The starting mechanism requires no exertion, a couple of turns of a small vertical hand-wheel and the great engine starts easily and without shock. The use of electricity as a connecting link between the engine and the driving wheels eliminates that vibration and pounding of the ordinary engine, which is so destructive of the track as well as unpleasant to the passengers

General News.

THE TELEGRAPH AND TELEPHONE.

BRISTOL, PA.—The Standard Telephone Company has been granted a franchise to construct and operate a telephone system in the Borough of Bristol.

GALVA, ILL.—The Galva Telephone Company has already 109 'phones put in. Indications are that 150 'phones will be in operation before many months.

ELMIRA, N. Y.—The New York & Pennsylvania Telephone & Telegraph Company is building a metallic circuit line from Towanda to Wyalusing to take the place of the present line.

LYONS, N. Y.—The Wayne County Telephone Exchange has begun to set poles in Lyons. It is expected that the exchange here will be in complete operation by the middle of December.

ONEONTA, ALA.—The new telephone line between Opelika and Lafayette, Ala., has been finished, thus completing the network of wires that run from Opelika in every direction, except to Birmingham.

McKEESPORT, PA.—The new combined telephone and telegraph service of the Baltimore & Ohio Railroad from Baltimore to Newark, Ohio, via the Pittsburg division, has been tested, and the system works satisfactorily.

TERRE HAUTE, IND.—The Citizens' New Independent Telephone line has opened for business, having connections with a large number of places north of here, in Indiana and Illinois. As yet there is no city exchange.

NAZARETH, PA.—The Slate Belt Telephone & Telegraph Company has commenced the reconstruction of its lines as metallic circuits. Over $10,000 will be expended in construction, and new switchboards will be put in at Nazareth, Bangor, Pen Argyl and Wind Gap, Pa.

TRENTON, N. J.—The Delaware Shore Telephone Company has been incorporated with a capital stock of $15,000. The incorporators are Mitchell B. Perkins, of Beverly; Nathan Haines, J. Howard Pugh, George C. Gunn, of Burlington, and Harry V. Massey, of Philadelphia.

NEW YORK, N. Y.—Some of the retail druggists in the Boroughs of Manhattan and Brooklyn, in whose stores are public telephone stations, are, it is reported, threatening to discontinue the maintenance of such stations because of the reduction of their percentage of the receipts.

RENOVO, PA.—Renovo's Council has adopted the ordinance which gives the Central Pennsylvania Telephone Company the right to construct its lines within the limits of the borough. An effort was made to impose a tax on the poles of the company, but this amendment was defeated.

NEW YORK, N. Y.—It is stated that the People's Telephone Corporation, the new independent company that is now canvassing for subscribers, secured 5000 subscribers the first few days of its work, and expects to secure 40,000 by February 1. It is expected that the company will begin active operations at that time.

BALTIMORE, MD.—An ordinance has been prepared for the repeal of the ordinance granting to the Cheasapeake & Potomac Telephone Company a franchise for laying conduits in the streets of the city. These new developments will place the telephone company in rather an awkward fix, and has put a stop to its work on conduits.

CHICAGO, ILL.—A company, in which Armour, Swift and Nelson Morris are interested, has been incorporated to build and operate an independent telegraph and telephone line to connect all of their packing houses in the West with their Chicago houses. The proposed line is to connect East St. Louis, Omaha, Sioux City, St. Joseph and Kansas City.

COLUMBUS, OHIO.—The new telephone company which is being organized in this city upon a new plan and which partakes largely of the cooperative plan will ask for franchises over the streets and alleys of the city for its wires. With the new company every subscriber is a stockholder and will have a voice in the management of the affairs of the company. The capital stock will probably be $100,000.

TOLEDO, IA.—The Commercial Telephone Company, operating exchanges here and at Tama and having toll lines to Crystal and Traer, with stations at several farm houses, has sold out to W. D. Spayth & Co. The officers of the new concern are: W. D. Spayth, general manager; W. H. Withington, president; H. C. Shanklin, treasurer; E. M. Spayth, secretary; W. H. Withington, A. G. Smith, W. D. Spayth, J. G. Bull and J. R. Caldwell, directors.

SHAMOKIN, PA.—The North & West Branch Telephone Company has decided to construct a line connecting Williamsport, Montgomery and Montoursville with the local line. The contract was awarded to W. D. Bernard, of the East Telephone Construction Company, work to be commenced within thirty days. The directors state that next spring a telephone line will be constructed between Danville and Bloomsburg to be connected with the local line.

LITTLE ROCK, ARK.—On the evening of November 27 a test was made of the long-distance telephone circuit between this city and Boston, a distance of about 1900 miles. Mr. Charles J. Glidden, president of the Southwestern Telegraph & Telephone Company, sat at the instrument at this end and conversed with Mr. Frederick A. Farrar at Boston. It is stated that the conversation was perfectly clear and distinct. Long-distance service tests were also made with other cities.

BOSTON, MASS.—The severe snowstorm of November 26-27 caused a great deal of damage to telegraph and telephone lines in this section. The New England Telephone & Telegraph Company's service was somewhat impaired in the suburban districts, where its wires are overhead. In the city there was no trouble, as the circuits are all underground. The long-distance service was also affected somewhat, about one-half the number of its wires being unavailable. The Postal Telegraph Company had no wires to New York on Monday morning. In fact, it had few wires in any direction for any great distance. The Western Union Telegraph Company accepted business to New York and distant points, subject to short delays. It had no wires to give to its wire lessees.

ELECTRIC LIGHT AND POWER.

PIERRE, S. D. The City Council at a special meeting decided to put in an electric light plant for the city, to be supplied with power from the gas well.

HAGERSTOWN, MD.—The Mayor and Council are still undecided whether to erect a municipal electric light plant or continue the present contract with the local company.

OCONTO, WIS.—The electric light plant on the People's Light & Manufacturing Company was destroyed by fire on November 24. The loss is placed at $35,000; insurance, $14,000.

ATTICA, N. Y.—The plant of the Attica Electric Light Company has been sold to Mr. Ulmer, of Buffalo, for a consideration of $2800. The wire and poles are being taken down and shipped to Buffalo.

PONTIAC, ILL.—Judge R. R. Wallace was appointed receiver of the Pontiac Water, Light & Power Company's plant in this city upon the application of the Illinois Trust & Savings Bank of Chicago, trustee for the holders of $49,000 in bonds, which were issued upon the plant in a foreclosure suit.

BUFFALO, N. Y.—The first step has been taken by the Buffalo General Electric Company toward lighting the streets of Buffalo with power generated at Niagara Falls. A circuit of 450 arc lights, including the double-light system on Main Street, from the docks to Virginia Street, is now operated by Niagara power transformers, and the whole system will be in operation before next summer.

ALBANY, N. Y.—The Valley Electric Light Company has been incorporated with a capital stock of $10,000. The company is to furnish light in Lansingburg, Melrose, Schaghticoke, Stillwater, Valley Falls, Johnsonville, Buskirk's Bridge and Eagle Bridge. The directors are Edward O'Neil, Hiland Carpenter and Augusta Carpenter, of Valley Falls, and Jonathan N. Carpenter, of Hoosick Falls.

NEW YORK, N. Y.—Naval Constructor Bowles at the Brooklyn Navy Yard has recommended certain changes to be made in the yard with the idea of facilitating the work of the various departments. He proposes a system of trolleys for the handling of boats and supplies, and also for the purpose of distributing the 6-inch and smaller guns among the vessels in the yard. It is estimated that the changes will cost $50,000.

FREDERICKSBURG, VA.—At a meeting of the City Council a resolution was passed for the erection of an electric light plant at an approximate cost of $11,600, and ordering an election for the ratification or rejection by the voters of the city. No contract will be awarded until the election is held, but the bids received by the light committee were read as follows: Kingsbury, Samuels & Co., of Baltimore, Md., $11,944; the Fort Wayne Electric Corporation, of Fort Wayne, Ind., $11,649.

PHILADELPHIA, PA.—It is reported that the Pennsylvania Manufacturing Company has purchased the electric lighting plants of Camden and Atlantic

City in addition to like properties in New York and this State. The aggregate capital of the acquired companies is placed at nearly $2,000,000. The transactions involved the payment of cash by the Pennsylvania Manufacturing Company. It is said the securities of the purchased properties, against which no new securities are to be issued, will be placed in the treasury of the Pennsylvania Manufacturing Company as treasury assets.

DURHAM, N. C.—The Durham Electric Lighting Company is preparing to install a 60-kw Westinghouse alternator. The present equipment consists of a 15-kw arc machine and a 750-light alternator, the former being run by a 60-hp engine and the latter by one of 90 horse-power. The contemplated improvements in the plant will give better service and a capacity of about 1700 or 1800 incandescent lights, as against 700 at the present time. There are forty-six arcs on the Thomson-Houston system, for which $100 a year each is paid, operating on moonlight schedule.

THE EDISON ELECTRIC ILLUMINATING COMPANY, of Easton, Pa., is preparing to extend its plant, and will probably use water power from the Lehigh River as an auxiliary to its present steam plant. It is also further considering the purchase of a direct-connected unit of 400 horse-power. This plant has always been able to produce current at a very low cost, but the company believes that by further improvement it can reduce the cost still more. Mr. Albert B. Herrick, the company's consulting electrical engineer, is preparing the plans of these improvements.

BALTIMORE, MD.—The consolidation of the three electric light companies of Baltimore will be consummated by January 1. "The Consolidated Electric Light Company" is the name of the new corporation, which absorbs the Brush Electric Light Company, the Edison Electric Company and the Northern Electric Light Company. The consolidation is being conducted by E. B. Smith & Co., of Philadelphia, and the Baltimore Trust & Guarantee Company. It will issue $4,000,000 5 per cent. gold bonds and $5,000,000 in stock. All the bonds and a majority of the stock have been subscribed for.

CHICAGO, ILL.—Armour & Co. will change the motive power at their packing house from steam to electricity. It is estimated that the work will take nearly a year on account of the necessity of making the change without interfering with the regular business. Work will soon begin on the power house, and some of the engines and dynamos have already been purchased. The works have already been wired for 5000 lights. There will be installed as soon as possible one 5000 and two 3000 light alternators, and more may be purchased. A cross-compound Corliss engine of 1700 horse-power is all ready for installation, and two power generators of 2400 horse-power are also ready. It is thought that the economy effected by the concentration of the power-generating system under one roof will be considerable.

THE ELECTRIC RAILWAY.

PHILADELPHIA, PA.—The Central Electric Railway Company, of Philadelphia, and Delaware County, has voted for an extension of its route.

FREDERICK, MD.—An extension of the Frederick, Middletown & Myersville Electric Railway from Myersville to Hagerstown, 10 miles, is contemplated.

LAUREL, MD.—It is stated that a preliminary survey will be made for an electric railroad to run from Laurel to Frederick, and also for one from Ellicott City to Rockville.

WILLIMANTIC, CONN.—The Willimantic Street Railway Company has been incorporated. The capital stock is $1000. The stockholders are Eugene S. Boss, J. Griffin Martin and Solomon Lucas.

PHILADELPHIA, PA.—Next month $20,000 more of the Continental Passenger Railway Company's bonds—6 per cent.—mature and will be retired, saving the Union Traction Company $1200 in interest. The process is going on throughout the system.

NEW YORK, N. Y.—The Brooklyn Heights Railroad Company has ordered [illegible] open cars to be delivered next spring. They are to be built by the St. Louis Car Company, and will be 36 feet long, with thirteen reversible benches, having a seating capacity of seventy-five.

CUMBERLAND, MD.—The survey is being made for the electric railway to be built from Cumberland to Westernport, a distance of 30 miles. Messrs. [illegible] & [illegible] & Son, of Philadelphia, have secured the contract, and work will be commenced not later than March 1.

RUTLAND, VT.—The bill consolidating the Bennington Electric Railway Company and the Hoosick Electric Railway Company has passed both branches of the Legislature. The total length of the two roads, which have been [illegible] for some time, is 16½ miles.

HULL, QUE.—The question of extending the Hull & Aylmer Electric Railway to Gatineau Point is under consideration. It is the intention to commence the construction next spring. At the last meeting of the City Council it was decided to call for tenders at once for the lighting of the city by electricity.

BALTIMORE, MD.—The negotiations for a union of the Baltimore Consolidated Railway Company and the Baltimore City Passenger Railway Company [illegible]

[illegible]

[illegible]

ZANESVILLE, OHIO.—Judge [illegible], of the United States Circuit Court, has ordered the sale of the Zanesville electric railroad on January 8, 1899, at the company's office in that city. Will Christy was appointed special master to make the sale. Suit was brought by the International Trust Company of Massachusetts on account of a default in interest. Over $800,000 principal and interest is due.

BARABOO, WIS.—The City Council granted a franchise to the Baraboo, Kilbourn & Devil's Lake Electric Railway Company to use a street in this city. The line will cover a distance of 18 miles, and the work will commence early in the spring. The road will connect two of the most popular summer resorts in the State. The incorporators are J. P. Cottrell, of Milwaukee; F. J. Butler, California, and H. Grotophorst, of this city.

WASHINGTON, D. C.—The work of equipping the Eckington street railroad, now the City & Suburban, with the underground electric system has begun. For the present the work will not go farther west than Fifth and G Streets, as it is the intention not to tear up G Street until all the iron work is on hand. When the New York Avenue line is finished then work will begin on the lines running through the eastern portion of the city.

LAWRENCEBURG, IND.—The Cincinnati, Lawrenceburg & Aurora Electric Street Railway Company has been incorporated with a capital stock of $10,000. The principal office of the company is in Lawrenceburg. The road begins at Aurora and extends from that point through Dearborn County to Lawrenceburg, thence to Cincinnati. Among the directors of the new company are J. C. Hoover, George H. Helvey and C. E. Hooven, all of Hamilton.

PITTSBURG, PA.—A daily paper of this city makes this pertinent remark: The proposition in Allegheny councils to make every street car carry a lifting jack for raising the car when people get under it appears to be highly proper if the present arrangements for getting people under the cars are to continue. But is it not a little more urgent to make them carry fenders that will give people, struck by the cars, a better chance to escape being thrown under them?

SOUTH BEND, IND.—A new street car service has been inaugurated in this city after a suspension of service for over four months. The lines have been entirely rebuilt at an expense of nearly $200,000, and the equipment is modern. Work will begin as soon as the weather will permit on lines connecting South Bend with Niles, Mich., and Goshen and Elkhart, Ind., making, with the present lines, 46 miles of electric street railway. The present city and suburban line cover 15 miles.

WASHINGTON, D. C.—The Belt Railway in Washington, with its franchises and property of different kinds, has been sold to Mr. Oscar T. Crosby for $350,000. Mr. Crosby represented the City & Suburban Company, of Washington, in which several Baltimoreans are interested. The Belt Company is the designation of the chain of roads acquired in Washington by the syndicate headed by Mr. Searles in connection with the old Beauregard line between Baltimore and Washington.

PETERSBURG, VA.—A deed of sale from the Petersburg Railroad Company to the Richmond & Petersburg Railroad Company has been recorded. In consideration of $1,952,072.50 the company conveys to the Richmond & Petersburg Railroad Company all of its real and personal property. The object of this deed is to carry out the provisions of the act of the General Assembly approved March 1, 1898. This deed has upon it $2000 of United States Internal Revenue stamps, and the State tax on it was $1970.

CHICAGO, ILL.—A vote taken in the City Council on the city railways' proposition to make permanent the trolley system, which it was recently permitted to operate temporarily in the business district, was defeated by a vote of 40 to 22. As this vote was considered a test of the street railway combination's strength, and as the next Legislature will favor the repeal of the Allen bill, it will be seen that the companies must do quick work in order to have their franchises extended for fifty years before the bill permitting the extensions is repealed. The franchises will all expire within a year or two.

WASHINGTON, D. C.—The request from the Washington, Arlington & Falls Church Railway Company, which has its northern terminus at the Virginia end of the Aqueduct Bridge, that the commissioners recommend that Congress grant permission for the construction of a single track across the bridge, has been denied by the District commissioners. The object of the railway company in seeking such construction is to have an outlet for its road to the city. At present the road extends only as far as the lower end of the Aqueduct Bridge, and the passengers have to cross the bridge by foot or in coaches.

NEW YORK, N. Y.—Fire in the Borough of the Bronx on the afternoon of November 30 destroyed the car shed and seventy-five cars of the Union Railway Company. The building was two stories high and on the second floor were stored sixty open summer cars and fifteen new closed cars, the latter of which had never been used. The fire started about noon, and difficulty was encountered by the fire department in reaching the scene on account of the snowdrifts in the streets. The entire loss to the railway company is estimated at about $150,000. Of this amount $25,000 represents the value of the building. It is stated that there is an insurance of about $100,000 on the property destroyed..

ALBANY, N. Y.—The Buffalo Traction Company filed its report for the quarter ending on September 30 with the Railroad Commissioners. It shows: Gross earnings, $[illegible]; operating expenses, $[illegible]; deficit, $7,980.20; fixed charges, $[illegible]; total deficit, $[illegible]. Assets, cost of road, $[illegible]; cash, $[illegible]. Profit and loss, deficiency, $[illegible]. Liabilities, capital stock, common, $[illegible]; funded debt, $[illegible].

CHICAGO, ILL.—It is stated that a syndicate of New York capitalists is being organized in that city for the purpose of acquiring the traction franchises from the city of Chicago. The report was that this company would offer to pay [illegible] per cent of the gross earnings of all lines, improve the streets in which the tracks run and maintain them for the life of the franchise, which was to be put at fifty years. The proposition was to be based on the failure of the present traction corporations to have passed satisfactory ordinances, and the consequent obligation of the municipality to purchase under arbitrators' award the rolling stock, trackage and other equipment of the three roads at a price to be determined. The city would then sell or lease this property to the new lessees of the streets, following the plan of purchase and lease which was adopted by the City Council of Toronto, Ont.

Legal Note.

A YOUNG WOMAN teacher of vocal music at Elwood, Ind., has sued the Elwood Electric Railway Company for $20,000 damages. She alleges in her complaint that while driving on the streets of that city her horse became frightened at a car, and she was thrown from the buggy, breaking her lower jaw and knocking out her front teeth, in consequence of which injury she cannot sing any more and is compelled to give up her vocation. Whatever may be the equities of her cause it is clear she cannot recover, as the Supreme Court of Indiana recently decided that people who will drive along a street containing a street car line take the risk of their horses becoming frightened at the cars. The operators are not bound to stop a car because a horse shows signs of fear or nervousness at its approach. People riding in cars have a right to proceed as well as those riding in buggies. (So held in Yant v. Terre Haute Street Car Co.)

Personal Note.

MR. FREDERIC SAXELBY, well known throughout the electrical trade, and who was recently connected with the Siemens & Halske Electric Company, has allied himself with the Bullock Electric Company, and will now handle this company's apparatus from its New York office in the St. Paul Building.

Trade and Industrial Notes.

THE OTTO GAS ENGINE WORKS announces that it has received a gold medal award at the Omaha Exposition for Otto gas and gasoline engines.

THE FIRM of W. C. Nagel & Co. has been organized at Toledo, Ohio, for the purpose of conducting a general business in electrical machinery, supplies and construction.

THE B. F. STURTEVANT COMPANY, Boston, Mass., has just issued a second edition of its pamphlet Bulletin E, entitled "Draft Without a Chimney." A copy will be mailed to anyone on application.

THE ELECTRIC APPLIANCE COMPANY reports that it is meeting with much success with the 1898 model Packard transformer, and that this transformer is more than fulfilling all the claims and guarantees that they have made.

MESSRS. MEYSENBURG & BADT, Chicago, report a large increase in their sales of Weston instruments during the month of November. They remind Weston clients of the fact that several days' time may be saved by addressing to them inquiries concerning these instruments.

THE INTERNATIONAL FACSIMILEGRAPH COMPANY has been incorporated at Cleveland, Ohio, by W. P. Dunlany, Thomas Mills, H. F. Fulton, A. S. Taylor and W. H. Dettelbach, with a capital stock of $25,000. The company will manufacture apparatus for transmitting pictures by electricity.

STURTEVANT GENERATING SETS.—The B. F. Sturtevant Company, Boston, Mass., in its Bulletin G, just issued, gives illustrations and points out the principal constructional features of its line of generating sets direct coupled to automatic horizontal and upright engines. Some interesting combinations are shown.

MR. C. F. CROSELMIRE, of Newark, N. J., refiner of crude platinum ore, is now in Europe for the purpose of making contracts with Russian mine owners for platinum ore. In addition to refining crude ores, Mr. Croselmire is a manufacturer, on an extensive scale, of platinum products used in the electrical industries and arts.

THE OSBURN ELECTRIC MANUFACTURING COMPANY, of 294-296 Dearborn Street, Chicago, has evidently struck a popular article of manufacture in its tripolar bell. This company writes that it cannot keep up with its orders in this line, and is compelled to add more machinery to its plant. It also reports an export order for 10,000 tripolar bells.

THE BALL ENGINE COMPANY, of Erie, Pa., supplied the 125-hp tandem compound engine installed in the electric light plant of the city of Elkhorn. This power plant was recently successfully started. The Schoenhoffen Brewing Company, Chicago, has recently installed a 100-hp engine built by the Ball Company. This engine is direct connected to a 60-kw Western Electric generator.

THE AKRON INSULATOR & MARBLE COMPANY, Akron, Ohio, has lately begun to manufacture a full line of white porcelain goods, and is now enjoying a very large trade in porcelain specialties. This firm is well equipped to manufacture all kinds of special work, and the fact that it is very busy in this department indicates that the merits of its new electrical devices are being recognized by the trade. This company claims to be the pioneer manufacturer of light and brown glazed-clay thin-wall wiring tubes, etc.

ELEVATOR COMBINATION.—A certificate of incorporation of the Otis Elevator Company was filed at Trenton, N. J., on November 28. This concern is said to be an expansion of the National Elevator Company, which included Otis Brothers & Co., the Crane Elevator Company and the Hale Company, of Chicago; the Whittier Company, of Boston, and Stokes & Parrish, of Philadelphia. It is reported that the combination will have no control over the business of the Sprague Electric Company, but will probably pay the company a royalty for the use of its patents.

THE CINCINNATI MILLING MACHINE COMPANY, Cincinnati, Ohio, has issued a very complete and well illustrated catalogue of its Universal cutter and tool grinder. Various improvements are embodied in this machine, and its special features are set forth and illustrated. The catalogue includes a long list of testimonials from various concerns using the Universal cutter and grinder, all of which speak of the machine in the highest terms. Illustrated examples of the work done on the machine shows that the word "Universal" is well applied, for its great variety is rather surprising.

THE WARREN ELECTRIC & SPECIALTY COMPANY, Warren, Ohio, on November 23 dedicated its new large two-story building by an entertainment to its employees, 128 in number. President T. H. Gillmer, in a few remarks, stated that the company was organized November 19, 1892, and had at the time very few employees on its pay roll. It now has 128 persons in its service. A nice supper was provided, after which the evening was spent in dancing. The utmost good feeling seems to exist between employer and employee as regards this company.

MESSRS. WARREN WEBSTER & CO., Camden, N. J., are out with a new circular on the Webster system of steam heating. It contains a story written by the late Edgar W. Nye, and illustrated by various thumb-nail sketches which are quite apropos. The story describes the nocturnal experience of a hotel guest with the radiator in his room, and the moral is that his slumbers would not have been disturbed had the hotel been fitted with the Webster system. A full-page illustration contains views of various large office buildings which are heated by the Webster system.

THE EUREKA TEMPERED COPPER COMPANY, North East, Pa., announces that it is now engaged in the preparation of one of the most complete and expensive catalogues ever issued by any concern in this line of business. The catalogue will be ready for distribution in the near future, and anyone using tempered copper would do well to write to the company for a copy. The company states that it is extremely busy not only in the filling of domestic orders but for goods to go abroad. Mr. Alfred Short, of this company, who is abroad looking after its interests, will soon return to the United States.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., is furnishing motors for small power uses ranging from one-thirtieth to 3 horse-power. A typographical error in The Electrical World of November 26 in an item on this subject made the range of powers from one-thirtieth to 30 horse-power. The company is not prepared to handle such heavy power; it, however, calls attention to the fact that it has over 100 kinds of motors adapted for small power purposes. Few electrical stations and dealers pay as much attention to the interests of small power users as the importance of the subject warrants.

WHAT PROMISES to be a very interesting as well as a very novel electric power transmission system is now being installed by the C & C Electric Company upon Riker's Island at the entrance to Long Island Sound, opposite Manhattan, for the R. H. Hood Company, of New York. The Hood Company has the contract for the removal of ashes and similar refuse from Manhattan, which will be used for the purpose of filling up Riker's Island. The ashes will be transferred in scows to the island, where they will be unloaded upon conveying belts and distributed by electric power. The C & C Electric Company will furnish two 250-volt belt-type generators, each of a capacity of 120 kilowatts at 525 revolutions, together with the necessary switchboard. The motor equipment will consist of a 50-hp multipolar and a 40-hp, a 20-hp and a 10-hp closed-type ironclad motors. Two of these ironclads will be fitted with back gears for driving the conveyors.

THE S. K. C. INDUCTOR ALTERNATOR, illustrated in Bulletin No. 12,001, recently issued by the Western Electric Company, Chicago, represents the latest development in alternating current apparatus. These generators are manufactured for single, two and three-phase currents and for high or low voltage. The standard belt-driven generators are made for 7200, 8000 or 16.000 alternations, from 50 kilowatts up to 750 kilowatts. Direct-connected machines are regularly built from 250 kilowatts to 1000 kilowatts. The smaller machines are wound from 1200 volts to 6600 volts, and the larger from 1200 to 12,000 volts. The Western Electric Company is the exclusive Western agent for all apparatus manufactured by the Stanley Electric Manufacturing Company. In addition to supplying apparatus this company installs power transmission plants, and erect all pole lines and circuits complete in every detail. A copy of Bulletin No. 12,001 will, on application, be mailed to anyone who has not been supplied.

THE RIDGWAY DYNAMO & ENGINE COMPANY, Ridgway, Pa., reports the following recent sales of machinery: To the Berwind-White Coal Mining Company, Windber, Pa., one 75-hp engine, direct connected to a 50-kw generator; Alpena Sulphite Fibre Company, Alpena, Mich., one 32-hp engine, direct-connected to a 20-kw generator; Nashville Abattoir, Hide & Melting Association, Nashville, Tenn., one 50-hp engine, direct connected to a 30-kw generator; the Newtown Electric Railway Company, Newtown, Pa., one 450 and one 225-hp engine; the Fred W. Wolfe Company, Chicago, Ill., one 125-hp engine, direct connected to a 75-kw generator; Buffalo Hospital, one 125-hp engine, direct connected to a 75-kw generator; Worcester (Mass.) County Court House, one 85-hp engine, direct connected to a 50-kw generator; F. Bissell & Co., Toledo, Ohio, one 85-hp engine; Clarksdale Water & Light Company, Clarksdale, Miss., one 85-hp engine; Lake Lighting Company, Hammond, Ind., one 370-hp engine; United Gas Improvement Company, Philadelphia, three 60-kw direct-connected generators; William M. Barker, Deadwood, S. Dak., one 30-kw belted generator; Model Mill Company, Nashville, Tenn., one 20-kw belted generator; Gregory Central Station Company, Chicago, Ill., two 60-kw belted generators; University of Tennessee, Knoxville, Tenn., one 30-kw direct-connected generator.

Business Notice.

THE ILLUSTRATIONS in this issue were made by the Photo-Engraving Company, 9-15 Murray Street, New York City.

ILLUSTRATED RECORD OF ELECTRICAL PATENTS

UNITED STATES PATENTS ISSUED NOVEMBER 29, 1898.

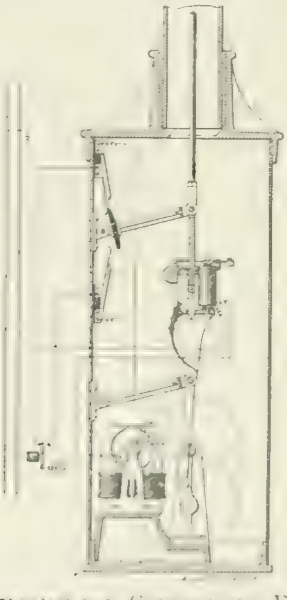
[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

614,794. CIRCUIT BREAKER; W. I. Crawford, of St. Louis, Mo. App. filed Aug. 23, 1897. In a circuit breaker, the combination of a standard, an armature, a clamp for connecting the stem of the armature in the standard, a set screw having a threaded connection with the standard, and an adjusting screw having a headed connection with the clamp, substantially as described.

614,819. PROCESS OF AND APPARATUS FOR COVERING WIRE WITH ASBESTOS; E. Albasini, of Turin, Italy. App. filed May 28, 1898. An apparatus for applying fibrous asbestos to wire, comprising means for applying a gradually increasing pressure to the asbestos, substantially as described.

614,839. METHOD OF FORMING ELECTRICAL CONNECTIONS; William B. Cleveland, Cleveland, Ohio. App. filed May 9, 1898. The method of joining two members of copper to form an electric connection, consisting of, first, casting one member upon the other, heating the two contiguous surfaces to a welding heat while free from atmospheric contact; second, supporting the casting in a die to prevent distortion, and third, uniting the two members by applicadtion of pressure while they are at a welding temperature and free from contact of atmospheric air.

[illegible]. TROLLEY FOR ELECTRIC CARS; H. W. Libbey, of Boston,

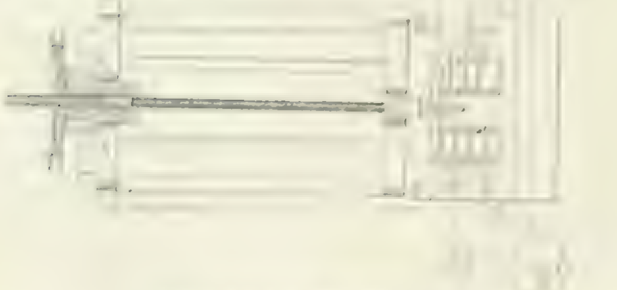


No. 61[illegible].—Mechanism for Controlling Electric Circuits.

[illegible] App. filed [illegible]. A trolley head having two arms, between [illegible] mounted and a bracket on each side, be- [illegible] mounted a small contact wheel or [illegible].

[illegible]. [illegible]; J. J. Murphy, of New York, N. Y. App. filed April [illegible]. [illegible] connecting electrical conductors, [illegible] of a refractory, non-conducting [illegible] with a [illegible] lining, and a screw [illegible] against the lining, [illegible] with a washer on the [illegible].

[illegible]. MECHANISM FOR CONTROLLING ELECTRIC CIRCUITS; [illegible], of [illegible], Md. App. filed April [illegible], 1898. In



No. [illegible]

[illegible]

614,941. TROLLEY DEVICE; J. C. Fernald, of Philadelphia, Pa. App. filed April 19, 1898. In a trolley, the combination of the trolley pole, a loosely jointed section connected to the pole on a transverse axis or hinge, a frame pivoted upon the upper end of the jointed section upon a vertical axis, two grooved contact wheels journaled one upon each end of said frame, and means independent of the pole consisting of a V-shaped shoulder and socket carried by the jointed section and frame for normally causing the wheels of said frame to lie in the plane of the pole and jointed section.

614,946. TELEPHONIC MICROPHONE; W. D. Gharky, of Philadelphia, Pa. App. filed Dec. 20, 1897. A telephonic microphone having a positive electrode of high thermo-electric value and a negative electrode of relatively low thermo-electric value.

614,964. DYNAMO-ELECTRIC MACHINERY; J. S. Lewis and F. J. Howitt, of Manchester, England. App. filed March 12, 1898. In a multipolar dynamo-electric machine, a field magnet comprising an outer magnet ring, inwardly projecting radial magnet cores secured to said ring, and annular plates of non-magnetic metal secured to said ring and to the cores, substantially as described.

614,982. AUTOMATIC TIME ELECTRIC-CIRCUIT SWITCH; F. Richard, of Boston, Mass. App. filed Oct. 30, 1897. The combination, with any number of open electric circuits, of a clock having a rotary dial furnished with adjustable pins adapted to engage the teeth of a toothed wheel, and during such engagement to rotate such wheel, and a switch having said toothed wheel adapted for such engagement and rotation, and furnished with arms adapted by said rotation to be brought into contact with and close any or all of said electric circuits, and to be carried out of such contact and open any or all closed electric circuits, substantially as described.

614,995. UNDERGROUND CONDUIT FOR ELECTRICAL CONDUCTORS; C. H. Sewall, of Chicago, Ill. App. filed March 2, 1898. The combination with a foundation having formed upon the surface thereof a continuous floor of indefinite width and length, of an inverted channel or block resting thereon, and having a plurality of conduit grooves therein, substantially as described.

615,014. REPEATER; W. M. Chapman, of Needham, Mass. App. filed March 17, 1898. In a signaling mechanism, the combination with a signal recording and transmitting device of a series of movable recording parts for said recording device, and a movable part for said transmitting device having secured thereto the roll, the pawl, the bell-crank lever and the rod, the roll and the pawl being adapted to co-operate with the movable recording parts, substantially as described.

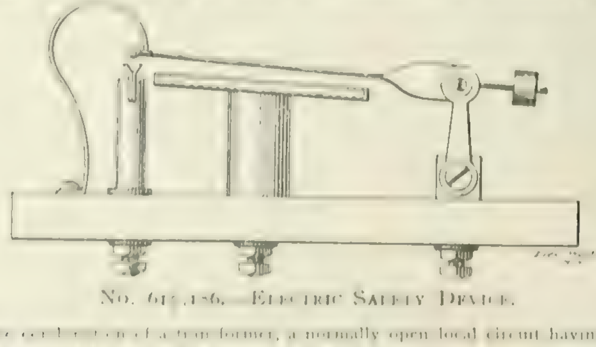
615,057. ELECTRO-MECHANICAL STRIKING MECHANISM; C. E. Beach and H. W. Doughty, of Binghamton, N. Y. App. filed Sept. 8, 1896. Magnets, an armature influenced thereby, a notch or projection moving with said armature, an actuating wheel engaging with the notch or projection, and an arm operated by said actuating wheel, and arranged to operate the armature for the purpose described.

615,136. ELECTRIC METAL-HEATING PROCESS; George D. Burton, Boston, Mass. App. filed Aug. 24, 1893. The art of heating metal bars, which consists in subjecting the parts to be heated while in contact with each other to the action of an electric arc sprung between them and an electrolytic bath.

615,142. SIGNALING; J. P. Coleman, of Edgewood Park, Pa. App. filed Jan. 3, 1898. In a signal apparatus, the combination of a signal, an electric motor for shifting the signal to clear and danger positions by rotation in the same direction, a circuit through said motor, two make-and-break mechanisms included in said circuit, said make-and-break mechanism being, respectively, adapted to be opened and closed by the movements of the signal to and from clear position.

615,172. PRIMARY BATTERY; H. K. Hess, of Philadelphia, Pa. App. filed Feb. 2, 1898. A section of a primary battery consisting of two side plates composed of a frame cast around thin plates of porous carbon, with strips of lead mounted between the two side plates and fused thereto, substantially as described.

615,186. ELECTRIC SAFETY DEVICE; J. F. Kelly, of Pittsfield, Mass. App. filed April 14, 1898. In a system of distribution by alternating currents,



No. 615,186.—Electric Safety Device.

the combination of a transformer, a normally open local circuit having both its terminals connected to said transformer, an electrostatically operated device closing said local circuit upon the passage of current from the primary to the secondary circuit of said system, and a circuit interrupting device operated as a consequence of the current flowing in said local circuit when closed.

The Electrical World.

Vol. XXXII. NEW YORK, DECEMBER 17, 1898. No. 25.

PUBLISHED EVERY SATURDAY BY

The W. J. JOHNSTON COMPANY,

9 Murray Street, New York.

Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York.

New England Office, 620 Atlantic Ave., Boston.
Western Office, 936 Monadnock Block, Chicago.
Philadelphia Office, 929 Chestnut Street.

SUBSCRIPTION IN ADVANCE, ONE YEAR, $3.00,
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THE ELECTRICAL WORLD,

9 Murray Street, New York.

Vol. XXXII. NEW YORK, DECEMBER 17, 1898. No. 25.

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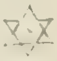
THE ROTARY CONVERTER.

There may be found on other pages of this issue an article by Mr. C. P. Steinmetz on "The Converter," discussing the peculiarities of this machine in the way of armature heating, field reaction, etc., features that are complicated by the internal combination of sinusoidal and square-cornered current waves in the same coils. These peculiarities have attracted considerable attention of late, as their mutual balancing effect gives the converter its advantage over the motor generator.[1] A valuable paper by Prof. Silvanus P. Thompson has been recently presented before the British Association on the same subject.[2]

As might be surmised, the discussions show that the more phases there are to the alternating current supplied to a converter the less is the heating of the armature coils. The last two tables in the part of the article by Mr. Steinmetz in this issue give the relative heating of a machine when used as a continuous-current generator and as a converter with a supply of one, two, three, four, six, twelve or as many phases as there are commutator segments. From these it will be seen that, assuming an internal energy loss of 4 per cent., and assuming unity as the power factor of the incoming current (the next to the last table), a 100-kw machine must be limited, for the same copper heating, to a rating of 82 kw if used as a single-phase converter, but may be run at 131 kw with three-phase supply, 161 with four-phase supply (commonly known as two-phase), 194 kw with six-phase supply, and 231 with as many phases as commutator segments. These figures are, of course, based on the use of commutators properly proportioned for the increased load.

The question naturally arises, can the number of phases of a given supply be readily increased without complication? In the case of three-phase rotaries this can be done. The number of phases can be exactly doubled without any change except in the rotary itself, and in the alternating-current transformers supplying it. This is due to the fact that three equal electromotive forces, differing from each other in phase by one-third of a period, if exactly reversed, give another three-phase system, which, superposed on the first, gives a six-phase combination. This reversal is readily obtained from the three single-phase transformers by a second secondary winding connected up in the reverse order from the first. This second three-phase system, displaced in phase from the first by half a period, would require, of course, three more collector rings on the rotary, and this would really be the only added complication, as most transformers are built with at least two independent secondary windings. Considering a delta-connected set of secondary windings, the corners of the delta being tapped off to the collector rings of the rotary, the added system would consist of another delta, its vectorial representation being twisted from the first, so to speak, by 60 degrees (giving a figure like this ), attached to three other collector rings, the only electrical connection between the two deltas being through the armature coils of the converter. This simple change would give an immediate reduction of the heating of the armature copper on the three-phase rotary by about 50 per cent., and a consequent increase in the converting capacity, with the same heating of the armature copper by about 50 per cent. (from 131 to 194 kw in the case assumed above). In the event of a phase displacement of the alternating system, the percentage improvement would be about the same, and there would be a further advantage in the more uniform distribution of the heating, which, as is shown by diagrams in some of the articles referred to above, piles up enormously at the coils adjacent to the collector-ring connections.

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[1] See The Electrical World, January 1, 1898, page 12, and February 12, page 216.

[2] See The Electrical World Digest, December 17, 1898, page 659.

REACTIVE COILS VS. VOLTAGE-REDUCING TRANSFORMERS FOR THE STARTING OF ALTERNATING-CURRENT MOTORS.

For giving reduced voltages from alternating-current circuits for brief intervals, particularly for the starting of alternating-current motors, there are two methods coming into general use. One is the insertion of reactive coils in the incoming leads, and the other the use of voltage-reducing transformers generally of the single-coil type, with one or more taps between which and one terminal various voltages may be obtained. The latter piece of apparatus is known under several names, among them compensator, autoconverter, economy coil, etc. Their purpose in the starting of synchronous motors or induction motors with permanently short-circuited secondaries is to cut down the rush of current that would take place were the motor windings connected directly across the lines. Their analogies may be found in direct-current work, that of the reactive coil being the rheostat of the direct-current motor and that of the single-coil transformer being the Leonard system of control.

The reactive coil is somewhat the simpler of the two, especially in its wiring and manipulation. All it requires is a short-circuiting switch to cut it out when its service is no longer needed, and this may be combined with the main switch of the motor by means of a double-throw arrangement. It takes, however, as much current from the line as is demanded by the motor to give the needed starting torque, and it gives this current a considerable lag, which, while it economizes power, is injurious to voltage regulation. Its chief distinguishing peculiarity from the other method is the fact that the drop of voltage is proportional to the load, so that as the back electromotive force of the motor rises and the current falls the impressed electromotive force at the motor terminals rises also. The torque of the motor at any speed being proportional to the square of the voltage impressed upon its terminals, quite a uniform starting torque may be obtained almost to synchronism. Reactive coils are commonly not built, as are the rheostats used with direct-current motors, with many steps by which they can be gradually cut out, but are thrown out as a whole in one step, the same practice prevailing with the use of transformers, the voltage being stepped up from one starting pressure to the line pressure in one step, except in instances where a speed variation is desired.

[illegible] the voltage delivered by the transformer, which, of course, remains [illegible] taken by the motor may be, the voltage reduction being thus limited by the starting torque demanded.

With the induction motor, reactive coils are rarely if ever used. The speed-torque curve of the induction motor supplied from a step-down transformer is a close copy of the speed-torque curve with full line supply with all torque values reduced in proportion to the square of the voltage reduction. As the torque of such a motor with constant-potential supply generally increases as the speed rises, and holds well toward synchronism, a transformer that will give the necessary standstill torque will bring its motor up pretty close to full speed. With synchronous motors both methods are used, even by the same makers, and for the same service. As a synchronous motor approaches synchronism its demand upon the line is subject to beats or excessive fluctuations of the current similar to those of phasing lamps. Reactive coils choke these down and thereby distribute more uniformly from second to second the demand upon the line and the torque given to the motor, while voltage-reducing transformers give extreme fluctuations, varying from heavy motoring currents to almost as heavy generating currents.

THE WEAKEST LINK IN THE CHAIN.

The electric motor directly coupled or geared to its load, with no intermediate mechanism which can slip, as can a belt, becomes, especially with high-gear ratios, a source of great possible strains. Unlike the steam engine and other sources of mechanical power its maximum torque is, as a rule, a great many times that of its normal load, and, especially in the case of shunt-wound motors, any obstruction to the movement of the load tending to reduce the speed causes an instantaneous application of the great force available.

Especially is this the case with motors driving such loads as cranes, elevators, etc., where the speed reduction is considerable and worm gears are commonly used. A recent disaster that was probably in part due to this very cause is the fatal accident which occurred recently in an electrically driven elevator in New York city. Here it appears that the car came down with full speed against the bumpers and the motor continued working, lifting the counterweights after the car had struck, in spite of the greatly increased load, until the counterweights struck at the top of the shaft, throwing some of them out of the frames, whence they fell and smashed through the car with fatal results. In other instances motors have torn the cables loose from elevator drums, cars or counterweights, broken the wheel spiders or stripped the gears.

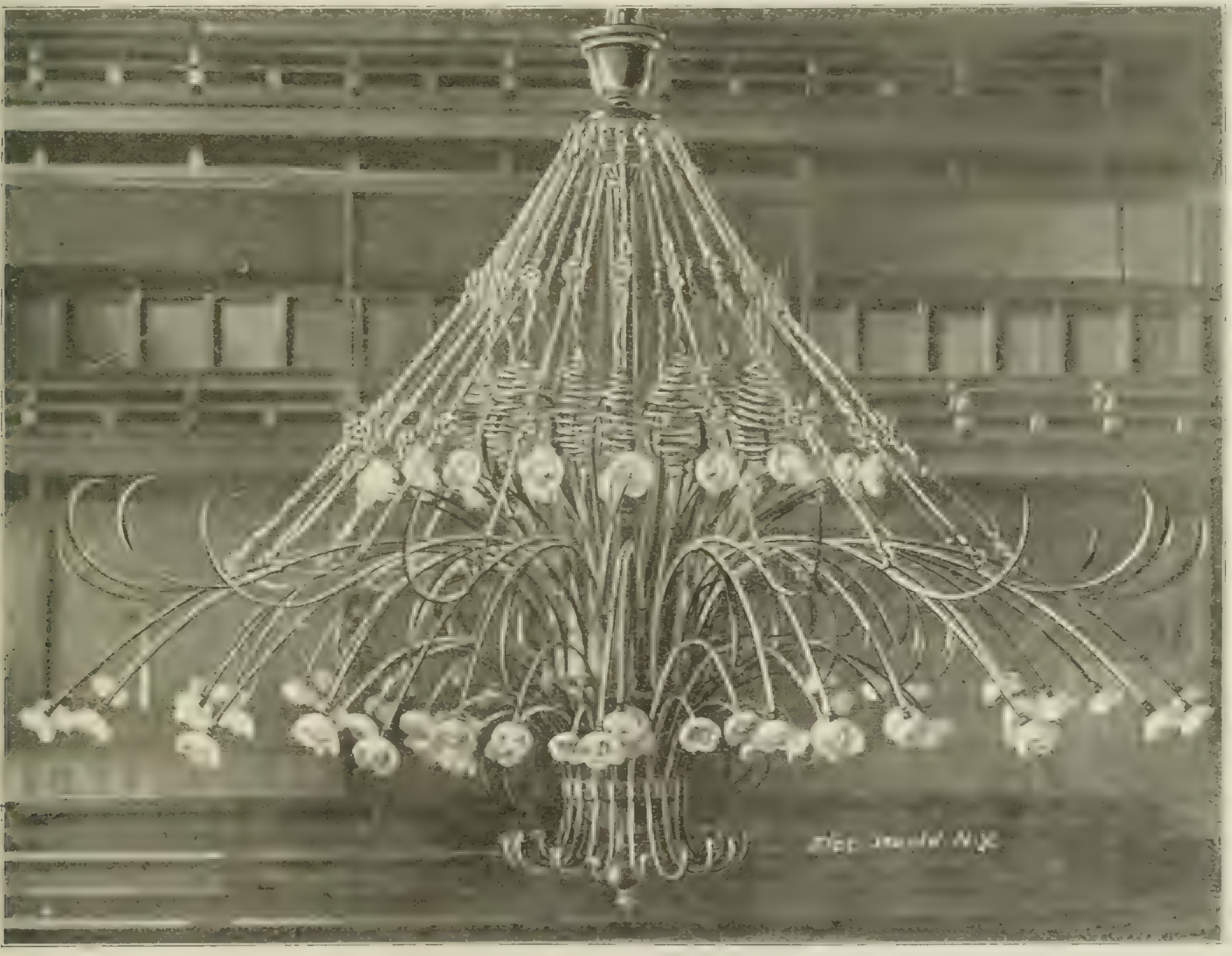
In cases of this kind the weakest point of the system will, of course, yield first to the strain, and very fortunately the weakest point can be readily made a part of the electrical circuit, the breakage of which causes no damage whatever. The action of fuses is [illegible] for such sudden loads as are liable to be imposed on rigidly connected machinery, so that circuit breakers should always be installed. Unfortunately the circuit breaker, like the safety valve of early boiler installations, is very readily overweighted or tied in, and one that, like most modern types of safety valves, could not be tampered with would be a blessing for such service. With a breaker that could be absolutely depended upon the maximum strain, outside of the inertia effect of fly wheels, etc., could be exactly [illegible] and allowed for. In most such loads, among them [illegible] there is no great amount of stored kinetic energy, and where this is necessary, as in printing-press service, etc., other safeguards might be provided if necessary.

The Japanese as Manufacturers of Electrical Fixtures.

With many centuries' development of the artistic sense, the Japanese undoubtedly have a good opportunity to excel in the adaptation of the beautiful to utilitarian service. An instance of this is the design of electrical fixtures, and their progress in this line is evidenced by the accompanying illustration of the largest chandelier ever constructed in Japan.

This fixture is 22½ feet in diameter, 30 feet high, and weighs, with its 100 lamps and shades, 3240 pounds. Its design was carried out by the Tokyo Fine Arts Academy (a suggestion for Americans), and the mechanical work was carried out by the Saiga Electric Company, of Kyoto, from whom this information is derived.

The symbolism of the design is characteristic of this interesting little nation. The chandelier illuminates the interior of the newly constructed opera house in Umeta, Osaka, the commercial centre of Japan. Tradition has it that at one time the vicinity was a lagoon in which reeds flourished, and the name Umeta signifies a plum field. For these reasons the chandelier combines arms and branches shaped like the blades of reeds, with reflectors of the shape of plum blossoms, giving, as the picture indicates, a harmonious and beautiful as well as appropriate combination. The finish is in gold leaf and silver plate, lacquered. The lamps are divided between three circuits and fitted with dimming rheostats.



A Japanese Chandelier.

Measurements of the Permanent Magnetism of Bricks.

An investigation has been carried on in the electrical laboratories of the University of Rochester on the relative magnetic moments of brick made of different clays and containing different amounts of magnetite and other iron oxides. The measurements have been in charge of Prof. Henry E. Lawrence and O. A. Gage.

A Power Transmission Plant in Central New York.

The hydraulic power station and long-distance transmission lines of the Wetmore Electric Company, of Lowville, N. Y., are rapidly nearing completion. The company was organized only last summer, with a capital stock of $40,000, and work was commenced about the 23d of August. The power plant is located at Belfort, on the Beaver River, and utilizes a fall of 50 feet obtained by a headrace cut through solid rock 150 feet in length. One unit is at present under construction, with space for two more. The dynamo is a 350-kw, 60-cycle, 2200-volt, three-phase Westinghouse machine, delivering its power to raising transformers, which give the line pressure of 11,000 volts. A three-wire line of No. 5 wires carries the power to a sub-station at Lowville, and will be extended to Croghan and New Bremen.

Proposed Electric Railway in Shanghai.

Bids have been called for covering the construction of 23 miles of electric railways in the streets of Shanghai, China.

The Next New York Electrical Exhibition.

The lease of Madison Square Garden for another electrical show to be held during the month of May, 1899, has been signed by Mr. C. O. Baker, Jr., president of the Electrical Exhibition Company. The show will be under the auspices of and in connection with the twenty-second annual convention of the National Electric Light Association, which will be held in New York city during the same month. The officers of the Electrical Exhibition Company are: C. O. Baker, Jr., president; H. L. Shippy, vice-president; George F. Porter, secretary and treasurer; Marcus Nathan, general manager; H. H. Harrison, L. F. Requa, J. W. Godfrey and C. A. Lieb, directors.

The Lighting and Power Plant of the Chicago Public Library Building.

GREAT public library buildings are not built every day. Consequently, the work of designing and installing an electric-light and power plant to meet the needs of a public library is one in which engineers have but little practice. Such a task has no hard and fast rules laid down for it, and follows no beaten path of custom. Each job of the kind is a law unto itself, the conditions to be met and the requirements to be fulfilled determining the nature of the completed work. Each such plant is interesting, when completed, as showing in what manner given necessities and conditions have been met.

Chicago has just finished building a great public library and a lighting plant for it. Starting with an even half block of space in the business centre, 352 x 146 feet, a building has been erected which is fondly boasted to be the handsomest of its kind in the world. It is of stone, without an iron frame, 90 feet high above the street level. It took five years to build, but the results accomplished seem to have more than made up for the delay. The electric plant which furnishes light and power for this palace of books is a part of the building, and is constructed on the same scale of magnificence and completeness as the rest of the structure.

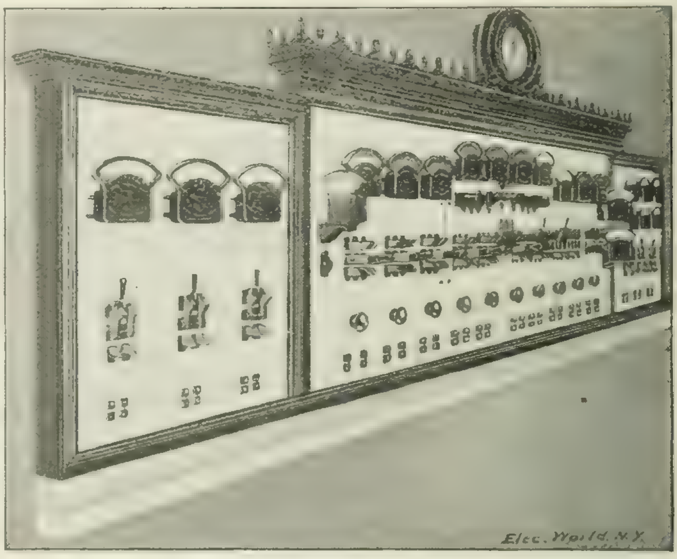
As it was desirable to use practically all the space at the disposal of the public library board, and as good looks were one of the first essentials striven for, it was necessary both to make the lighting plant a part of the building and also to conceal it from view as much as possible. These ends were secured by providing a court indenting the least conspicuous side of the building, and then hiding the power-house portions at the inner side of the indentation. As the building now looks from the street, except for the presence of a couple of coal and ash hoppers and a handsome brick stack, no one would ever suspect that an 1100-hp plant was concealed inside.

This court, sacred to the uses of the power plant, is just large enough to enable teams to enter and manœuvre comfortably in front of the coal and ash hoppers. It is enclosed by a 12-foot iron fence of a most ornamental pattern, which serves to help conceal the industrial work inside. The court is entirely floored with cement, in which is embedded a scale for weighing each load of coal [illegible] [illegible] [illegible] [illegible] in and out. Underneath this court yard floor are the coal storage vaults, large enough to hold [illegible] [illegible] [illegible].

The coal and ash handling machinery is [illegible] [illegible] [illegible] [illegible]. From the hopper the coal is dumped into a five-ton hopper. It is then raised by a conveyor driven by an electric motor to a pair of pockets over the boiler room, from which it is sent down through a chute to the boiler floor, whence it is shoveled into the furnaces. No mechanical stoker is employed. The coal used is the best quality of anthracite of the size known as small egg. The ashes are conveyed in the same manner as the coal, to a hopper outside the building, from which they are dumped into wagons brought into the court.

The Chicago Public Library.

The boiler-room floor is ten feet below the street level. Room in the building was extremely valuable, so the boiler equipment was contracted into a very small space. The boilers were consequently made of a special design of the water-tube type, by John Mohr & Sons, Chicago. They consist of four units in two batteries, containing 11,000 square feet of heating surface. Particular attention in their design was paid to every point that would make certain of a first-class performance in economical steam production. A special effort was made to secure a circulation of feed water that would insure the precipitation of all impurities in the large purifier installed.



The Switchboard.

Complete and compact as the boiler room is, these characteristics of the plant are not fully appreciated until the engine room is reached. This is far more compact and complete, reminding one by its large amount of power crowded into a small space and by the perfection of its details of the engine room of a transatlantic steamer. The engine-room floor, of iron, is about five feet below the street level, with a sub-basement under it. In the centre of the room, occupying almost the entire space, stand the engines with their direct-coupled generators. Along the north wall is a model switchboard. At the south end is a gauge room and gauge board, pumps and fan motors. At either side is an elevator shaft, with electric elevator motors and cable drums. Outside of the machinery there is barely room for the attendants to move about, except in front of the switchboard. The only spare corner is filled by Chief Engineer Rietz's desk and a wash stand.

The engines are five in number, four of 250 horse power apiece and one of 75 horse power. The large ones are upright, non condensing, cross-compounds, made by the Ball Engine Company of Erie, Pa. The fifth is from the same makers, but is a tandem compound. The cross-compounds have the fly and governor wheels in the centre between the housings. Inertia governors of the Rites type were installed, and particular attention bestowed to make them sensitive in regulating. In spite of the effort, however, certain electrical precautions have yet to be taken to prevent the lights jumping from the influence of the motor demands.

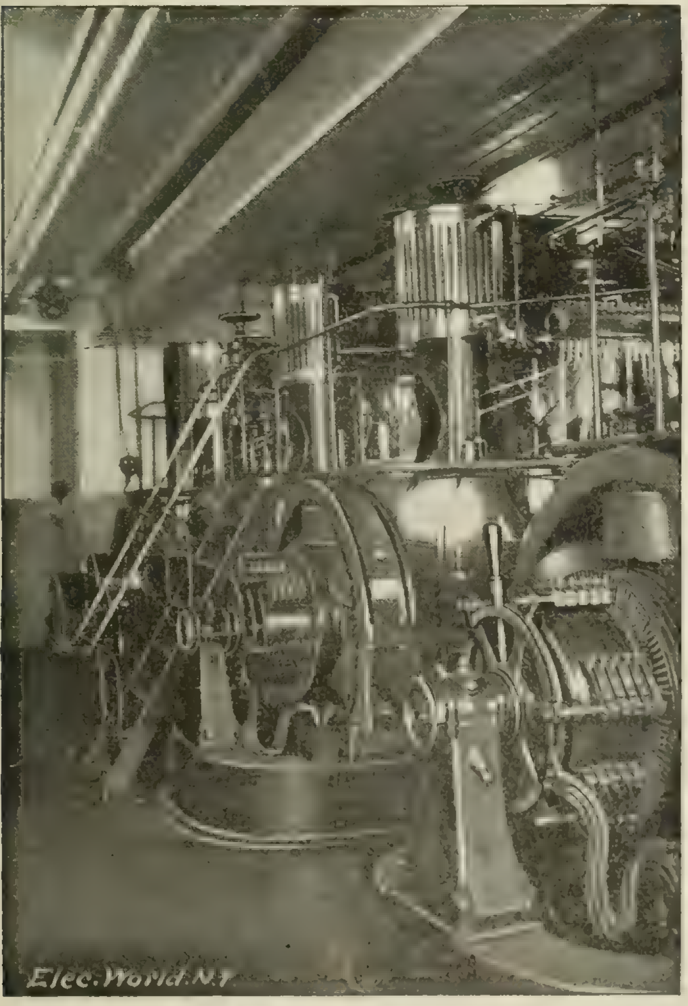
The gauge board in the back of the engine room is a novelty. It is built of white marble and bronze and adorned with no less than twelve gauges. There are gauges for the steam pressure, gauges for back pressure, gauges for the heating system, gauges for the air pressure, gauges to show the height of water in the tanks on the roof and gauges for everything an engineer could wish to keep track of. Back of the board is a little room kept under lock and key, and in it are all the recording gauges whose records can be of value.

Two six-pole 125-volt General Electric generators of 60 kilowatts each are direct coupled to each of the larger engines. The smaller engine has two of 22½ kilowatts each, making of all the units three-wire sets. The large ones are driven at 175 r. p. m. and the smaller ones at 305.

The Edison three-wire system is used throughout the building. On it are 13,000 16-cp 110-volt incandescent lamps, and a number of 220-volt motors. There are thirty-five of the latter, ranging in size from 1 to 30 horse-power. Ten Gibbs electric elevators are in the building, four of them being supplied with 30-hp motors and the rest with 22½-hp motors. The makes of motors used throughout the building include Gibbs, Crocker-Wheeler, C & C, Westinghouse, Northern and International. They perform all the power work of the building, even to running the air compressor for the pneumatic tube system.

The switchboard is one in a thousand. It occupies the entire north side of the engine room. It is made of purest white Carrara marble, bound with a heavy ornamental border of solid bronze, costing several thousand dollars in itself. Above, the bronze trimming forms the frame for a handsome electrical clock, which runs by means of circuits twenty-eight electric clocks in the various rooms throughout the building. The copper instruments combine with the bronze and white of the board to give a most handsome effect. The board was installed by the Chicago Edison Company, which did the electrical work on the plant.

There are three panels to the switchboard. The centre one is the generator panel, holding the rheostats, ammeters and controlling switches for the machines. The main switches are triple-pole, double-throw, putting in the equalizer bar in each case before the outside bar. One throw connects the dynamo to the power circuit and the other to the lighting circuit. A central junction switch enables the power and lighting buses to be thrown together if desired. This is usually done during the day in order to make a load sufficiently heavy to be economical for one pair of machines. But it results in flickering lights when the elevator motors are started, in spite of the special governors. Yet in the daytime the lights in use are in the basement and corridors, so no harm is done. At nighttime, even if the two circuits are thrown together, no fluctuation is noticed, since the lights form the greater part of the load and the variation due to the motors is a small factor. Usually one pair of machines is run daytime, unless cloudy, and two to three pairs at night.



THE MAIN GENERATING UNITS.

The left-hand panel feeds the motor circuits. They are put for convenience on three feeders, running to different portions of the building. The right-hand panel is for the lights and here again three circuits are used. Light and power voltmeters are on the board, attached to the bus bars of the two circuits. A novelty of considerable value consists in both light and power pilot wires run to the board from the extreme points of the building, so that the throw of the voltmeter switch will show in succession the voltage at different places in the structure.

ASH HOIST, CHUTE AND TANK, SHOWING COAL HOPPER AT THE LEFT.

In front of the switchboard are small air tubes, connected with the compressor which supplies air for the pneumatic-gate openers on the elevators and for the sewage ejectors. These tubes are used for blowing dirt off the boards and instruments. The generators are similarly provided. Behind the switchboard are located the wattmeters, of the Thomson integrating variety. These keep a close record on the energy used for both light and power circuits.

The wiring throughout the building is done in iron-armored conduits. The main cables are carried on insulators, but everything smaller is concealed and in conduits. Between the machine and switchboard and from the street to the building the cables run under the engine-room floor in the sub-basement to wiring shafts through the building. The largest cables contain 1,250,000 circular mils.

Tests have been recently completed on the Chicago Public Library plant by George H. Barrus. The results in full have not been given out. But they have occasioned some important changes lately in the electrical machinery—changes not yet fully completed. As far as published, the engines and boilers made a good showing. The dynamos gave an efficiency of 0.856 on full load, 0.785 on half load and 0.854 on 1¼ load.

This plant, designed by N. E. Wydert, is relied on for furnishing the lighting of the Chicago Public Library in every event. Although there are a few gas pipes in the building, no connection with the street mains has ever been made. Likewise, no breakdown connection with the Chicago Edison street circuit, now so common as a safety reserve in the down-town plants, has been provided. The usefulness of the building to the public is expected to stand or fall by its lighting plant. Judging by past records and the large reserve of machinery provided, the distribution of the 2,700,000 books given out by the Chicago Public Library each year will not be interfered with by lack of light or power.

Experiments with Electric Traction on the London Underground Railways.

The London "Electrical Engineer" announces a few details of the electrical traction experiments to be carried out on the Metropolitan and District railways of London. It is proposed to have the motors distributed among the different cars of the train, some four gearless motors with series-parallel control to be used for each train. Both lead and return conductors will be insulated, the train rails not being utilized for conduction purposes, and the present experiments are chiefly intended to ascertain the best arrangements of the conducting system. The experiments will be carried on until July.

The Resistance of the Human Body.

The London "Electrician" describes measurements carried on by Siemens & Halske to determine the resistance of the bodies of a large number of workmen. Between the hands values ranging from 900 to 2000 ohms were obtained, and between the hand and earth—the men wearing the wooden shoes of German workmen—resistance ran from 14,000 to over 150,000.

The Converter—I.

BY C. P. STEINMETZ.

I. GENERAL.

FOR long-distance transmission, and to a certain extent also for distribution, alternating currents, either polyphase or single phase, are extensively used. For many applications, however, as especially for electrical railroading and for electrolytic work, continuous currents are required, and are usually preferred also for low tension distribution on the Edison three-wire system. Thus, where power is derived from an alternating system, transforming devices are required to convert from alternating to continuous current. This can be done either by a direct-current generator driven by an alternating synchronous or induction motor, or by a single machine consuming alternating and producing continuous current in one and the same armature. Such a machine is called a converter and combines, to a certain extent, features of a direct-current generator and an alternating synchronous motor.

Since in the converter the alternating and the continuous currents pass through the same armature conductors, and therefore cut the same field flux, their e. m. fs. stand in a definite relation to each other, which is such that in practically all cases step-down transformers will be necessary to give from the comparatively high pressure line circuit the required alternating voltage.

Comparing the converter with the combination of a synchronous or induction motor and a direct-current generator, the converter requires step-down transformers, while the synchronous motor, if the alternating line voltage is 10,000 volts or more, generally requires step-down transformers also, but with voltages of 1000 to 10,000 volts the synchronous motor can frequently be wound directly for the line pressure and stationary transformers eliminated. Thus, in the one case, we have two machines with or generally without stationary transformers, and in the other case a single machine with transformers.

Regarding the reliability of operation and first cost, usually a single machine is preferable. Regarding efficiency, that of the stationary transformer of large size varies from 97 to 98 per cent., with an average of 97.5 per cent. That of the converter or of the synchronous motor varies between 91 and 95 per cent., with 93 per cent. as average, and that of the direct-current generator between 90 and 94 per cent., with 92 per cent as average. Thus the converter with its step-down transformers will give an average efficiency of 90.7 per cent., a direct-current generator driven by synchronous motor with step-down transformers an efficiency of 83.4 per cent., and without step-down transformers an efficiency of 85.5 per cent. Hence the converter is more efficient.

Mechanically the converter has the advantage that no transfer of mechanical energy takes place, since the torque consumed by the generation of the continuous current and the torque produced by the alternating current are applied at the same armature conductors, while in a direct-current generator driven by synchronous motor the power has to be transmitted mechanically through the shaft.

Fig. 1

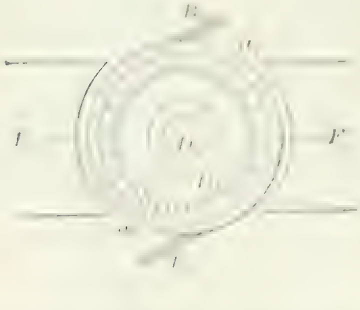
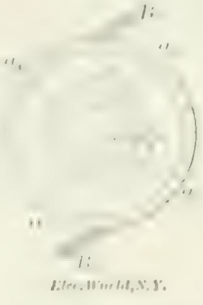


Fig. 2



Elec.World,N.Y.

2. RATIO OF ELECTROMOTIVE FORCES AND OF CURRENTS.

Let Fig. 1 represent diagrammatically the commutator of a direct-current machine with the armature coils shown connected to adjacent commutator bars. The brushes are B_1 and B_2 and the field poles F_1 and F_2.

If now two oppositely located points a_1 and a_2 of the commutator are connected with two collector rings D_1 and D_2 it is obvious that the e. m. f. between these points a_1 a_2 and thus between the collector rings D_1 D_2 will be a maximum at the instant when the points a_1 a_2 coincide with the brushes B_1 B_2, and will at this time be equal to the direct-current voltage E of the machine. While the points a_1 a_2 are moving away from this position the difference of potential between a_1 and a_2 decreases and becomes zero at the instant when the line a_1 a_2 coincides with the direction of the field poles F_1 F_2. At this point the difference in potential between a_1 and a_2 reverses and then increases again, reaching equality with E, but in opposite direction when a_1 and a_2 coincide with the brushes B_2 and B_1.

Fig. 3

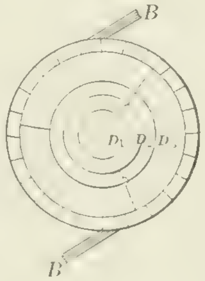
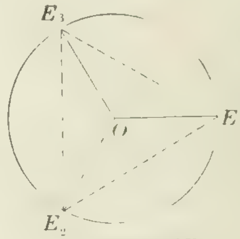


Fig. 4



Elec.World,N.Y.

That is, between the collector rings D_1 and D_2 an alternating voltage is produced whose maximum value equals the continuous current e. m. f., E, and which makes a complete period for every revolution of the machine (in a bipolar converter, or p periods per revolution in a machine of $2p$ poles).

Hence this alternating e. m. f. is

$$e = E \sin 2 \pi N t.$$

Where $N =$ frequency of rotation and $E =$ e. m. f. between brushes of the machine.

Thus the effective value of the alternating e. m. f. is

$$E_1 = E / \sqrt{2}.$$

That is, a direct-current machine produces between two collector rings connected with two opposite points of the commutator an alternating e. m. f., equal to the direct-current voltage, divided by the square root of two, at a frequency equal to the frequency of rotation, and since every alternating-current generator is reversible such a direct-current machine with two collector rings, when supplied with an alternating e. m. f. of $1/\sqrt{2} \times$ the direct-current voltage at the frequency of rotation, will run as a synchronous motor, or if at the same time generating direct current as a synchronous converter.

Since, neglecting losses and phase displacement, the output of the direct-current side must be equal to the input of the alternating-current side, and the alternating voltage in the single-phase converter is $E / \sqrt{2}$, the alternating current must be $I \sqrt{2}$, where $I =$ direct-current output.

If now the commutator is connected to a further pair of collector rings D_3 D_4 (Fig. 2) at two points a_3 a_4 midway between a_1 and a_2, it is obvious that between D_3 and D_4 an alternating voltage of the same frequency and intensity will be produced as between D_1 and D_2, but in quadrature therewith, since at the moment when a_3 and a_4 coincide with the brushes B_1 B_2, and thus receive the maximum difference of potential, a_1 and a_2 are at zero points of potential. Thus connecting four equidistant points a_1, a_3, a_2 and a_4 of the direct-current generator to four collector rings D_1, D_3, D_2 and D_4 gives a four phase converter of the e. m. f. per phase.

$$E_1 = E / \sqrt{2}.$$

The current per phase is (neglecting losses and phase displacement)

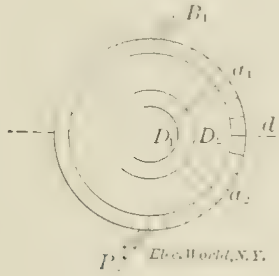
$$I_1 = I / \sqrt{2}.$$

since the alternating power $2 E_1 I_1$ must equal the direct-current power, $E I$.

Connecting three equidistant points of the commutator to three collector rings, as in Fig. 3, gives a three-phase converter.

Let, in Fig. 4, the three e. m. fs. between the three collector rings and the neutral point of the three-phase system (or Y voltages) be represented by the vectors $O E_1$, $O E_2$ and $O E_3$, and the e. m. f. between the collector rings (or delta voltages), by vectors $E_1 E_2$, $E_2 E_3$ and $E_3 E_1$. The e. m. f. $O E_1$ is, however, nothing but half the e. m. f. E_1 in Fig. 1 of the single-phase converter, that is $= E/2\sqrt{2}$. Hence the Y voltage, or voltage between collector ring and neutral point of a three-phase converter, is

Fig. 5



$$E_1 = \frac{E}{2\sqrt{2}},$$

and the △ voltage thus,

$$E^1 = E_1 \sqrt{3} = \frac{E\sqrt{3}}{2\sqrt{2}}.$$

Since the total three-phase power, $3\ I_1\ E_1$, equals the total continuous-current power $I\ E$, it is,

$$I_1 = \frac{I\ E}{3 E_1} = \frac{2\ I\sqrt{2}}{3} = 0.943\ I.$$

In general, in an n-phase converter or converter in which n equidistant points of the commutator (in a bipolar machine, or n equidistant points per pair of poles in a multipolar machine) are connected to n collector rings, the voltage between any collector ring and the common neutral, or star voltage, is

$$E_1 = \frac{E}{2\sqrt{2}},$$

consequently the voltage between two adjacent collector rings

$$E^1 = 2\ E_1 \sin\frac{\pi}{n} = \frac{E}{\sqrt{2}} \sin\frac{\pi}{n},$$

since $2\ \pi/n$ is the angular displacement between two adjacent collector rings, and herefrom the current per line is found as

$$I_1 = \frac{2\ I\sqrt{2}}{n}$$

and the current flowing from line to line, or from collector ring to adjacent collector ring,

$$I^1 = \frac{I\ \sqrt{2}}{n \sin\frac{\pi}{n}}.$$

Table No. 1 gives, with the continuous-current voltage and continuous current as unit, the alternating voltages and currents of the different converters.

TABLE 1.

	Continuous Current.	Single Phase.	Three Phase.	Four Phase.	Six Phase.	Twelve Phase.	n Phase.
Volts between collector ring and neutral point.	1.0	$\frac{1}{2\sqrt{2}}$ = .354	$\frac{1}{2\sqrt{2}}$ = .354	$\frac{1}{2\sqrt{2}}$ = .354	$\frac{1}{2\sqrt{2}}$ = .354	$\frac{1}{2\sqrt{2}}$ = .354	$\frac{1}{2\sqrt{2}}$ = .354
Volts between adjacent collector rings.		$\frac{1}{\sqrt{2}}$ = .707	$\frac{\sqrt{3}}{2\sqrt{2}}$ = .612	$\frac{1}{2}$ = .5	$\frac{1}{2\sqrt{2}}$ = .354	.183	$\frac{1}{\sqrt{2}} \sin \pi/n$
Amperes per line.	1.	$\sqrt{2}$ = 1.414	$\frac{2\sqrt{2}}{3}$ = .943	$\frac{1}{\sqrt{2}}$ = .707	$\frac{\sqrt{2}}{3}$ = .472	.236	$\frac{2\sqrt{2}}{n}$
Amperes between adjacent lines.	1.0	$\sqrt{2}$ = 1.414	$\frac{2\sqrt{2}}{3\sqrt{3}}$ = .544	$\frac{1}{2}$ = [illegible]	$\frac{\sqrt{2}}{3}$ = .472	.455	$\frac{\sqrt{2}}{n \sin \pi/n}$

These currents give only the energy component of alternating current corresponding to the continuous-current output. Added thereto is the current required to supply the losses in the machine, and the wattless component of current if a phase displacement is produced in the converter.

3. VARIATION OF THE RATIO OF ELECTROMOTIVE FORCES

The preceding ratios of e. m. fs. apply strictly only to the induced e. m. fs., and that under the assumption of a sine wave of alternating induced e. m. f. The latter is always sufficiently closely the case, since the armature of the converter is a multitooth structure, that is, contains a distributed winding.

The ratio between the difference of potential at the commutator brushes and that at the collector rings of the converter usually differs somewhat from the theoretical ratio, due to the e. m. f. consumed in the converter armature, and in machines converting from alternating to continuous current also due to the shape of impressed wave. When converting from alternating to continuous current, under load the difference of potential at the commutator brushes is less than the induced continuous-current e. m. f., and the induced alternating e. m. f. less than the impressed, due to the voltage lost in the armature resistance.

If the current in the converter is in phase with the impressed e. m. f., armature self induction has little effect, but reduces the induced alternating e. m. f. below the impressed with a lagging, and raises it with a leading current, in the same way as in a synchronous motor.

Thus in general the ratio of voltages varies somewhat with the load and with the phase relation, and with constant impressed alternating e. m. f. the difference of potential at the commutator brushes decreases with increasing load, decreases with decreasing excitation, lag—and increases with increasing excitation, lead. When converting from continuous to alternating current the reverse is the case.

The direct-current voltage stands in definite proportion to the maximum instantaneous value of the alternating voltage (being equal to twice the maximum star voltage), but to the effective value (or value read by the voltmeter) only in so far as the latter depends upon the former, being equal, with a sine wave, to $1/\sqrt{2}$, multiplied by the maximum value. Thus with an impressed wave of e. m. f. giving a different ratio of maximum to effective value, the ratio between continuous-current and alternating-current voltage is changed in the same proportion as the ratio of maximum to effective. Thus, for instance, with a flat-topped wave of impressed e. m. f. the maximum value of alternating impressed e. m. f. and thus the continuous-current voltage depending thereupon are lower than with a sine wave of the same effective value, while with a peaked wave of impressed e. m. f. they are higher by as much as 10 per cent. in extreme cases.

Hence the ratios of e. m. fs. given under heading 2 have to be corrected by the drop of voltage in the armature, and have to be multiplied by a factor which is $\sqrt{2}$ times the ratio of effective to maximum value of impressed wave of e. m. f. ($\sqrt{2}$ being the ratio of maximum to effective of the sine wave on which the ratios in section 2 were based.) With an impressed wave differing from sine shape, a current of higher frequency, but generally of negligible magnitude, flows through the converter armature, due to the difference between impressed and counter e. m. f. waves.

Fig. 6

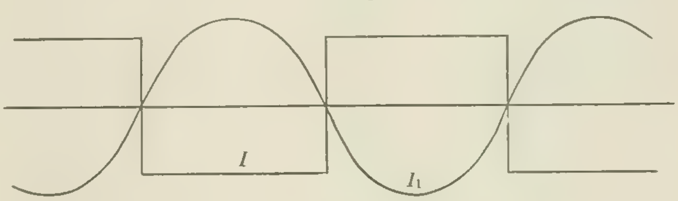
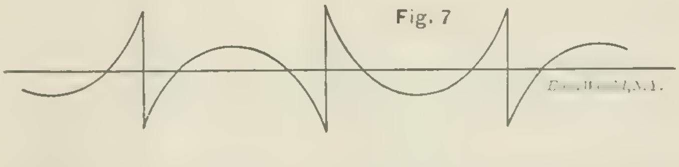


Fig. 7



4. ARMATURE CURRENT AND HEATING.

The current flowing in the armature conductors of a converter is the difference between the alternating-current input and the continuous-current output.

Let in Fig. 5 a_1 and a_2 be two adjacent leads connected with the collector rings D_1 and D_2 of an n-phase converter. The alternating e. m. f. between a_1 and a_2, and thus the alternating energy current flowing in the armature section between a_1 and a_2, will reach a maximum when this section is midways between the brushes B_1 and B_2, as shown in Fig. 5.

The continuous current in every armature coil reverses at the moment when the coil passes under brush B_1 or B_2, thus giving a rectangular alternating current, as shown in Fig. 6 as I. At the moment when the alternating energy current is a maximum, an armature coil d midway between two adjacent alternating leads a_1 and a_2 is midway between the brushes B_1 and B_2, as in Fig. 5, and is thus in the middle of its rectangular continuous-current wave, and consequently in this coil the alternating and the rectangular continuous current are in phase with each other, but opposite, as shown in Fig. 6 at I_1 and I, and the actual current is their difference, as shown in Fig. 7.

In successive armature coils the continuous current reverses successively. That is, the rectangular currents flowing in successive armature coils are successively displaced in phase from each other, and since the alternating current is the same in the whole section a_1 a_2 and in phase with the rectangular current in the coil d it becomes more and more out of phase therewith when passing from coil d towards a_1 or a_2, as shown in Figs. 8, 9, 10 and 11, until the maximum phase displacement between alternating and rectangular current is reached at the alternating leads a_1 and a_2, and is equal to π/n.

Thus if $E =$ continuous voltage and $I =$ continuous current, in an armature coil displaced by angle ω from the position d midway between two adjacent leads of the n-phase converter, if the continuous current is $I/2$ for the half period from zero to π the alternating current is

$$[illegible]$$

where

$$[illegible]$$

is the effective value of the alternating current. Thus the actual current in this armature coil is,

$$[illegible]$$

[illegible]

$$[illegible]$$

$$[illegible]$$

[illegible]

$$[illegible]$$

[illegible]

[illegible]

$$[illegible]$$

[illegible]

$$[illegible]$$

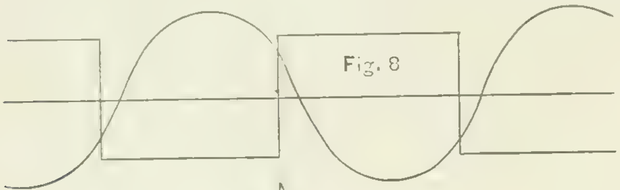


Fig. 8

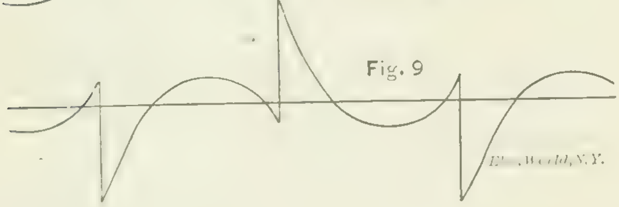


Fig. 9

Integrating over ω from 0 (coil d) to π/n, that is, over the whole phase or section a_1 a_2,

$$\Gamma = \frac{n}{\pi}\int_0^{\frac{\pi}{n}} \Gamma_\omega \, d\,\omega = \frac{8}{n^2 \sin^2 \pi/n} + 1 - \frac{16}{\pi^2}$$

is the ratio of the total energy loss in the armature resistance of an n-phase converter to that of the same machine as direct-current generator at the same output, or the relative armature heating.

Thus, to get the same energy loss in the armature conductors and consequently the same heating of the armature, the current in the converter, and thus its output, can be increased in the proportion $1/\sqrt{\Gamma}$ over that of the direct-current generator.

SUBSTITUTING FOR n NUMERICAL VALUES.

Type	Continuous Current Generator	Single Phase.	Three Phase.	Four Phase.	Six Phase	Twelve Phase	∞ Phase *
n		2	3	4	6	12	
Γ	1.00	0.45	0.225	0.20	0.19	0.187	
Γ_a	1.00	3.00	1.20	0.73	0.42	0.24	0.187
Γ	1.00	1.37	0.555	0.37	0.26	0.20	
Rating by mean armature heating	1.00	0.85	1.34	1.64	1.96	2.24	2.31

* That is, as many collector rings as commutator segments.

In these values the small energy current supplying the losses in the converter is neglected.

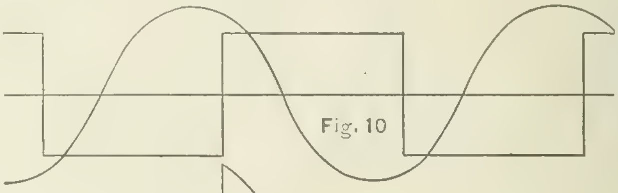


Fig. 10

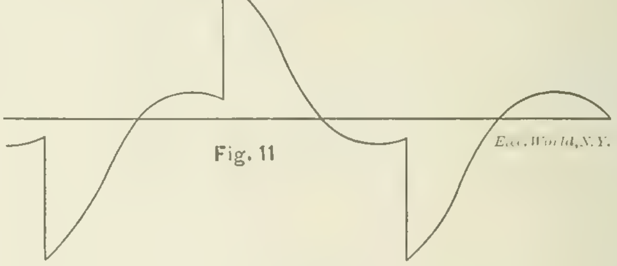


Fig. 11

Assuming this current $= \rho I^1$, where I^1 equals the energy current corresponding to continuous current (where $\rho = 0.04$ when assuming 4 per cent. loss in mechanical and molecular magnetic friction), the total alternating energy current is:

$$I_1^1 = I^1 (1 + \rho)$$

and the resultant current

$$[illegible]$$

$$[illegible]$$

thus its effective value:

$$[illegible]$$

$$[illegible]$$

hence,

$$[illegible]$$

$$[illegible]$$

[illegible]

$$[illegible]$$

$$[illegible]$$

$$[illegible]$$

[illegible] relative current heating, Γ^1, [illegible] by assuming $\rho = 0.04$.

Type.	Continuous Current.	Single Phase.	Three Phase.	Four Phase.	Six Phase.	Twelve Phase.	∞ Phase.
Γ =	1.00	1.37	0.555	0.37	0.26	0.20	0.187
Γ^1 =	1.00	1.457	0.585	0.385	0.267	0.201	0.187
Rating	1.00	0.825	1.31	1.61	1.94	2.24	2.31

If a phase displacement exists between current and e. m. f. in the converter, the current can be resolved into an energy component in phase with the e. m. f. and a wattless component in quadrature therewith.

The loss of power in a resistance due to an alternating curent is equal to the sum of the losses due to the two components, the energy current and the wattless current, and thus if a phase displacement is produced in a converter the loss of power due to the wattless current has to be added to the loss of power due to the energy current as discussed and recorded in above given tables.

Assuming, for instance, a wattless current at full load (leading or lagging) of 30 per cent. of full load current, the additional energy loss in the armature corresponding thereto amounts to $0.3^2 = 0.09$ of that of the same machine as a direct-current generator. Adding this to the values given in above tables gives a relative heating of the different types of machines, and permissible rating (as based on armature heating) as follows:

30 PER CENT. WATTLESS CURRENT.

Type.	Continuous Current.	Single Phase.	Three Phase.	Four Phase.	Six Phase.	Twelve Phase.	∞ Phase.
Γ^1 =	1.00	1.475	0.585	0.385	0.267	0.201	0.276
Γ_0 =	1.00	1.565	0.675	0.475	0.357	0.291	0.277
Rating	1.00	0.80	1.22	1.45	1.67	1.85	1.90

5. ARMATURE REACTION.

The armature reaction of the polyphase converter is the resultant of the direct-current and the alternating-current reactions. If the commutator brushes are set at right angles to the field poles or without lead or lag, as is usually done in converters, the continuous-current armature reaction consists in a polarization in quadrature behind the field magnetism. The armature reaction due to the energy component of the alternating current in a synchronous motor consists in a polarization in quadrature ahead of the field magnetism, and thus is opposite to the armature reaction as a continuou-current generator.

Let m be the total number of turns on the bipolar armature of an n-phase converter, and I be the continuous current, then the number of turns in series between the brushes equals $m/2$, hence the total armature ampere turns or polarization equals $m/2$. Since however, these ampere turns are not unidirectional, but distributed over the whole surface of the armature, their resultant is:

$$F = \frac{m\,I}{2}\,\text{avg.}\cos\Big|_{-\frac{\pi}{2}}^{+\frac{\pi}{2}}$$

And since $\text{avg.}\cos\Big|_{-\frac{\pi}{2}}^{+\frac{\pi}{2}} = \frac{2}{\pi}$

$F = m\,I/\pi$ = continuous-current polarization of the converter (or direct-current generator) armature.

In an n-phase converter the number of turns per phase equals m/n. The current per phase or current between two adjacent leads (ring current) is

$$I^1 = \frac{I\sqrt{2}}{n\sin\pi/n}$$

hence the ampere turns per phase are

$$\frac{m\,I^1}{n} = \frac{m\,I\sqrt{2}}{n^2\sin\pi/n}.$$

These ampere turns are distributed over one n-th of the circumference of the armature, and their resultant is thus:

$$F^1 = \frac{m\,I^1}{n}\,\text{avg.}\cos\Big|_{-\frac{\pi}{n}}^{\frac{\pi}{n}}$$

And since $\text{avg.}\cos\Big|_{-\frac{\pi}{n}}^{+\frac{\pi}{n}} = \frac{n}{\pi}\sin\frac{\pi}{n}$

$$F^1 = \frac{m\,I\sqrt{2}}{\pi\,n}$$

is the resultant polarization in effective ampere turns of one phase of the converter.

Thus the total polarization of all n-phases* is

$$F_0 = \frac{n\sqrt{2}}{2}\,F^1 = \frac{m\,I}{\pi}$$

that is, the polarization of the converter due to the alternating energy current is equal to that of the continuous current, but opposite thereto, and their resultant armature reaction is thus equal to zero. The same is obviously the case in an "inverted converter," that is, a machine changing from continuous to alternating current.

Different, however, are the conditions in a single-phase converter. At the instant when the alternating current equals zero the full continuous-current reaction exists.

At the instant when the alternating current is a maximum, the reaction is the difference between that of the alternating and of the continuous current, and since the maximum alternating current in the single-phase converter equals twice the continuous current, at this instant the resultant armature reaction is equal but opposite to the continuous-current reaction.

Hence the armature reaction oscillates with twice the frequency of the alternating current, and with full intensity; and since it is in quadrature with the field excitation, tends to shift the magnetic flux rapidly across the field poles, and thereby tends to cause sparking and energy losses. This oscillating reaction is, however, essentially reduced by the damping effect of the magnetic field structure.

Since the resultant main armature reactions neutralize each other in the polyphase converter, there remain only:

1. The armature reaction due to the small energy current required to cover the internal losses of power, which is in quadrature with the field excitation or distorting, but of negligible magnitude;

2. The armature reaction due to the wattless component of alternating current where such exists; and

3. An effect of oscillating nature, which may be called a "higher harmonic of armature reaction."

The continuous current, as a rectangular alternating current in the armature, changes in phase from coil to coil, while the alternating current is the same in the whole section of the armature between adjacent leads.

Thus, while the resultant reactions neutralize, a local effect remains, which in its relation to the magnetic field oscillates with a period equal to the time of the motion of the armature through the angle between adjacent alternating leads, that is, double frequency in a single-phase converter (in which it is equal in magnitude to the continuous-current reaction, and is the oscillating armature reaction discussed above), triple frequency in a three-phase converter, and quadruple frequency in a four-phase converter.

The amplitude of this oscillation in a polyphase converter is small, and its influence upon the magnetic field is usually negligible, due to the damping effect of the field winding, which acts like a short-circuit for an oscillation of magnetism.

A polyphase converter on unbalanced circuit can be considered as a combination of a balanced polyphase and a single-phase converter, and since even single-phase converters operate fairly satisfactorily, the effect of unbalanced circuits on the polyphase converter is comparatively small.

Since the armature reaction of the continuous current and of the alternating current in the converter neutralize each other, no change of field excitation is required in the converter with changes of load. Furthermore, while in a continuous-current generator the armature reaction at given field strength is limited by the distortion of the field caused thereby, this limitation does not exist in a converter, and a much greater armature reaction can be safely used in converters than in continuous-current generators, the distortion being absent in the former.

Since the armature heating is relatively small, the practical limit of overload capacity of a converter is that due to the commutator, and is usually far higher than in a continuous-current generator, since the distortion of field which causes sparking on the commutator under overloads in a continuous-current generator is absent in a converter.

The theoretical limit of overload, that is, the overload at which the converter drops out of step and comes to a standstill, is far beyond reach at steady frequency and constant impressed alternating voltage, while on an alternating circuit of pulsating frequency it obviously depends upon the amplitude and period of the pulsation of frequency.

(To be continued.)

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* "Theory and Calculation of Alternate-Current Phenomena," Steinmetz, p. 354, 1st ed.; p. 369, 2d ed.

The Paris Exposition of 1900.

BY FRANCIS E. DRAKE, DIRECTOR OF MACHINERY AND ELECTRICITY, UNITED STATES COMMISSION.

Though occupying only about one-half the area of the World's Columbian Exposition at Chicago, the Paris Exposition of 1900 will have great opportunity for the satisfactory presentation of the arts of peace. The location of the grounds is practically in the heart of Paris, and, lying as they do, on both sides of the River Seine, they afford an unrivalled opportunity for providing comfortably for great crowds.

The part which machinery and electricity will play in this coming exposition is a more important one than ever assumed by these two great industries in former expositions. In a general way it may be said that but few important changes or improvements will be shown in the service of the Paris exposition over the Columbian exposition of 1893. The French classification, however, is a distinct advance over that of any previous exposition, inasmuch as it provides for the installation of the finished product, together with the machinery and processes used in connection therewith. Under this classification collective exhibits will be most successful in presenting to the visitors a clear understanding of the state of the art in that particular industry.

The great service power plant of the exposition will occupy a favorable position in the main group of buildings. It will be installed immediately adjoining the space allotted for the exhibits of electrical and other machinery, and any benefit which might naturally accrue to the builder of machinery installed in the service plant will be accentuated and made more apparent by reason of its being located in close proximity to the exhibits not offered for regular service. The capacity of the boiler plant for the service of the exposition will be approximately 20,000 horse-power. The two plants will feed into one general system of mains and distributers, and either, or both, may be utilized at the same time, as occasion requires.

The engines and generators for this power plant will be placed in close proximity to the underground subways, carrying the steam and other mains. Each power unit must be of the direct-connected type, the generator armature being mounted direct upon the extended shaft of the engine. The designation of these units, according to the exposition nomenclature, will be "Electrogene Groups." It is proposed by the administration to divide the total power comprised in the various electrogene groups required, equally among the French and foreign builders. From present indications, manufacturers will offer electrogene groups largely in excess of the requirements of the exposition. No actual contracts have as yet been made for them for either the French or foreign sections, except a nominal arrangement entered into some time ago with three German manufacturers, who desire to furnish an aggregate approximating 5000 horse-power.

The location of the electrogene groups operating as generating units for the power plant will be within the regular exhibit space devoted to the Department of Machinery and Electricity. Electricity will furnish the motive power for the operation of an intramural elevated railway, which will encircle the Champs de Mars, pass in front of the main palace on the Esplanade des Invalides, and along the Quai d'Orsay from the Bridge of Alexander III. to the Eiffel Tower.

Not all of the main palaces will be lighted at night. The Palace of Manufacturers, Palace of Electricity, Palace of Transportation and Civil Engineering, Palace of Textiles, and perhaps one or two other palaces will be well illuminated every evening. The great Hall of Fêtes, which occupies a central position in the Palace of Agriculture, will be illuminated brilliantly whenever in use for evening gatherings. The Palace of Education and Liberal Arts, Palace of Mines and Metallurgy, Palace of Chemical Industries, and Palace of Agriculture will not be equipped for evening illumination.

It is the Palace of Electricity to which all eyes will naturally turn at night, and, as its main façade reaches across the entire width of [illegible] op-portunity will be afforded for the attractive treatment of the archi-[illegible] series of cascades, all to be effectively illuminated by vari-colored lights, thus making a most brilliant and striking attraction for the [illegible] power plant for condensing purposes is to be discharged through the Chateau d'Eau, and the cascades surrounding it, thus making use of this water in artistic effects, and obviating the necessity of pumping from the river another great volume of water simply for fountain use.

There will be no regular compressed-air service established by the exposition administration, but arrangements will be made with the City Public Service Company whereby compressed-air mains will be brought into the exposition buildings and air service offered to the exhibitors at the regular city rates, less 10 per cent.

The administration has considered well the necessity for making the gallery space in the various palaces as accessible to the public as possible, and provision has been made not only for numerous vertical elevators of steam, electric or hydraulic type, but for a large number of inclined elevating ways, or "rolling carpets," to carry the passengers easily and speedily from the crowded ground floor to the galleries, where many interesting and instructive exhibits will be installed. The limited ground area at this exposition makes necessary the husbanding of all available gallery space. On the Champs de Mars there will be installed fourteen of these elevators, or "escaladers," which will have a capacity each of not less than three thousand passengers per hour. A fee not exceeding 2 cents for each passenger will be charged for the use of these "escaladers."

The exhibit of automobiles, or horseless carriages, trolley cars, railway trains, etc., will be made in the special pavilions provided at the annex in the park at Vincennes. A special track will be provided there for trials and tests, and for the daily speeding of the various automobiles, bicycles, tricycles, etc. The electric vehicle is at present very popular in Paris, and will no doubt come in for its full share of interest.

In addition to the contemporary exposition, the official classification provides for the installation of a retrospective exhibit which shall present a historical view of the progress in all branches of industry during this century. The department of electricity has been specially favored in this regard by the construction of a special Salon d'Honneur within the Palace of Electricity, where the retrospective exhibit covering the great field of electricity may be properly undertaken, and where the personal exhibits of the great inventors of the century, and the collective exhibits of associations or individuals may, in their several ways, illustrate the evolution and advance of science.

For the information of those interested in the organization of the technical service under the director-general of exploitation it is desirable to state that the mechanical installations will be under the immediate direction of Monsieur Ch. Bourdon, professor of the Central School of Arts and Manufactures. The work of this departments falls under two distinct categories. The first relates to the execution of the necessary installations for motive power, and may be subdivided as follows:

(a)

PRODUCTION OF STEAM.

1st, Installation of Boilers,

2d, Construction of Flues and Chimneys.

(b)

DISTRIBUTION OF WATER AND STEAM.

1st, Construction of Subways,

2d, Installation of Steam Mains, Etc.

(c)

PRODUCTION OF POWER.

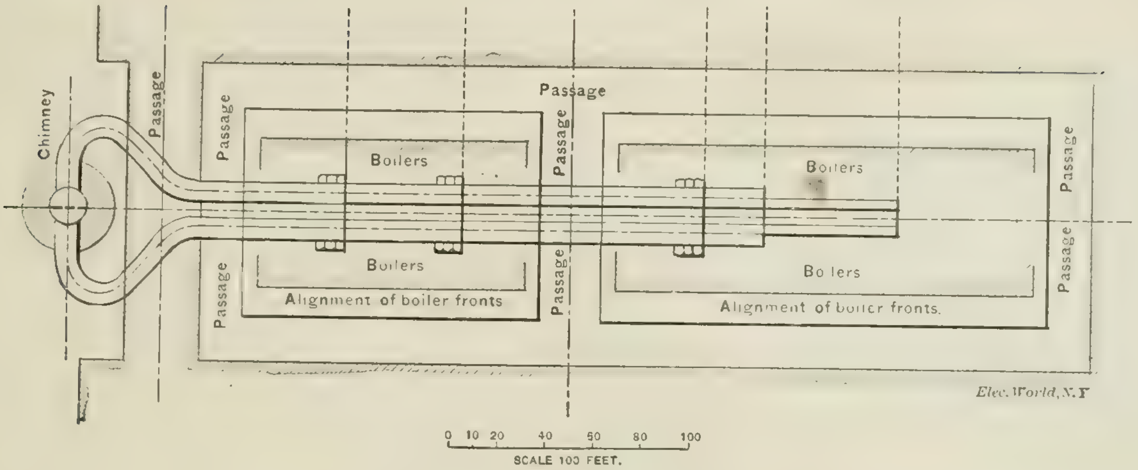
Installation of Electrogene Groups.

The distribution of motive power is practically assigned to the service of electric installations.

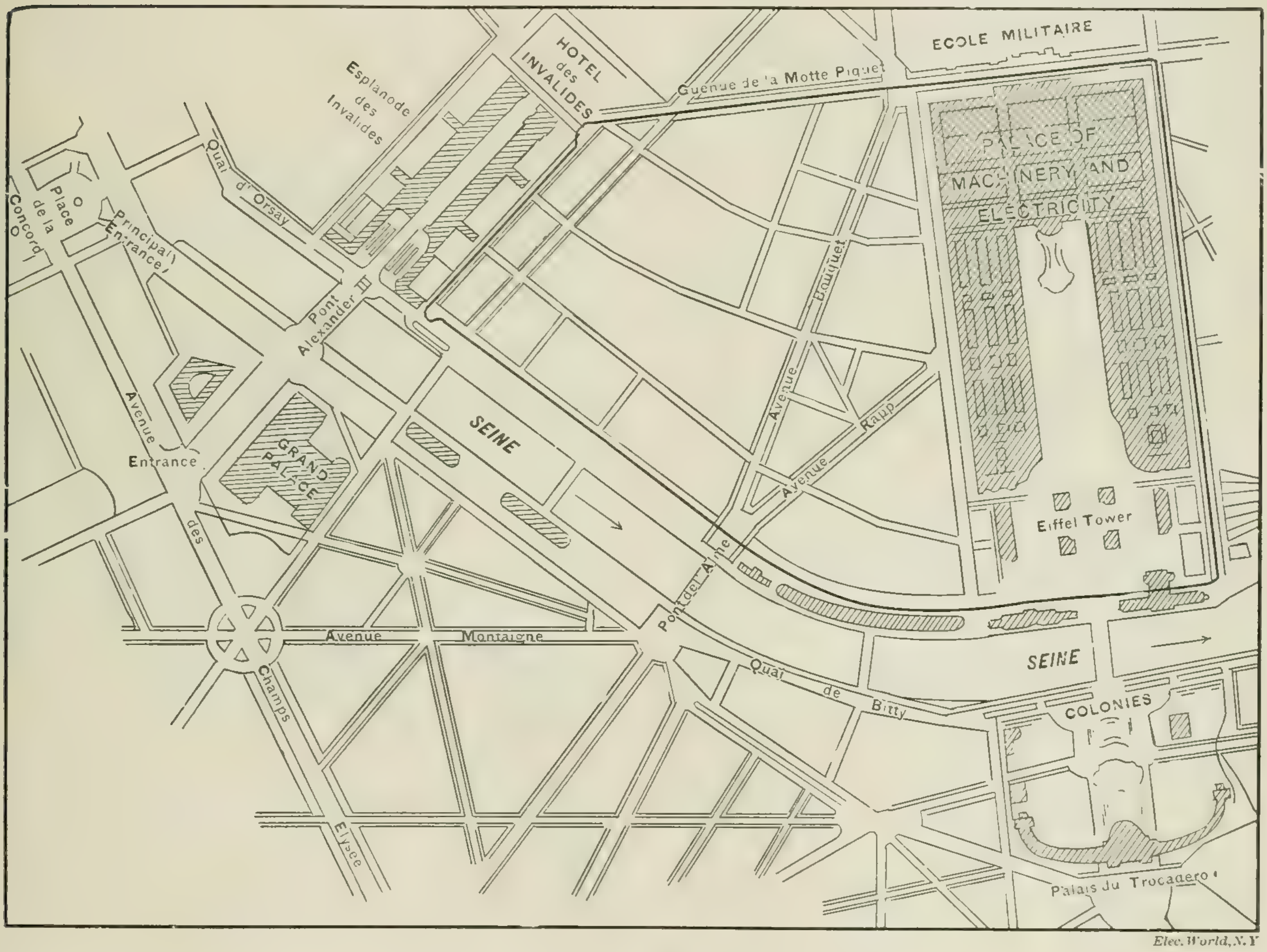
The work under the second category is of an administrative order, and especially concerns the general conditions of exploitation of the boilers and electrogene groups and such other apparatus as is required for the furnishing of the steam for power service.

The total mechanical power furnished will be in the neighborhood of 20,000 horse-power, of which 15,000 horse-power will be for electric lighting and 5000 horse-power for motor service. These figures, while not absolutely correct, are those used by the administration as the basis of the installation.

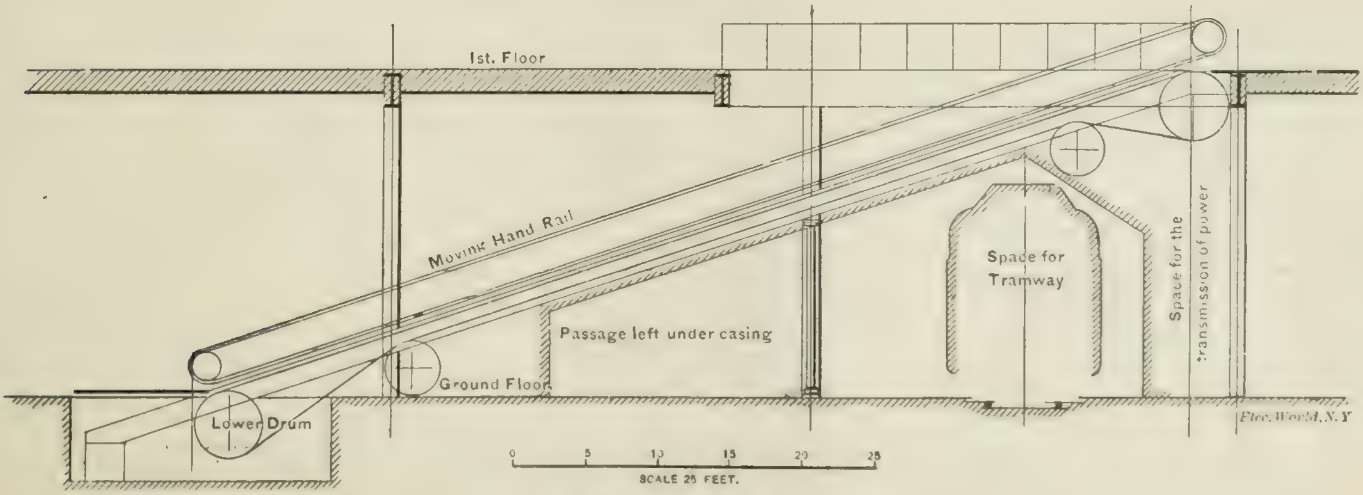
In the two power plants the boilers will be placed in two lines of batteries, with the boilers back to back. Ample space for general circulation of the public has been provided. The controlling minds of this great undertaking have not lost sight of the artistic side of



THE ARRANGEMENT OF BOILERS, FLUES AND STACKS.



A PLAN OF THE GROUNDS.



THE INCLINED ELEVATOR.

questions surrounding the service power plant, and in the construction of the chimneys for the two boiler plants ample provision has been made for the æsthetic treatment of the exterior of the towering stacks which will conduct the gas from the furnaces.

In appropriating funds for the power plant the administration has, upon the advice of the technical committee, provided a minimum sum, which may be said to be only about one-third of the allowance made for the use of power units at the Columbian Exposition of 1893. The great commercial rivalry between the principal nations of Europe has been a factor in determining the course of the administration. Many large concerns would have granted the use of engines and dynamos during the period of the exposition without charge, providing advantageous arrangement of space, etc., could have been assured them. It was after mature deliberation, however, that the authorities settled upon a very nominal compensation which should apply alike to French and foreign manufacturers.

A new feature of the exposition service is the "escalader," an inclined elevating way, constructed in the form of an endless carpet or belt, propelled by a drum at one end. No former exposition has made such generous provisions for means of carrying the public to the galleries, and as the typical "escalader" has been so recently brought into public use, nearly every one in the commercial world will be anxious to see the results obtained with it. The extent to which the elevating stairway may be successfully used can scarcely be estimated at this time. They are safe, easily installed, simple to operate, and have a capacity far in excess of vertical elevators so far as transportation from floor to floor of large crowds is concerned. Such devices have long been sought for large stores, elevated railway stations, etc. It may, therefore, be of interest to many to read the general programme for the competition open to French constructors for the large number of "escaladers" required. Privilege has been granted the Commissioner-General for the United States to install a working exhibit of one or more of these "inclines," in or near some United States section.

The Electromotive Force of an Asymmetrical Arrangement of Cells.

BY WM. A. LUBY.

Given an asymmetrical multiple-series arrangement of cells, each having an internal resistance, r, and a constant e. m. f., e. Let the number of series-groups 1, 2, 3, etc., in parallel with each other, be s, and the number of cells in each series-groups be n_1, n_2, n_3, etc. Further let the terminals be connected through an external resistance R. Then we can obtain an expression for the e. m. f. between the terminals, which becomes independent of r and R on open circuit.

Let c_1, c_2, c_3 and c_4 be the currents flowing in the paths numbered respectively 1, 2, 3 and 4. Then Kirchhoff's laws give the following equations:

$$n_1 r c_1 + R c_4 = n_1 e \qquad (1)$$

$$n_2 r c_2 + R c_4 = n_2 e \qquad (2)$$

$$n_3 r c_3 + R c_4 = n_3 e \qquad (3)$$

$$c_1 + c_2 + c_3 - c_4 = 0 \qquad (4)$$

The expression:

$$\frac{\begin{vmatrix} n_1 r & 0 & 0 & n_1 e \\ 0 & n_2 r & 0 & n_2 e \\ 0 & 0 & n_3 r & n_3 e \\ 1 & 1 & 1 & 0 \end{vmatrix}}{\begin{vmatrix} n_1 r & 0 & 0 & R \\ 0 & n_2 r & 0 & R \\ 0 & 0 & n_3 r & R \\ 1 & 1 & 1 & -1 \end{vmatrix}}, \qquad (5)$$

[illegible]

$$\frac{3 r^2 n_1 n_2 n_3 e}{[illegible]} \qquad (6)$$

[illegible]

$$E = \frac{3\, n_1 n_2 n_3 e}{n_1 n_2 + n_2 n_3 + n_3 n_1 + \frac{n_1 n_2 n_3 r}{R}} \qquad (7)$$

[illegible] When R becomes very large $\frac{n_1 n_2 n_3 r}{R}$ becomes inconsiderable and on open circuit, when R = infinity, zero.

It can be seen in the simplification of the determinants (5) that the numerical coefficient of (6) 3 will always be equal to s, the number of series groups, the numerator of the expression being

$$s\, e\, (n^1\, n^2\, n^3 \ldots\ldots\, n_p)$$

and the denominator being the sum of the following numbers:

$$(n_1\, n_2\, n_3 \ldots n_p)\frac{r}{R}$$

$$(n_2\, n_3\, n_4 \ldots\ldots\ldots n_{p-1}\, n_p)$$

$$(n_1\, n_3\, n_4 \ldots\ldots\ldots n_{p-1}\, n_p)$$

$$(n_1\, n_2\, n_4 \ldots\ldots\ldots n_{p-1}\, n_p)$$

$$\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots$$

$$\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots$$

$$(n_1\, n_2\, n_3\, n_4 \ldots\ldots n_{p-2}\, n_p)$$

$$(n_1\, n_2\, n_3\, n_4 \ldots\ldots n_{p-2}\, n_{p-1})$$

Or when $s = 3$ this becomes

$$\frac{3\, e\, n_1\, n_2\, n_3}{(n_1\, n_2\, n_3)\frac{r}{R} + n_1\, n_2 + n_2\, n_3 + n_3\, n_1}$$

In practice, of course, polarization would affect the results. However, the voltage of a number of Daniell cells, measured by a high resistance voltmeter, would closely agree with the value computed by above formula.

Colonel Eugene Griffin on Modern Science in Warfare.

At the dinner given by officers of the First Regiment of Volunteer Engineers in honor of their colonel, Eugene Griffin, the latter made an address, outlining the history of the regiment during the late war, from which the following remarks of interest concerning the work during hostilities of engineers in general have been quoted:

Col. Eugene Griffin.

"However necessary it may have been to prove the value of engineer troops under the ordinary conditions of modern warfare, every military man would have recognized the necessity and value of engineers in siege operations. The opportunity would have been offered us to introduce modern engineering methods and to change in many ways the traditional methods for the 'attack of fortified places.' Searchlights would have prevented sorties, and electric motors would have played no small part in the trenches. Hospitals would have been lighted by electricity and cooled by fan motors. The wounded on the battlefield would have been found at night by the aid of searchlights, and the surgeons would have operated in field hospitals by the aid of the electric light.

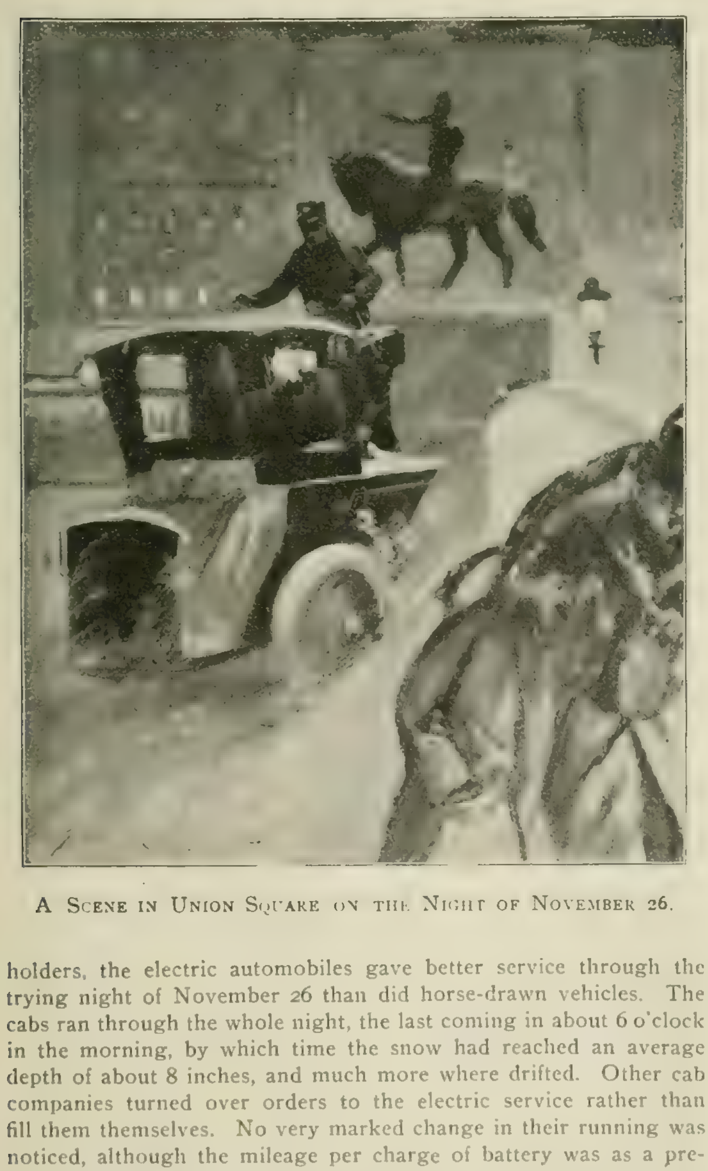
"The whole modern development of electricity has taken place since the last great war, that between the Turks and Russians in 1878.

"In other branches of engineering great progress has been made. Modern high explosives are more powerful, easier and safer to handle, and, therefore, more useful for many purposes. The development in the use of nickel steel, Harveyized plates, and other forms of defensive armor for battleships would have been applied to modern siege rollers and trench defenses, and it is almost certain that the siege of Havana, under the conditions now existing, would have gone down to history as marking a new era in the art of war, a change from the old conditions, brought about mainly by the engi neers. But it was not to be so. Cervera did not wait. He made his sally, was destroyed; Toral surrendered, and the war was over.

"We have had our experience, which I hope will not be without value to each and all of us, and which, I believe, has taught some useful lessons. It is my deliberate judgment that engineers, including tradesmen, will make better soldiers than any other class of men, and by soldiers I mean all that the word implies—men trained in drill and markmanship, able to care for themselves in the field, and to make long marches and to meet the enemy under all conditions, either offensively or defensively. The very nature of the training and daily lives of carpenters, blacksmiths, plumbers, lumbermen, railroad men, steam engineers, electricians' masons, etc., is a preparation for the life of the soldier. Moreover, we found that many of these men who had no intention of volunteering in the ordinary State regiments hastened to join an engineer regiment raised by the United States under a special act of Congress. This is another important fact that should not be forgotten."

Electrical Vehicles in the Recent Storm.

The recent severe snowstorm in New York city gave the first opportunity for observing the behavior under trying climatic conditions of the cabs and broughams operated by the Electric Vehicle Company. To the surprise of even some of their most staunch upholders, the electric automobiles gave better service through the trying night of November 26 than did horse-drawn vehicles. The cabs ran through the whole night, the last coming in about 6 o'clock in the morning, by which time the snow had reached an average depth of about 8 inches, and much more where drifted. Other cab companies turned over orders to the electric service rather than fill them themselves. No very marked change in their running was noticed, although the mileage per charge of battery was as a precautionary measure greatly reduced, the vehicles being ordered in for fresh charges after covering ten or twelve miles. The ease with which they ran is probably due to the large pneumatic tires, 5 inches in diameter, with which they are fitted, which give a large bearing surface and reduce the tendency to cut deeply into the snow. The accompanying illustration is a reproduction of a drawing by B. West Clinedinst, made for "Leslie's Weekly," to illustrate this rather remarkable feature of the storm



A Scene in Union Square on the Night of November 26.

An Ampere Balance.*

BY PROF. W. E. AYRTON AND PROF. J. V. JONES.

The report of the Committee on Electrical Standards for 1897 ended with the following paragraph: "It thus appears to be a matter of urgent importance that a redetermination of the electrochemical equivalent of silver should be made, and that the general question of the absolute measurement of electric currents should be investigated. . . ." This work we were asked by the committee to carry out, and a grant of £75 was voted in its aid. We were thus led to examine into the methods which had been employed by Lord Rayleigh, Professor Mascart and others, for determining the absolute value of a current, as well as to consider some other methods which have not, as far as we know, been hitherto used.

After much consideration we decided to adopt a form of apparatus which, while generally resembling the type employed by some previous experimenters, possessed certain important differences, and, before expending any part of the grant of £75 to construct, without expense to the British Association, the following preliminary ampere balance:

On a vertical cylinder about 17 inches high and 6.8 inches in diameter we wound two coils, about 5 inches in height, separated by an axial distance of 5 inches. The coils consisted each of a *single* layer of about 170 convolutions of wire, and were wound in opposite directions. From the beam of a balance there was suspended, inside this cylinder, a light bobbin about 4 inches in diameter, on which was wound a coil about 10 inches long, consisting of a *single* layer of 360 convolutions, and the whole apparatus was so adjusted that when the beam of the balance was horizontal the inner and outer coils were coaxial and the top and bottom of the inner suspended coil were respectively in the mean planes of the outer stationary coils.

This arrangement was adopted because with coils consisting of only one layer the geometrical dimensions could be accurately determined, and because the shapes of the coils lent themselves to the use of the convenient formula, readily expressible in elliptic integrals, for the force, F, between a uniform cylindrical current sheet and a coaxial helix, viz:

$$F = r\, r_h\, (M_1 - M_2),$$

where r is the current per unit length of the current sheet, r_h the current in the helix, and M_1 and M_2 the coefficients of mutual induction of the helix and the circular ends of the current sheet.[1]

The value of a particular current of about 0.63 ampere having been determined *absolutely* by means of this apparatus, the rate at which it would deposit silver under specified conditions was ascertained indirectly by observing its silver value on a Kelvin balance, which had been kept screwed down in a fixed position for several years past, and which had been calibrated many times during that period by reference to the silver voltameter.

The result of this preliminary investigation showed that the silver value of the *true* ampere was so nearly equal to the reputed value, viz., 1.118 milligrammes per second, as to require the use of an apparatus still more perfectly constructed, and therefore of a much more expensive character to enable the error, if any, in this value to be ascertained with accuracy.

We, therefore, started on the design of the instrument, of which we now submit the working drawings, and for the future construction of which we would ask for a grant of £300, including the unexpended grant of £75 voted last year.[2] And we anticipate that this new piece of apparatus may prove worthy of constituting a national ampere balance, the counterpoise weight for which will be determined purely by calculations based on the dimensions of the instrument, the number of convolutions of wire in the three coils, and the value of the acceleration of gravity at the place where the instrument may be permanently set up. In this particular it will differ entirely from the "Board of Trade Ampere Standard, Verified 1894," which has had its counterpoise weight adjusted so that the beam is horizontal when a current passes through the instrument, which will deposit *exactly* 1.118 milligrammes of silver per second under specified conditions. In fact, the proposed ampere balance and the existing ampere standard will differ exactly in the same way as do a Lorenz apparatus and the "Board of Trade Ohm Standard, Verified 1894."

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*Paper read before the British Association

[1] Proceedings of the Royal Society, Vol 63.

[2] This grant of £300 has since been made.

Practical Points in Street Railway Engineering. *

BY W. A. HARDING.

It was suggested to me that rather than present to you a paper full of data, etc., that I should call your attention to the different points of interest and problems that are met with in practical street railway work, so you could start a discussion and give to each other your personal experiences.

First, I must call your attention to the fact that it is impossible to make any arbitrary laws for the conduct and management of street railway property, conditions altering under various circumstances; financial conditions, condition of travel, nature of ground, locality, speed and climatic conditions, all require different managements and different problems to solve.

A road running through a very thickly populated district with good roads, etc., has the cost of operation at a minimum, and can afford to spend a few thousand dollars to raise low joints, put in plenty of feed wires and keep cars well painted.

But take a road running out far into the suburbs and sparsely settled districts; to put up feed wire, keep up voltage as it ought to be and to raise low joints would bankrupt the company, and as for painting cars, it is out of the question. Many a country road runs through marshy land, making low joints the rule. The mud and water may be thrown all over the cars, and if this is of an alkaline nature, you can easily see what becomes of your paint. Motors that under ordinary conditions are called water-tight will here fill with water unless extreme measures are taken to provide against it.

The choosing of a suitable car and equipment in the past consisted of buying car, truck and motor, without any reference as to their suitability to each other, and car or truck would have to be rebuilt to fit. I remember a company that bought long 36-foot combination cars, closed in the centre and open, with seats, at each end, having two massive four-wheel centre pivot trucks, and put in two 15-hp motors. Grades were from 3 to 12 per cent. It was only a short time before the motors were completely roasted. The company then went to the expense of cutting the body down to two-thirds size, taking one truck and lengthening out to 7 feet and putting in two 15-hp motors. The equipment now ran very satisfactorily, but owing to poor construction of the car body, they would "hog-back" in a very short time, necessitating constant renewals of subsills, etc.

Now what cars shall we use? Take a supposed case. For winter the public demands a five-minute schedule, and the average load is from twenty-five to thirty-five people, during rush hours say 100 people per load. We do not want to haul around a large car empty half the day, so we will put on a 22-foot car as large as is advisable for a single truck, with two motors and large and roomy platforms; if in a cold climate, preferably vestibuled. Now, if the cars should be a little crowded, the platform would always accommodate a few. [illegible] one or two trailers could be added for a few hours. If quickness and dispatch in unloading are not the predominating features, or too many transient passengers, a large double-truck trailer car is, in my mind, much the better. They are [illegible] to ride, easier on the track joints, require one conductor in place of two, and can make much faster time.

During the summer the same rule applies, except that when the climate allows open ten-bench cars should replace the closed ones. If travel warrants it, there is still a better field for larger cars (which have side entrances) making less units.

Now, in the suburban districts sometimes the smaller cars will [illegible] you cannot afford [illegible] large cars to advantage. [illegible] the largest seating capacity cars that a satisfactory schedule will warrant. For suburban travel where speed is the main point, [illegible]

[illegible]

without undue oscillation. The same rule applies to tracks for double equipment, only the wheel base should be as short as the motor truck will allow, also allowing for the car to oscillate sideways.

The motors should be carefully chosen for the work to be done. A powerful motor, if put under a light car hauling trailer, will slip the wheels on the track and the car will not make sufficient speed; but if car body, trucks and motor are of sufficient weight to get the best traction, the train will now make faster time. The bearings of the armature should be large and fed from below with wick feed from oil with box above to hold wool waste with additional oil in place of the usual plan of dope. Such bearings should be built outside of the motor frame and also protected by large circular discs to prevent the oil from working into the motor.

The commutator should be made of good drop-forged copper bars, the diameter to be as large as possible. In G. E. 800 we use a bar 1½ inches high. By using soft amber mica between the bars the commutator wears smooth and keeps polished. The number of slots in the armature should be kept as low as possible, it being cheaper to make repairs when four to six coils can be put into one slot; also coils should be machine-wound, a thing not possible with all our armatures now.

A motor, if carefully kept clean, the brushes properly treated and changed each night and not abused unnecessarily by the crew, will last without rewinding for from four to five years, and even longer. With proper attention to brushes, commutators of the modern type should wear not more than one-eighth inch per year.

How are we to get the voltage raised at a distant point of the line where it is required for only a few weeks in a year? The cost to install a storage battery or booster, or to put up more wire, is all out of proportion to the returns. Take one of your dynamos with a capacity equal to the load demanded at this particular point. Change your two switches to double throw. When thrown up all connections are for running as a dynamo on the switchboard in the usual way. By throwing blades down, the + of machine is thrown onto an auxiliary bus bar and the — onto the positive main at the switchboard, making this particular dynamo in series with the station. The equalizing switch is left open; the field wires are not altered. The dynamo is now run at whatever voltage you need, may be 200 or 300. The feeder that goes out to the point of the line where you wish voltage raised is now thrown onto this booster, as we must now call it. Again, if the feeders are properly adjusted, a switch and fuse can be put in between the circuit breakers of several sections and a whole district raised in voltage, if only for a few hours during rush time. As the station usually holds a reserve unit, there is no additional outlay or expense needed. In case of a breakdown or disabled generating unit, the boosting would be discontinued until such time as repairs were made.

That Aluminum Arc Lamp.

An announcement has been sent out to the trade by Mr. James Byrne, 95 High Holborn, London, that he has purchased English patent No. 23,138 of 1898, issued to Peter Spies, for the carbonless arc lamp, vague rumors of which have already reached this country. Another grain or two of information is contained in the circular, which reads as follows: "My arc lamp is simply an air-tight glass globe, from which the air has been exhausted. Inside are two L-shaped aluminum arms tipped with platinum, which take the place of the old-fashioned carbon, and are regulated by a pendulum. The lamp does not require to be suspended perpendicularly. In fact, it is intended to be fixed to project horizontally. It throws no shadows, and reduces the expenses of maintenance to a minimum. The wasting of the aluminum arms, owing to their being enclosed in the airless globe, is so small that only a yearly replacement becomes necessary."

Hoot Mon!

There is a proposal on foot for the utilization of an available water power in the Scottish Highlands, the scheme being promoted by the Highland Water Power Syndicate. The plan calls for an artificial waterway from Loch Ericht, near Dalwhinnie, via Loch [illegible] and other lochs to Loch Leven, near Ballachulish. A head of 1100 feet will be obtained, which will be utilized in two falls of [illegible] feet each. With water also taken from another source it is expected that some 27,000 horse power can be obtained.

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DIGEST OF CURRENT ELECTRICAL LITERATURE AMERICAN AND FOREIGN

By Carl Hering.

Dynamos, Motors and Transformers.

ROTARY TRANSFORMERS. S. P. Thompson. Lond. "Elec. Eng.," "Elec." and "Elec. Rev.," Nov. 25.—The continuation of the reprint of his paper (see "Digest" last week). He describes briefly the device of Heldt for changing the awkward percentage numbers which exist between the voltages of the two sides of such a converter; he introduces a second ring around which the alternating currents flow in passing from the armature to the collecting brushes, and in these windings the alternating voltage is brought up from 70.7 to 100, thus making the voltages of the continuous and alternating currents alike. This is equivalent to using a mixed star and delta winding, the latter constituting the true converter winding. Another solution exists in altering the distribution or concentration of the magnetic field at the poles, as any concentration of the field will alter the conversion ratio; a machine of this kind is described and illustrated. He then quotes from Kapp's recent paper on the question of the influence of changes in the distribution of the flux on the conversion ratio and on the efficiency; also from his treatment of the question of the limit of output for equal heating, different pole breadths and different angles of phase displacement.

FREQUENCY AND EFFICIENCY OF TRANSFORMERS. —Lond. "Elec. Eng.," Nov. 25.—Answers to the question, what difference is made in the efficiency of a transformer by raising the frequency from 50 to 100?

BRAKING INDUCTION MOTORS. Eichberg. "Elek. Zeit.," Nov. 24.—A long article in which he discusses the braking action of such motors, with special reference to its application for traction purposes. There are two conditions when the multiphase induction motor will absorb mechanical energy; the first is an oversynchronous speed and the other a counter rotation of the armature against the field. The condition of the braking is, either that the number of revolutions of the motor is greater than the number of revolutions of the field, or that the latter is negative compared to the former; the first is accomplished by reducing the number of revolutions of the field—that is, by reducing the frequency or increasing the number of poles; the second condition is fulfilled by changing the direction of revolution of the field. It is therefore possible to brake in three different ways—to excite by a current of a lower frequency; to increase the number of poles per phase; to reverse the direction of the revolving field by changing the connections; several of these may be combined. The braking is not equivalent in all these cases. He then discusses them mathematically at considerable length, giving formulas for the braking action, efficiency, etc.; in the first and second case the braking action will be a useful one, as the work performed is given off externally; the motor becomes a generator; but it is quite different in the third case, in which the braking energy is set free in the armature, heating it. In his discussion he shows a number of diagrams from which it is possible by direct reading and some calculation to find the efficiency, the duration of the braking action and the amount of energy returned. (For another article on a similar subject see "Digest" last week.)

STARTING AND REGULATING MOTORS. Guilbert. "L'Eclairage Elec.," Nov. 19.—Illustrated descriptions taken from patent specifications. The method of Egger, which was described some time ago in a German journal, is fully described with the aid of a number of diagrams.

Lights and Lighting.

ALLEGED REVOLUTION IN ARC LAMPS.—"Elek. Anz.," Nov. 24.—A note taken from an English daily paper on the new form of lamp devised by Spies. These lamps are claimed to require no recarboning and no other attention for a period of twelve months, except an occasional cleaning; they contain no mechanism like that of the usual arc lamp. The lamp consists of a glass vacuum bulb which contains two L-shaped arms of aluminum provided with platinum points, which are "regulated by a pendulum," and which are said to take the place of the usual carbons; the lamp need not be vertical; it throws no shadow, and the consumption of the aluminum arms is so slight that they need be renewed only once a year. No further details are given.

ELECTRIC FOUNTAIN. Levy. "El'ty," Dec. 7.—A reprint of a short, illustrated article on electric fountains, with special reference to the one in the Brooklyn park.

Power.

TRANSMISSION OF POWER. Forbes. Lond. "Elec.," Nov. 25.—A brief editorial mention of a recent Society of Arts paper, referring to his "simple financial transactions which copper merchants or others would willingly make, and which may avoid the huge capital hitherto required by those who transmit the power, and will increase the dividends on moneys spent on transmission"; in an example the net income is shown to be increased from 9 to 40 per cent. The financial scheme referred to is that the capital should be divided into two parts, the major part, represented by copper, is a 4 per cent. mortgage on the transmission line, while the smaller part, spent on hydraulic and electric machinery, will then produce a net income equal to 40 per cent. of this part of the capital after the interest on the mortgage has been paid. Editorially it is thought that this scheme is like the one known as "robbing Peter to pay Paul," with an element of uncertainty as to who is Peter and who is Paul.

TRANSMISSION OF POWER. Siemens. "El'ty," Dec. 7.—The beginning of a reprint of his Brit. Assn. paper which was noticed in the "Digest" Oct. 15.

POWER TRANSMISSION FOR MINING. Esson. "Eng. and Min. Jour.," Dec. 3; and "El'ty," Dec. 7.—A reprint of the abstract of his paper noticed in the "Digest" last week.

CRANES.—"El'ty," Dec. 7.—A reprint, without the illustrations, of the article noticed in the "Digest" last week.

SHOREDITCH DESTRUCTOR PLANT.—"El'ty," Dec. 7.—Extracts from the recent reports published in the English papers.

Traction.

ELFCTRICITY FOR HEAVY RAILROAD WORK.—"Elek. Anz.," Nov. 20; abstracted from "L'Elettricita."—A brief description of the project of Ganz & Co. for the line from Lecco to Sondrio and Chiavenna, Italy, a distance of 63.6 miles, including grades of 2 per cent. In an introduction the advantages of the multiphase motors for such lines are pointed out; they are more simple to operate, involve a cheaper installation and permit of a simple reduction of the voltage with stationary transformers; the question of the voltage is the deciding one in the application of electricity on railroads. It has been shown that alternating currents are dangerous at a much lower voltage than is generally supposed, and therefore installations at 2,000 to 3,000 volts should not be considered under a different category than those for 400 and 500 volts which are in daily use. The present line will be for both passengers and freight; at times of dense traffic the number of trains will be increased, instead of the number of cars per train. The passenger trains will have a maximum weight of 65 tons, consisting of a motor-car and one or two trailers; the freight trains will be drawn by a motor-car with a pull of 5000 kg. and can have a weight of 200 tons; the speed of the passenger trains will vary between 36 and 18 miles an hour, and of the freight trains between 18 and 9 miles. A motor-car will have four motors, two of which will operate continuously; the high-voltage current will pass through the stationary field; the two other motors are only used when the speed is to be reduced to one-half, in which case the movable armatures will be supplied from the first two motors, the regulating resistance being inserted in the stationary winding of the second motors; with this system only low-voltage currents will be used for regulating the speed. There are no more difficulties in the installation of such motors than there are with the usual transformers. The primary voltage is to be 15,000 and the voltage on the trolley wires 3000; by a special method not described the wire will be disconnected in case it breaks. Soldering of the wires is not permitted, as all junctions must be made with metallic couples. The current is taken from the wires by means of two rollers on the end of an insulated pole; these are made of aluminum, and have a width and length of about 60 cm; both are held "at their ends by a rectangle" with which are connected two systems of spring contacts for making connections with the line; the first has a tension of 100 kg for high speeds and the other of 10 kg for low speeds. At crossings the wires are on a different level, and the current is broken at the crossings itself. There is a set of trolley wires at each end of the current. The current is generated directly by hydraulic power, at 15,000 volts by means of seventeen alternators in three groups, each of 2000 horse-power maximum, one group acting as reserve.

ELECTRIC RAILWAYS IN AUSTRIA.—"Zeit. fuer Elek.," Nov. 20.—A table for the third quarter of this year, showing the operation of the electric railways in Austria and Hungary.

LIVERPOOL MOTOR VEHICLE TRIALS.—Lond. "Elec. Eng.," Nov. 25.—A mention of the judges' report referring to the trials of last August; it forms a volume of 150 pages in which full details and illustrations are given. The conclusions are reprinted in that notice.

SOME ELEVATED RAILWAY PROBLEMS AND RESULTS.—"St. Ry. Jour.," Dec.—A presentation of the results of electric railway operation in Chicago in comparison with steam elevated railway operation in New York city. The article is fully illustrated with diagrams showing acceleration, speed, distance and power curves, plotted from actual runs on the South Side, Lake Street and Metropolitan elevated railways of Chicago, which, it is claimed, were never before published. The influence of speed upon gross receipts, and of rapid acceleration upon schedule speeds of different systems of motive power, are carefully discussed, and the comparative economy of steam and electricity in this character of service are set forth at length. It is shown that the Manhattan Elevated Railway Company, of New York, could nearly double its present rate of earning power upon both old and new investment should it adopt electricity as a motive power. A description of the Sprague multiple unit system as used in Chicago is given, and it is shown that this system has large possibilities.

SOME FALLACIES REGARDING ELECTROLYSIS. Herrick. "St. R'y Jour.," Dec.—He claims that the danger to water-pipes and other subterranean conductors by the return current is greatly exaggerated, and can always be prevented by proper methods. He first discusses the general subject of electrolysis, and shows that the effect of the flow of current from rails to water-pipes is not to deposit the metal of the rails upon the pipes, but upon the ground adjacent to the rails. This deposit is an iron oxide, which has a high resistance, and its immediate effect is to increase the resistance of the space between the rails and the water-pipes. Potential measurements are therefore not a criterion of electrolysis destruction. Nitrogen is also generated at the water-pipes, and its presence tends to preserve their surface. On the other hand, the flow of current through the soil increases the capillary activity of the latter, attracting water, and so lowers the resistance to a certain extent. As each case requires special consideration, he describes a method of making preliminary tests. He discusses the method for measuring the current flow in a water-pipe, that from the rail to the water-pipes at any point, and the relative value of the rails as return conductors. One method employed to reduce electrolysis is to connect the water-pipes and ground return with a common return feeder of low resistance, and where this is done properly it is a satisfactory solution of the question. Another solution under proper conditions is to introduce insulating "rust" joints in the water-pipes. Electrolysis of lead-covered underground cables can be prevented by connecting their covering to the station by a metallic return.

SURFACE CONTACT SYSTEM AT MONACO.—"Elec. Eng.," Dec. 8.—A brief, illustrated description of this short line, extending from that city to Monte Carlo. The original plans were prepared by the General Electric Company, of this country. The gauge is 3 feet 3 inches; the cars carry thirty-six passengers each; there are six cars in operation at present; the road is 3 miles long, and will ultimately be increased to 6 miles. The contact studs are placed in two parallel rows between the rails, alternating in their position; each of the negative or low-potential series on one side is connected, through a solenoid, to the rails, which form the return circuit; the positive or high potential series on the other side transmits the current from the feeders to the motors; the automatic switches are placed in large chambers containing twenty-two switches, each of which consists of a solenoid, which moves a soft iron core, which actuates an iron plate, carrying three pieces of carbon for making the contacts. A small battery on the car sends a current through the low-potential studs to the rail, through the solenoids, and this energizes them and operates the switches connecting the feeder with the high-potential studs, after which the battery is cut out as the return current serves to energize the magnet. The connections between the cars and the studs are made as usual with long shoes. The studs are 16 feet apart; each switch chamber works forty-five studs, extending over a length of 218 feet; a 500-volt current is used.

CONDUIT CONSTRUCTION.—"St. R'y Jour.," Dec.—The Third Avenue Railway Company, of New York, will install immediately 73.66 miles of electric conduit track, of which 28.5 miles are [illegible] for cable and 45.16 by horses. On the main Third [illegible] the present conduit will be utilized, the One Hundred and Twenty-fifth Street and Tenth Avenue cable line, however, is quite old and will be removed. The construction adopted here and for the new work differs radically from anything heretofore installed. The chief feature of the novelty is in the employment under the track rails of a creosoted yellow-pine timber, 5½ inches wide, 6 inches high, and laid in 30-foot lengths, the object of which [illegible]. The yokes on the new construction [illegible] are made up of three pieces, riveted together, viz., a steel I-beam and two cast-iron side pieces; the [illegible], the track rail is laid in 60-foot lengths, is 9 inches high, and weighs about 107 [illegible] employed.

THE [illegible] ELECTRIC TRAMWAY. [illegible]

THE GLASGOW CORPORATION TRAMWAY.—"St. R'y Jour.," International Edition, Dec.—A fuller description is given of the engines and cars of the Glasgow Corporation, of which a general article was published last month. The engines are of the compound type, and each drives a 200-kw generator. The cars are for the most part single deck and double truck, with a seating capacity of fifty. The lower frame of the car is of steel and the upper framing of ash, with mahogany panels.

THE UNION ELEVATED RAILWAY OF CHICAGO.—"St. Ry. Jour.," Dec.—An extended description with engravings and plans of this power station.

RAILWAY BETWEEN ANDERSON AND MARION, IND.—"St. R'y Jour.," Dec.—This system embraces 80 km and connects a number of the towns in the natural gas belt region. A number of views are given.

TRAMWAYS IN FRANCE.—"St. Ry. Jour.," Dec.—A tabulation from the "Zeit. f. Kleinbahnen" of the French tramways operated by mechanical and animal power, and the gauges employed.

Installations, Systems and Appliances.

SHUNT DYNAMOS IN PARALLEL. Philip. Lond. "Elec.," Nov. 25.—A short article referring more particularly to the explanation of the recent breakdown at Brighton. As is well known, special precautions must be taken when shunt machines of different designs are run in parallel, in order that the e. m. fs. of all the machines (he no doubt means the difference of potential) may fall and rise at the same rate when the load varies; if the adjustments are not made very well, a large increase of load may cause the distribution of it to vary so greatly that some of the dynamos may become motors. A sudden drop in voltage on the bus bars may be due to four causes—by decreasing the resistance between the bus bars, by the breaking of a shunt circuit, by a short circuit in the armature, and by suddenly switching out one dynamo which carried a large part of the load. Each of these is discussed. He supposes in an illustration that there is a short circuit outside of the brushes, but inside of the minimum cut-outs at the bus bars; the armature would then act like the primary of a step-up transformer, of which the shunt windings form the secondary; "the e. m. f. thus set up in the shunt would act so as to lower the potential across the mains, or even possibly reverse it"; it should also increase the armature current of the other machines and weaken their shunt circuits. In order to test the magnitude of this effect he made an experiment with a hedgehog transformer and a battery in connection with a dynamo, and the results show that there is no doubt that the kind of action predicted takes place, although its magnitude in the experiment was but slight. The sudden removing of the armature from the circuit by means of the minimum cut-outs would by itself cause a drop in the bars, and the two effects together may account for the other similar dynamos cutting out, leaving the other two alone on the bars. If the accident at Brighton was not due to a short circuit of the bus bars, but is accounted for by the above facts, the fluctuation in a dynamo's field appears to follow the alteration of the exciting current more rapidly than one would expect.

VOLTAGE REGULATOR IN THREE-WIRE SYSTEM. Del Proposto. "Elek. Anz.," Nov. 24.—The beginning of a translation in abstract of the article noticed in the "Digest" Nov. 26.

SWITCH FOR ACCUMULATORS.—"L'Eclairage Elec.," Nov. 19.—A brief, illustrated description of a method for switching in and out accumulators as the voltage of the charging dynamo rises or falls; the device is made by Guenee & Co.

ELECTRICITY ON A VESSEL.—"L'Elec.," Nov. 26.—A brief description of the electrical equipment of the German steamer Aegir, the electrical equipment of which is said to be very complete.

GAS ENGINE LIGHTING PLANT.—"Elec. Eng.," Dec. 8.—A brief description of the plant in the French Chamber of Deputies in Paris, which is a very large gas engine plant supplying 4610 lamps. A fuller description in a foreign journal was recently referred to in the "Digest."

Wires, Wiring and Conduits.

FIXTURES.—Lond. "Elec. Eng.," Nov. 25.—Reproductions of illustrations of ornamental electroliers from the catalogue of the English General Electric Company.

Electro-Physics and Magnetism.

POLARIZATION AND DISPERSION. Becquerel. "L'Eclairage Elec.," Nov. 19.—A long abstract of an Academy paper on rotary magnetic polarization and abnormal dispersion, with special reference to the new experiment of Macaluso and Corbino.

TOTAL REFLECTION OF ELECTRIC RADIATION. Bose. Lond. "Elec.," Nov. 25.—A reprint of a recent Royal Society paper on the influence of the thickness of air space on total reflection of electric radiation.

COMPONENTS OF HARMONIC WAVES. Stern. "Elek. Zeit.," Nov. 24.—A short article calling attention to an error of a sign in the article by Houston and Kennelly in THE ELEC. WORLD, May 14, on "A Simple Approximate Method of Determining the Harmonic Components of a Graphically Given Complex Harmonic Wave." He praises the method, but states that the error may give rise to others. A suggestion is also made of a modification which would give the result more quickly.

ALTERNATING CURRENT CALCULATIONS. Lyle. Lond.

"Elec.," Nov. 25.—The conclusion of his long serial (see "Digest," Dec. 3). He continues the solution of a number of problems to illustrate his method of making such calculations.

CONTINUOUS CURRENT IN THE ALTERNATING ARC. Eichberg and Kallir. "Zeit. fuer Elek.," Nov. 20.—The beginning of a long abstract of the paper noticed in the "Digest" Nov. 5.

RESEARCH LABORATORY.—Lond. "Elec. Rev.," Nov. 25. —A long editorial on the engineering research laboratory in its relation to the public.

EARTH CURRENTS AND EARTH'S MAGNETISM. Weinstein. "Elek. Zeit.," Nov. 24.—An abstract of a recent paper giving the results of scientific research which has been carried out in Germany. These researches appear to have been very extended, and the present report is in the nature of a summary of the results. The number of records of earth currents which were recorded amounted to more than 2000, and of the earth's magnetism to more than 5000. Some rather interesting polar curves are reproduced, showing the daily horizontal variations in the earth current for four years, and another, their mean; these all show a characteristic similarity. In both intensity and direction of the earth current there was found to be a remarkable regularity of the variations during the day; it is greatest about noon and least at night, but it varies in a wave-like way, and there is a peculiar reversal; the irregularity is greater at night than during the day, and the currents vary in such a way that the curve forms a loop. The current also varies with the seasons of the year, decreasing constantly from November to December, increasing again rapidly from January to February, and remaining nearly constant during the rest of the year. Curves drawn for a large number of years all show the same form, even in the finer details; it is only in the amplitude of the variations that there are changes. This goes to show that it is a natural phenomenon. The results seem to show that the earth currents are not an induction action of the variations in the earth's magnetism; also that the greater disturbances in the earth's current appear to be the cause of the movement of the magnetometer.

MODERN THEORY OF MAGNETISM. DuBois. "Elek. Zeit.," Nov. 24.—An article discussing the mathematical theory, based chiefly on that proposed by Hopkinson. It is of a highly mathematical character, and is illustrated with an example.

Electro-Chemistry and Batteries.

CHLORATE WORKS. J. B. C. Kershaw. Lond. "Elec. Rev.," Nov. 25.—A brief, illustrated description of the works in the southeast of France, where over 10,000 horse-power furnished by a water power is used for the manufacture of chlorate of potash, aluminum and calcium carbide; 3000 to 4000 horse-power are used in the manufacture of chlorates of potassium and sodium by the Gall and Montlaur process, which in principle is the old process of Watt patented in 1851. A solution of an alkali metal chloride is electrolyzed between insoluble anodes at a moderately high temperature and the less soluble chlorate salt, formed by the reaction between the free chlorine at the anode and the caustic alkali formed at the cathode, is separated by crystallization. The anodes are of an alloy of platinum and iridium, containing 90 per cent. of the former, as this stands the action of chlorine better than the pure platinum; the cathodes are of an iron-nickel alloy and are covered with an asbestos cloth to carry off the hydrogen, of which 19,000 cubic feet are produced for each ton of chlorate obtained. The details of the process are kept secret; the current density is said to be 465 amperes (but for what area is not stated). No external heat is required, as the current keeps the mass at a sufficiently high temperature; the presence of metallic oxides must be carefully avoided, as they decompose the product; the latter requires re-crystallization before it is ready for the market. In addition to these works at St. Michel the same company has a chlorate factory at Vallorbes, in Switzerland, where 3000 horse-power is used, the two works together producing 1800 tons of chlorate per annum. At first the output per electrical horse-power day was only 1 kg in place of 2.69 required by theory, but the yield has now been considerably increased. No details of cost are given, but he assumes that 1 pound could be produced for 5.5 cents; the selling price, however, has become lower, thus narrowing the former good profit; the outlook is said to be rather gloomy, as the number of these electrolytic plants is increasing. Two good photographs of the plant at St. Michel are given.

TREATING REFRACTORY ORES.—Lond. "Elec. Rev.," Nov. 25.—A brief, illustrated article on the Cowper-Coles electrolytic cyclic process for the treatment of refractory ores. A former description having already been given, the present article only points out some further details. Zinc from the sulphate solution is deposited on aluminum plates, which greatly facilitates the stripping of the zinc. The deposit is intentionally a zinc sponge, which forms a good substitute of what is known as zinc dust, and is used among other things for his regenerative electro-zincing process; an analysis of this zinc dust is given; to ensure the deposit in the form of sponge a low density of current and a weak solution are used. The lead obtained by the leaching with caustic soda is deposited on revolving discs and scraped off; it is very pure; an analysis is given. The apparatus for producing white lead from the sodium plumbate solution obtained by the leaching is shown. The silver is leached out from the ore with cyanide of potassium, from which it is then deposited on to silver sheets. The white lead is precipitated with carbon dioxide, which is produced from calcium carbonate by passing through water the sulphurous acid given off from the roasting, this acid being used to drive off the carbon dioxide from the calcium carbonate; the gases are passed through the lead solution and precipitated as sulphide, and the carbon dioxide, thus purified, is then passed through another cylinder, where lead carbonate is precipitated. Litharge is also made from the plumbate solution by evaporating it. More details are promised. A short summary of some of the inventor's conclusions from the commercial experiments in New South Wales are given briefly in the "Eng. and Min. Jour." (N. Y.), Dec. 3.

CALCIUM CARBIDE. Nicolai. Lond. "Elec. Eng.," Nov. 25. —A very brief abstract of a recent German paper. He states that the best proportions of the mixture is 100 parts by weight of lime to 70 of coke; lime averaging 99 per cent. of calcium and coke which is low in ash will produce an almost pure carbide; the coke should not run higher in ash than 5 per cent.; charcoal is unsuitable in the furnace process, but in the smelting machine invented by him it can be used, for in this the material to be smelted is compressed on to a conductor of a suitable height, and the arc touches the compressed mass only at the moment of smelting. In the manufacture of the carbide care should be taken that the raw material is not burnt by the hot gas, as is often the case in the electric furnace, so that the loss in electric power may be reduced to a minimum; the raw material should be exposed to the arc only as long as is necessary for its conversion into the carbide.

ALUMINUM.—Lond. "Elec. Rev.," Nov. 25.—A short abstract of a recent paper by Ristori, in which he described the Milton works and discusses the working of this metal, which at first presented so many difficulties; these have now to a very large extent been surmounted. The principal uses of aluminum are also discussed.

CALCULATED VOLTAGE OF ACCUMULATOR. Fitz-Gerald. Lond. "Elec. Eng.," Nov. 25.—A discussion of the relation between the volts and the calories in a lead accumulator. The voltage might be calculated from the calories as in the ordinary battery, and the question arises whether that application to the accumulator is approximately true or fundamentally false. In a Daniell cell the number of calories generated is about 46,000 per volt, and therefore it should be 92,000 per dyad-gram equivalent in the lead accumulator. He quotes S. P. Thompson, who discusses the various hypotheses explaining the chemical action in accumulators, of which he mentions five, and discusses their relative correctness, concluding that he thinks that the last one is the real action in the cells, this last one being that the peroxide is changed to monoxide, and that the spongy lead also becomes litharge. Fitz-Gerald also quotes from Treadwell's recent book, which he praises very highly, but criticises the quotation. Thomson's law is briefly explained. He maintains in opposition to the general consensus that in the case in which the e. m. f. is not constant, but falls from a maximum to a minimum, Thomson's formula will give the mean e. m. f. and not the minimum or the maximum. In the case of the accumulator the fact that the calculated value is 2 volts is a proof that the assumed reactions and their calorific values are incorrect and inapplicable.

ACCUMULATORS FOR AUTOMOBILES. Reyval. "L'Eclairage Elec.," Nov. 19.—An illustrated description, with tabulated data, of the Fulmen accumulator, which is used largely on French automobiles. Its special features are great power per pound and great storing capacity per pound. The plates appear to be mere modifications of the old form of grid accumulators, the meshes being rather large, and the amount of active material, therefore, relatively great. A table gives the various data for a five-hour discharge; some curves of the discharge are also given.

ELECTROCHEMICAL SOCIETY. Muller. "L'Eclairage Elec.," Nov. 19.—The continuation of the account of the proceedings of the congress at Leipsic.

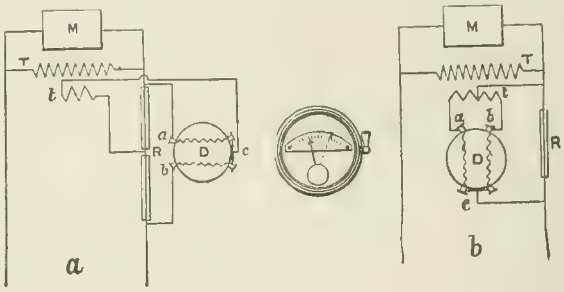
THERMO-ELECTRIC AND GALVANIC ACTIONS. Reed. "Jour. Frank. Inst.," Dec.—A reprint of an interesting paper read before that institute defining and comparing these two actions. The two processes are of an entirely different nature, but the electrochemical one can never take place without being accompanied and modified by the thermo-electric process, while the latter may take place without any chemical action; in another kind of apparatus the thermo-electric process is always accompanied by chemical change; this concurrence of the two, which is due to the nature of the materials, has given rise to difference of opinion as to whether the action in a particular case is electrochemical or thermo-electric. He then discusses certain actions which have been subject to this confusion. He defines what is meant by each of the two actions, starting with the premise that no body or system can be the origin of energy or of any process evolving energy unless in its final state its energy is less than in its initial state. The Peltier and the Thomson effects are described and discussed at some length, both analytically and graphically; the existence of these effects in electrolytes has been conclusively established. Galvanic action is then defined; it always necessitates the following conditions: The chemicals must be electric conductors and form part of the circuit; at least one of the conductors must be a compound and an electrolyte; the chemical reaction must evolve energy; a further condition seems to be that the electrolyte shall not be a single compound, but a solution of one compound in another. The two laws governing such actions—namely, Faraday's and Thomson's—are then described. When electrical energy is evolved without the application of heat there is no doubt that it is evolved as the result of chemical change, and if no heat enters or leaves during the process, and no change of temperature occurs, the chemical action is the only source of the energy;

but when this electrical energy is evolved only during the application of heat and when the chemical state is identical at the beginning and end, the electrical energy must come solely from the heat absorbed, and the process is then thermo-electric. The initial and final chemical state may be different, and yet the process be entirely thermo-electric; this occurs when heat is applied and electrical energy evolved, and when the final chemical state involves more energy than the initial. Illustrations are given; in one of these two iron electrodes are placed in fused alkali hydrate and at 500° to 700° the voltage may be as high as 1.2. In another case a silver crucible formed one electrode, a carbon rod the other and fused sodium hydrate the electrolyte, heat being applied, and a current of air was blown into the electrolyte; the carbon rod was oxydized and metallic sodium was reduced; the Jacques cell differs only in the substitution of an iron vessel for the silver cup. The e. m. f. required for dissolving and depositing the same metal may be very minute and may be generated thermo-electrically within the cell by raising the temperature of one electrode above that of the other, as, for instance, by making one electrode a tube through which a stream of hot or cold water is passed; copper is then deposited from a sulphate solution on the hot electrode and dissolved from the cold, the two electrodes being connected with each other. Another interesting illustration of a thermo-electric action was an experiment in which a zinc tray containing a strong solution of zinc chloride is heated; when a copper strip is introduced it will be covered with a smooth, perfect deposit of zinc as soon as the copper is in contact with the tray; iron or other metal which is not dissolved by the solution may be plated in this way. The initial and final chemical states are identical and the action is thermo-electric; the metallic strip is at a lower temperature than the tray, since it receives its heat only from the electrolyte, which in turn receives it from the tray, the junction of the electrolyte with the tray being necessarily hotter than its junction with the copper strip; the e. m. f. is several tenths of a volt. A similar action takes place with sulphate of zinc, although the deposit is obtained only with difficulty; the e. m. f. is about 0.6 volt, and tends to deposit zinc on the copper. In the discussion Kennelly pointed out that it was difficult to determine whether a cell belongs to one type or to the other, as every voltaic cell is always accompanied by thermo-electric action, and every thermo-electric cell containing an electrolyte is accompanied by electrolytic action, the two being in some cases blended together; one element heated to a higher energy than another might then be endowed with chemical affinity for the electrolyte by virtue of the heat received. A thermo-electric action is limited in its efficiency of transformation by the range of temperatures employed, according to the well-known laws of thermo-dynamics, whereas with voltaic action an efficiency of 100 per cent. is possible; if, therefore, the losses of energy in the cell could be measured it might become possible to determine whether the action is thermic or chemical. He therefore thinks it cannot be demonstrated which it is, without experimental observation. Richards did not accept Reed's conclusions regarding the thermo-electric character of the Jacques cell; he claims that there is no difference of temperature, as all the parts are heated to the same degree, and therefore there can be no thermo-electric action, for which reason the current must be due to chemical action. There is, on the other hand, abundant material for supplying a chemical explanation of the action; carbon, for instance, will reduce fused caustic soda. In making calculations it would be necessary to know the heats of formation at those high temperatures. Reed, in his reply, admits the application of the thermo-dynamic law and claims that the conversion of heat into chemical energy by absorption, or into any other higher form by any other process, must come under the same limits. There is no necessity for a new theory to account for something that is not known to exist. He claims that there is a difference of temperature between the different parts of the Jacques cell, as heat is received at about 800° C. and rejected at about 300°. With regard to his illustration of the thermo-electric cell he states that it was understood that the heat be applied so as to produce unequal temperatures. There is no surplus energy in the action of carbon when it reduces sodium hydrate, except the superfluous heat of the furnace, as this reaction absorbs energy, and does not set it free. [illegible] which it contains before any external heat is applied.

ELECTRO-DEPOSITION OF COPPER.—"Elec. Rev.," Dec. [illegible]

Units, Measurements and Instruments.

HOT WIRE [illegible] VOLT-WATT METER.—[illegible] re given by the difference of the [illegible] measured. There are two ways of connecting, one is to divide the non-inductive resistance and the other is to divide the secondary winding of the transformer into two different parts; the current in one of the halves in either case passes through the whole of the other before passing through the corresponding hot wire, as shown in the adjoining figures. The voltage which exists between the branches *a c*, *b c*, then corresponds to the vector sum and difference respectively of the different e. m. fs. which represent the main current and the supply e. m. f. If the instrument is calibrated to indicate directly the mean square value of the potential difference, then the difference between the two indications will be a measure of the watts. By means of a switch the connections may be changed, so that one needle measures the current and the other the voltage, thus enabling the lag of the current to be determined; the scale is very nearly a square root scale, and therefore if graduated to indicate the square, an almost equi-proportional scale is obtained. The very small self-induction of the branches are of no account; in his theoretical discussion which follows he assumes self-induction in all the branches in order to compare the results with those from a two-coil wattmeter.



PREPAYMENT METER.—Lond. "Elec.," "Elec. Rev." and "Elec. Eng.," Nov. 25, and "Lightning," Nov. 24.—An illustrated description of the Long-Schattner meter, into which coins are placed, which will enable a corresponding amount of current to be used. It is an electrolytic meter similar to the old Edison type, except that copper is used instead of zinc, the solution being copper sulphate. A balanced arm contains trays on to which the coins are dropped; their weight tilts the beam which operates the meter by means of two mercury cups; when the corresponding amount of copper has been dissolved from the anode, which is supported by the end of the beam, the latter will rise again; this latter movement switches the main current through a rather large resistance, which reduces the brilliancy of the lights without, however, extinguishing them, thus giving notice that another coin must be added; the current flowing at that time is also measured in the meter, and is paid for by the coin which is subsequently put into the meter. The electrolytic cell is shunted by a resistance, so that only a definite portion of the current is measured; the object of the mercury cups is merely to short-circuit the resistance through which the main current passes when there are not sufficient coins in the box. The mercury cups are covered with creosote, and the make and break is said to be perfectly sparkless. One copper plate and box will last for 700 kw hours. A thin layer of machine oil is poured over the top of the solution to prevent its evaporation. The meter is adapted for silver coins, and not for those of copper. It is the copper which is dissolved, and not that which is deposited, which operates the beam; the current is led in at the top of the plate and out at the bottom of the copper box, thus giving an even distribution of the current; there is such a low density of current that there is no heating and no gas evolved; the loss of volts across the meter is only 0.2 for 5 amperes at 220 volts, or half this for 110 volts.

PHASE METER. Aliamet and Brunswick. "L'Elec.," Nov. 26.—An illustrated description of the Bruger instrument which was referred to in the "Digest" July 16 and Aug. 6. It consists of two coils fastened together perpendicularly to each other, and suspended so as to move as a whole; through one of these passes a current whose phase is not shifted, while through the other passes a current whose phase is shifted through 90°; this double coil is suspended between two fixed coils through which the current whose phase angle is to be determined passes; the deflection of the movable coil will then be equal to the phase-shifting between the current and the voltage; the sign of the angle will be determined by the direction of the deflection. The two currents in the movable coil between which the phase angle must be 90° are obtained by having one coil in series with the primary of the transformer, and the other coil in series with the secondary. The theory of the instrument is given briefly.

IRON-CONSTANTAN THERMO-COUPLES. Van Aubel. "Arch. Sc. Phys. Nat.," Geneva, 103, p. 4; noticed briefly in Lond. "Elec.," Nov. 25.—An account of the researches by a number of [illegible] of the use of thermo-couples of this kind for measuring [illegible] found that the temperature curve is very near to a straight line. Van Aubel used it for determining the thermal conductivities of various alloys.

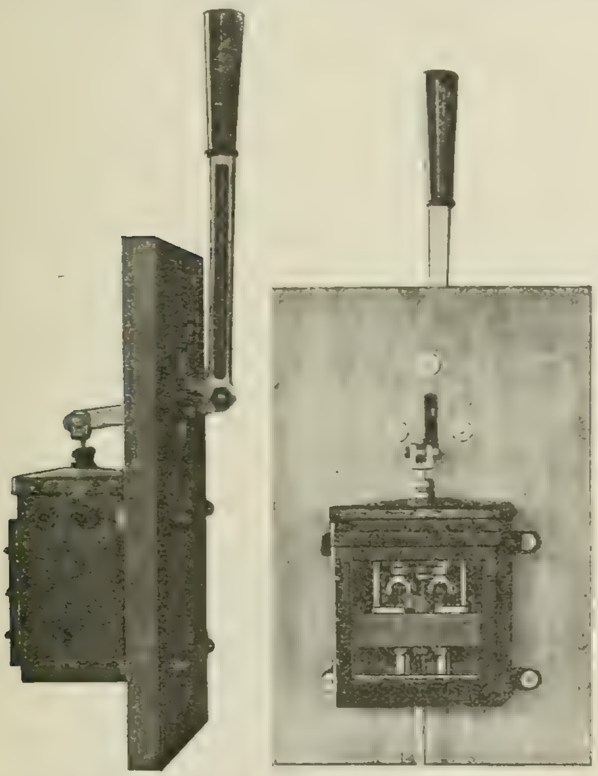
DETERMINATION OF DIELECTRIC CONSTANTS. [illegible] "Wied. Ann." [illegible] noticed briefly in Lond. "Elec.," [illegible] are capacities inserted in a primary and secondary circuit and [illegible] the respective currents, he proves that [illegible] very rapidly with [illegible] when [illegible] has certain values; hence with a [illegible] current indicator the mutual influence of the two circuits may be used for comparing two capacities with great accuracy, and hence also for the determination of dielectric constants; a suitable indicator is a set of magnetized steel wires 1 cm long. The primary current consisted of the discharge of an influence machine; the secondary coil was not enclosed in the primary, but was placed a few centimetres away with a coinciding axis; to maintain the constancy of the discharge potential the primary condenser was always charged very rapidly, as recommended by Jaumann.

MEASURING DISCHARGES. Witting. "Wied. Ann.," June; abstracted in "L'Eclairage Elec.," Nov. 19.—He describes a galvanometric method of measuring a succession of sudden discharges. The best results are obtained by using a method of multiplication or by the Toepler method. The former consists in reversing the direction of the current at the moment when the needle arrives at one of the extreme positions; the other method consists in reversing the current at the moment of the second change in the direction of the needle. He measured by these methods the current furnished by a machine of twenty plates; the results are regular, and show that the intensity of the current is within large limits, independent of the resistance of the circuit and the length of the spark.

MEASURING HIGH VOLTAGES. Puekert. "L'Eclairage Elec.," Nov. 19.—An abstract, with illustrations, of the description noticed in the "Digest" Oct. 22; it is a longer abstract than the French one noticed last week.

EDDY CURRENT LOSSES IN ARMATURES.—Lond. "Elec. Eng.," Nov. 25.—Several answers to the question how to determine the watts thus lost in a direct-current dynamo.

MEASURING HIGH MECHANICAL PRESSURES. Palmer. "Am. Jour. of Sc.," Dec.—A brief, illustrated description of a method of measuring very high mechanical pressures, by measuring the electrical resistance of a column of mercury subjected to this pressure. A column of mercury in a glass tube is placed in the vessel in which the pressure is produced, and contact is made at both ends, the column forming one branch of a Wheatstone bridge. Previous researches show that up to 2000 atmospheres the relation between the electrical resistance and pressure of mercury is a linear law. Experiments show that a change of pressure of one atmosphere could easily be detected; with reasonable care the errors of measurement do not exceed one part in 1000. Pressures were produced up to 4385 atmospheres.



SIDE ELEVATION AND REAR VIEW OF OIL BREAK SWITCH.

Telegraphy, Telephony and Signals.

RAILWAY SIGNALS. Reich. "Zeit. fuer Elek.," Nov. 20.—A brief, illustrated description of a system in which the train, after passing the signal, will itself operate the signal which it has passed, settting it to danger.

HIGH-SPEED TELEGRAPHY.—"Sc. Am. Sup.," Dec. 10.—A reprint from "Nature" of a short article on the Squier and Crehore method, known as the synchronographic system, the original descriptions of which have already been published in THE ELEC. WORLD.

CLEARING OUT SIGNALS. Clausen. "West. Elec.," Dec. 3.—A short article giving descriptions of the various systems in use for clearing signals in telephone centrals, after the completion of the conversation. The description is of a non-technical kind.

BRUSSELS.—"Elec. Eng.," Dec. 8.—A brief consular report on the new telephone station.

Miscellaneous.

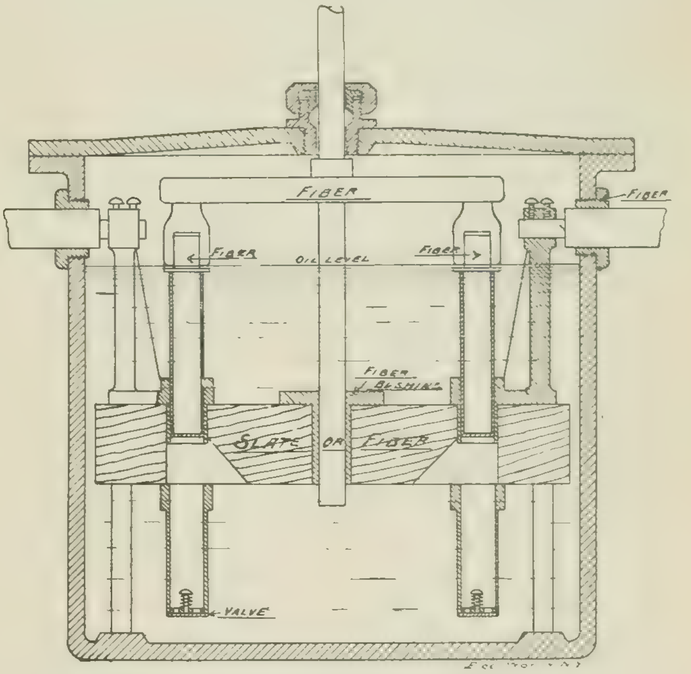
STATUS OF ELECTRICAL INVENTION. Rosenbaum. "Jour. Frank. Inst.," Dec.—The beginning of a reprint in full of the paper noticed in the "Digest" Dec. 3.

New Oil Break Switches.

These switches are enclosed in iron boxes varying in size, according to the capacities required, the two-pole, 20-ampere, 2500-volt box being 4x6x7 inches, while the three-pole, 300-ampere, 2500-volt box is 9x11x13 inches. These boxes are of cast iron, and are fastened to the back of the switchboard panel by four stud bolts through four lugs cast on the box. A right angle lever connecting with the draw-bar, hinged on the face of the panel, extending upwards, offers sufficient leverage to open or close the switch with little effort.

The wires run into the box through fibre bushings in the smaller sizes, while in the largest sizes cable connections are made outside of the box by means of brass sleeves; the wires pass through these fibre bushings (the latter extending to the binding posts), and are held in contact by means of screws set in the top of the posts. The current passes down the posts to contact plates cast with the posts. These plates and posts are mounted on top of a slate or fibre plate, as occasion requires, and through the plates a plug passes, carrying the current to a thimble below. This thimble is also cast to a contact plate, which is fastened to the bottom of the slate or fibre plate, and carries the current along to the next thimble, which connects with the outgoing plug. In this manner the current is carried up to the outgoing binding post and out to the line.

The number and size of the plugs is determined from the potential or pressure carried and the amount of current that must be broken. The present standard is that each plug shall break not over 625 volts, consequently very high voltage switches require a number of plugs or "breaks," while heavy currents demand large plugs, or plugs placed in multiple, but broken simultaneously in series. All of the conducting parts are made of steam metal, and the higher capacity plugs are reinforced with pure copper centres. These plugs fit with exactness into their receptacles, and are attached at the top by means of a fibre cap and metal yoke to a fibre spider, which is fastened to the draw bar, the lower portion of which passes through a fibre bushing or guide in the case of using a slate plate, thus insuring a straight pull on all the plugs simultaneously. The box is filled to the top of the plugs with a special acidless oil, and the switch is ready for service.



SECTIONAL ELEVATION OF THREE-POLE QUADRUPLE OIL BREAK SWITCH.
CAPACITY 5000 VOLTS, 150 AMPERES.

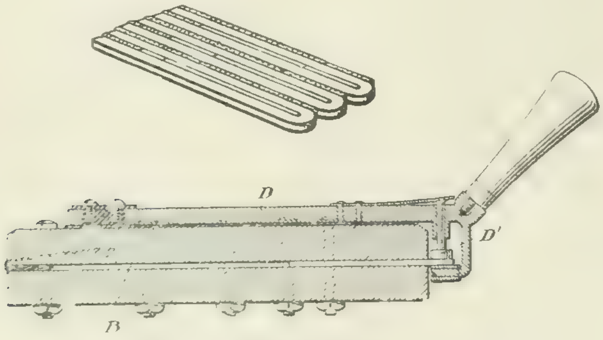
To operate the switch the lever on the face of the switchboard is pressed in, the draw-bar is forced downward and with it the spider, with all the plugs attached, and as the plugs enter the lower thimble the oil passes out of a valve, ground in place at the bottom of the thimble, and the switch is in use.

To open the switch the operation is reversed, and as the plugs are being drawn from the lower thimbles they close the valve and create a vacuum, which is increased until the plug leaves the thimble, which is the arcing point, or at least where one would naturally expect to see an arc. Just at this point the oil is drawn with great force between the two contacts by the vacuum, and the arc is "nipped in the bud."

The instructions given with these switches is to "tease the arc" when the switch is opened under full load, as no arc can form nor will the plug be injured a particle by repeated use. The switches are manufactured by the Cloos Electrical Engineering Company, Milwaukee, Wis.

An Improvement in Rheostats.

A type of rheostat designed to control large currents with a simple construction not liable to derangement is the subject of patent No. 615,419, issued to Mr. Charles Wirt, December 6. The rheostat material consists of a metallic strip or ribbon bent edgewise into a flat sheet somewhat as shown in Fig. 1, and inserted between heat-radiating cover plates either of slate or some such insulating material or of metal with an insulating sheet between. The path from terminal to terminal is designed to have no joints, and the contact with the moving part is made without wire connections, but directly on the ends of the loops of the strips. This is clearly shown in Fig. 2, where *B* is the conducting strip enclosed between slate slabs and making contact with the stud *D'* mounted in the arm *D*.



FIGS. 1 AND 2.—AN IMPROVEMENT IN RHEOSTATS.

Efficiency of Worthington Electric Pumps.

The two accompanying diagrams will be interesting in showing graphically just what efficiency one may expect to obtain with an electrically driven mine pump. This test was run on an 11x12 horizontal triplex pump manufactured by Henry R. Worthington, New York, and driven through a double reduction of machine-cut spur gearing by two 65-hp General Electric Company alternating-current motors. The speed of the motors was 450 revolutions, and that of the pump 45, making a total gear ratio of 10 to 1. The normal capacity of the pump was 1250 gallons per minute, the head 350 feet.

The first test (Fig. 1) was run at constant speed and a variable head. The voltage of the motors was kept constant at 220, and the frequency constant at 60 cycles. The head was measured by pressure gauges on the delivery pipe, the quantity of water by the plunger displacement, less an allowance of 2 per cent. for slippage. The total input at the motors was measured by wattmeters placed in the main circuit. The following readings were taken :

EFFICIENCIES.

Volts.	Total pressure.	Head in feet.	Pump.	Motors.	Set.	Power. factor.	Amps.
220	[illegible]	[illegible]	[illegible]	82.7	44.4	72.6	63
[illegible]	[illegible]	[illegible]	67.0	86.3	57.8	82.0	[illegible]
[illegible]	[illegible]	231.0	[illegible]	88.0	67.0	88.5	133
[illegible]	[illegible]	350.0	80.1	86.5	69.3	85.6	[illegible]

The second test (Fig. 2) was run under a constant head at variable speed, the pressure being kept steady at 100 pounds per square inch, and the voltage at 220. The following readings were taken:

EFFICIENCIES.

Cycles.	[illegible]	Pump.	Motors.	Set.	Power factor.	Amps.	Volts.
[illegible]	[illegible]	72.3	77.4	56.0	86.5	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	86.8	[illegible]	[illegible]
[illegible]	[illegible]	78.2	86.0	67.0	86.0	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	87.3	68.0	85.0	[illegible]	[illegible]

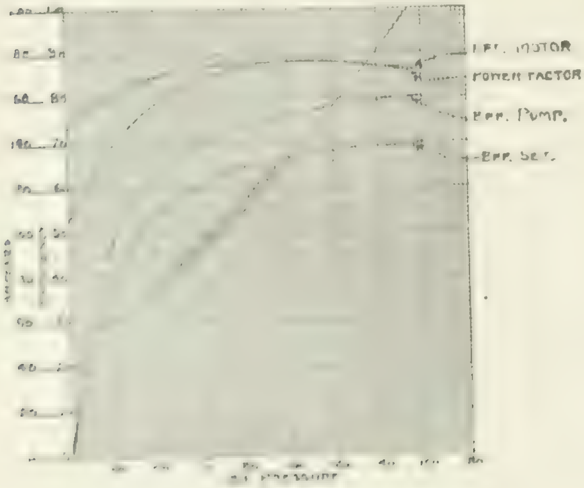


FIG. 1.

acting outside packed plungers and that the pump had just come from the shop, all the working parts being stiff and not yet having worked down to a perfect bearing, the results obtained are thought to be remarkably good.

A Tile Bolt and Lock.

The advantages of the device illustrated herewith will be at once recognized and appreciated by electrical contractors and wiremen. It has been devised for use in fireproof buildings, where the columns and girders are covered with tiling, and offers a safe and simple method for fastening insulators, rosettes and other electrical appliances to ceilings, columns or walls. After it has been properly set it cannot be pulled out, though it can be easily removed when desired.

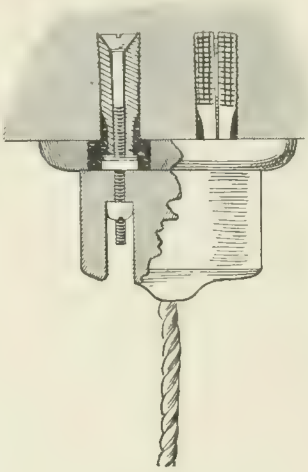


FIG. 1.—CEILING BUTTON.

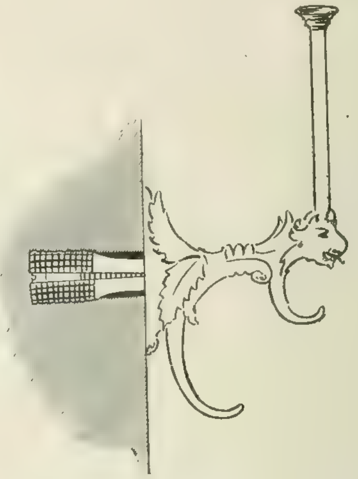


FIG. 2.—ORNAMENTAL BRACKET.

The device consists of two pieces of metal with partially corrugated outside surfaces, which, when placed together, form a shape somewhat conical. The opening in the upper end when the two parts are together is countersunk, allowing the bolt head to which the insulator or other device is to be fastened to fit snugly between them. To place the bolt the two metal parts, with the bolt between them, are inserted in the hole in the tiling. A small concave washer slips over the bolt, and a nut is then screwed up close to the ends of the metal pieces. As the nut gradually tightens it draws the bolt head down into the space between the two parts and separates them, until it effects a tight binding at the sides of the hole. This leaves the shank of the bolt free, to which any device may be attached.

Fig. 1 shows a ceiling button attached to the bolt, and Fig. 2 shows how [illegible] can be used for the attachment of ornamental brackets [illegible]

[illegible] made by the Western Electric Company in two [illegible] inch in diameter and 2 [illegible]

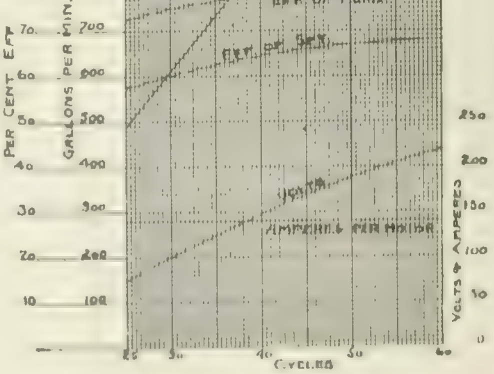
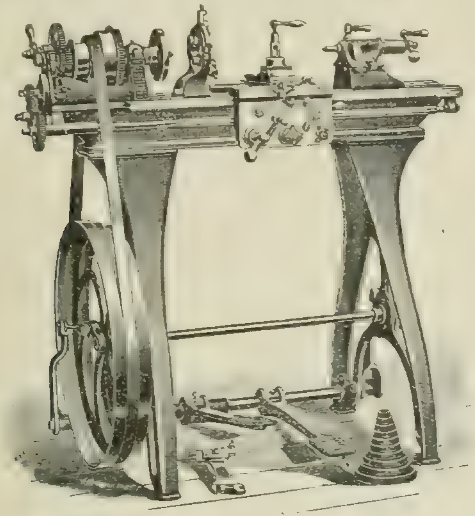


FIG. 2.

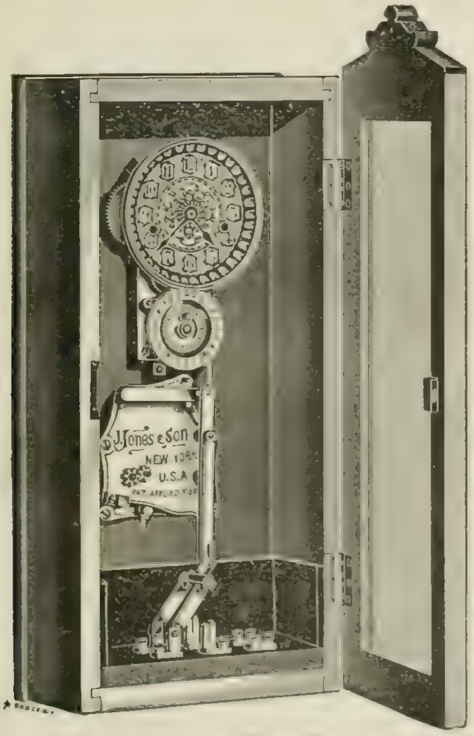
"Star" Screw-Cutting Engine Lathe.

The lathe represented in the accompanying illustration will no doubt be of interest to central station and street railway managers who have machine or repair shops connected with their plants. The head has a hollow spindle made from a crucible steel forging, and the improved end-thrust ball-bearing reduces the friction 75 per cent. in the work of drilling. The tail stock has an adjustable side movement for turning tapers. The plain gib rest is said to be the strongest, most rigid and practical for general use on a lathe of this size. The compound rest is furnished as an extra attachment. The tool post is provided with an improved collar and shoe for raising and lowering the tool. The improved automatic friction cross and longitudinal feeds are actuated by a phosphor-bronze worm on the lead screw, which is splined. The feed may be thrown in or out of contact by simply turning a hand knob in the apron, and will feed in or out, right or left, cut screws right or left or may be thrown out of gear entirely by moving a lever in the headstock without changing the motion of the foot or driving power. The cross-feed secures perfect accuracy in turning or facing up work. The lead screw will cut all standard threads from 3 to 64 inclusive, without compounding the gears, and nearly all threads by compounding them. The lathe can be started and stopped instantly by foot power. This lathe is manufactured by the Seneca Falls Manufacturing Company, 422 Water Street, Seneca Falls, N. Y.


Screw-Cutting Lathe.

An Automatic Time Switch.

A novelty in the line of automatic devices for cutting out lamp circuits has been brought out by Messrs. J. Jones & Son, 66 Cortlandt Street, New York. There have been many devices of this character brought out for the purpose of cutting out only, but this instrument not only cuts out but cuts in again at any predetermined time. Necessity often requires the closing of circuits at distant points not in proximity to the central station or switchboard, and at that particular time the entire attention of the engineer in charge is needed at another point of the engine. Here the automatic time switch does the service of a helper.



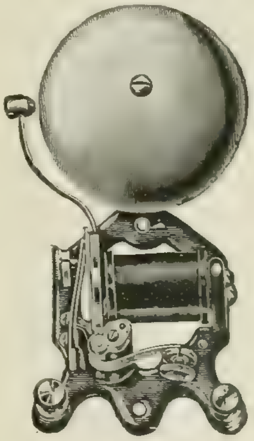
An Automatic Time Switch.

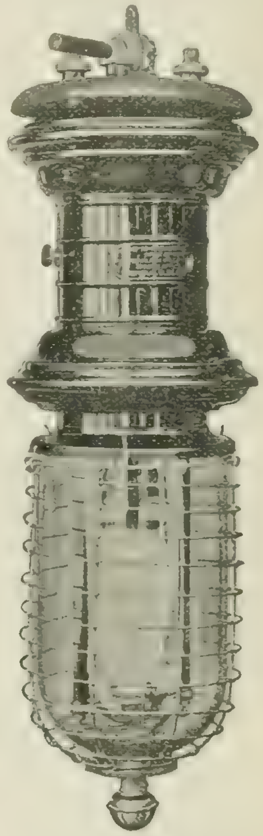
The apparatus is peculiarly adapted to the lighting of signs and for the turning on and off of window lights. The clock movement operates two cams, which make one revolution in twenty-four hours. The lower or switch-operating movement is wound up in the manner of an ordinary clock and furnishes the power for the operation of the switch. A combination of levers is connected with the switch handle in such a way that it can be moved up and down, according to the direction of movement of the mechanism. This apparatus will operate single, double, triple and four-pole switches. The regular clock movement is of the best make, so as to insure reliable time for the operation of the switch.

A Portable Arc Lamp for General Marine Work.

Adequate electric illumination of wharves, docks, warehouses, dry docks, shipyards, with their adjacent iron working shops, and the holds of vessels, while loading or discharging, demands a type of lamp somewhat different from that used for street or store lighting. It must be strong, compact and durable or it will not withstand the hard usage which such service will naturally give it; it should give a large volume of clear, white light, which will not dazzle the eyes of the workmen nor throw heavy shadows in already obscure corners; it should require little attention, and be so simple that it can be attended by an average lamp trimmer; lastly, it should require trimming not daily, but only at long intervals.

The marine enclosed arc lamp, manufactured by the General Electric Company, meets these requirements. It has been made the object of special design to adapt it to marine usage on shipboard or land. The mechanism is compact, simple and reliable, and is protected from injury or the effects of the weather by a stout metal casing. It is only necessary to renew the upper or long carbon once in 100 to 150 hours. The outer globe is cylindrical in shape, of thick glass and protected from injury by a heavy wire guard. The globe can be lowered by a half turn of the thumbscrew at the side, and when pushed back in position is automatically and securely locked. The lamp is only 28 inches long. It can be carried from place to place if necessary or may be permanently fixed in place like an ordinary arc lamp. The lamp can be used on a 110-volt circuit, and can be adjusted for 4, 4.5 or 5 amperes, the latter being the standard.


An Improved Electric Bell.

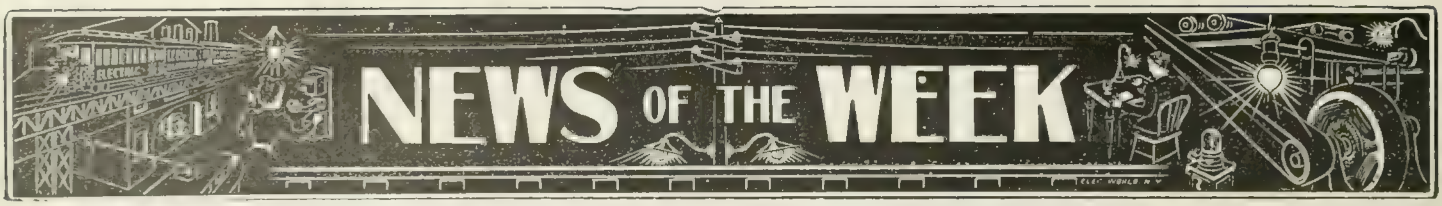

A Portable Marine Arc Lamp.

Many of these marine lamps have been installed in locations such as those mentioned above, and have in every case given very satisfactory service.

An Improved Electric Bell.

A new type of electric bell has just been brought out by the Rousseau's Electrical Works, Inc., 329 Fourth Avenue, New York. As shown in the cut above, the two spools are in a plane at right angles to the bell frame, instead of parallel. This gives an equal pull from both pole pieces, thereby increasing the power of the blow. The most notable feature of this bell, however, is the multiple contact, whereby a large surface is obtained and the sparking is made to take place between two or more contact points, instead of at one. This is accomplished by having the usual contact spring on the armature much wider and split into two or more fingers, these fingers being brought into contact with another spring insulated from the bell frame. The adjustment of the contact is made by a screw bearing on the second spring, but insulated from it. On a 3-inch bell the contacts have three fingers, giving a surface of over one-quarter of an inch long and one-thirty-second of an inch wide. If one of the fingers becomes burned there will still be two left. The continued vibration of the bell, it is stated, removes the oxide from the burned finger. It is therefore almost impossible to damage this bell at the contact point by excessive current. The contacts are of pure platinum. The bell has a double adjustment and locked binding posts. The armature is pivoted in brass bearings and, due to the magnet arrangement, has a very long leverage. The design of this bell is the result of twenty-five years' experience in the manufacture of bells, and those desiring a serviceable instrument will do well to consider its merits.

NEWS OF THE WEEK


ELEC. WORLD N.Y.

Financial Intelligence.

THE COMMERCIAL CABLE COMPANY has declared a quarterly dividend of 1¾ per cent., payable January 3, 1899.

INCREASED DIVIDEND.—The directors of the Metropolitan Street Railway Company, of New York, increased the dividend rate from 1¼ quarterly to 1¾ per cent. A dividend at the latter rate was declared last week, payable January [illegible].

THE NASSAU ELECTRIC RAILROAD COMPANY, Brooklyn, reports gross earnings during the quarter ended September 30, $685,254, an increase of $52,213 over the same period last year; net earnings, $294,007, a decrease of $104,817; total income, $295,981, a decrease of $95.514; surplus, $75.253; decrease, $117,7[illegible].

GENERAL ELECTRIC DIVIDENDS.—In a circular recently issued by the General Electric Company to its stockholders it is stated that the recent dividend of $17.50 on the preferred stock equals the unpaid accumulative dividends upon that stock for eighteen months, beginning July 1, 1894, and ending December 31, 1895.

Special Correspondence.

NEW YORK NOTES.

AT A MEETING of the Board of Directors of the Electrical Exhibition Company, held in this city on December 7, Mr. H. L. Shippy was elected vice-president and a director in place of Mr. F. W. Roebling, resigned.

MR. HIRAM S. MAXIM delivered an illustrated lecture before the American Society of Civil Engineers at 220 West Fifty-seventh Street, this city, on Wednesday evening last. The apparatus used in his artificial-flight experiments was described, and the evolution of the automatic gun was illustrated. A small Maxim gun was exhibited and blank cartridges fired.

SPECIAL TROLLEY CARS FOR SCHOLARS.—In the last issue of THE ELECTRICAL WORLD reference was made to the special car service for the accommodation of the scholars of Packer Institute in Brooklyn. It now turns out that this is not the first case where special trolley cars have been provided for the use of scholars in that borough. The special school-car service originated with President Rossiter, of the Brooklyn Heights Railroad Company, who is an interested trustee in Adelphi College, and such cars have been running to Adelphi since September 1, 1897. Therefore Adelphi precedes Packer by over a year in its special-car service.

TO VESTIBULE STREET CARS.—It is proposed to compel the street railway companies to equip their cars with vestibuled platforms, and a public hearing was given on the subject by the Railroad Committee of the Board of Aldermen on December 9. The railroad companies object to the measure. Mr. B. F. DeFrece spoke for the Third Avenue Railroad Company, and contended [illegible] and obscure the motorman's view of the track ahead. Another contention was that the motorman, gripman or driver, as the case may be, would be more liable to take cold inside of vestibules than if he had no protection at all. This solici[illegible] highly commendable.

[illegible] the New York Electrical Society was held at the College of the City of New York [illegible] recently returned from active service in Porto Rico, as colonel of the First Regiment United States Volunteer Engineers, made an address on "Ideas Underlying [illegible] by It in Porto Rico and the Opportunities of Future Usefulness." Mr. W. D. [illegible]

[illegible] service can be [illegible]

[illegible] the first floor below which it appears there is only 8 inches clearance to the bottom of the shaft—at full speed, the attendant apparently not cutting off the current as he should. It is also claimed that there is only 18 inches clearance between the counterweights and the I beams supporting the overhead sheaves when the car is at the ground floor level. The automatic limit stop on the machine had been found to be out of order by an inspector that morning. At any rate, the car ran into the bottom bumpers at full speed, and the momentum and motor torque pulled the counterweights up against the I beams, when the counterweight frames sprung sideways, letting the weights themselves—which were, as usual, merely slipped in between vertical tie bars—fall out, and four weights, each weighing in the neighborhood of 70 pounds, fell the full height of the shaft and through the car.

THE ANNUAL MEETING of the Electrical Committee of the Underwriters' National Electrical Association was held at 34 Nassau Street, in this city, on December 6, 7 and 8. Several matters of more or less importance were brought before the meeting for its consideration. Very few changes were made in the National Electrical Code, none of them being of any great importance. The subject of changes in installations and wiring rules was referred to a committee of seven. Some changes were made in the specifications for sockets, and changes in other wiring devices, such as switchboards, cut-outs, etc., were considered. It is likely that other changes will be made in the specifications for restandardizing and reproportioning various wiring devices, but nothing definite in this direction was arrived at. Definite action was taken regarding 220-volt lamp sockets. No changes were made in the requirements for central station construction and the installation of switchboards and dynamos therein. Efforts were made to agree upon a proper test for transformers so as to lessen the liability of breakdown between primary and secondary circuits. The recommendations were referred back to the various organizations allied in the movement for final action. It was resolved as the sense of the meeting that on and after July 1, 1899, all inspectors should refuse to accept any devices or materials on new work not enumerated in the edition of the list of approved devices and materials of the above date. There were about forty representatives in attendance at the meeting, coming from all parts of the country.

THE NEW ELECTRIC LIGHT AND POWER COMPANY'S PLANS.—The true nature of the New York Gas, Electric Light, Heat & Power Company, which was incorporated at Albany recently, and which has at odd times since excited a vast amount of curiosity and speculation, is beginning to be revealed. Although nothing authentic has yet been given out regarding the plans of the company, it is now generally supposed that it purposes acquiring control of all the existing lighting and power interests in Greater New York, and conduct them under one management. In support of this belief comes the announcement made on Saturday last that the Hon. W. C. Whitney had acquired the controlling interest in the Mount Morris Electric Light Company, the Edison Electric Illuminating Company, the Manhattan Electric Light Company and the Empire Subway Company, all of Manhattan. Mr. Whitney, it is stated, is one of the principal backers in the New York Gas, Electric Light, Heat & Power Company. It is also reported that the new company has acquired an interest in the New York Telephone Company, which controls the Empire City Subway Company and the subways of the Consolidated Telegraph & Electric Subway Company. The interest in the telephone company thus acquired, it is stated, will enable the new company to use all the high-tension wires in the subways for light, heat and power purposes, the telephone company retaining control of the low-tension wires for telephone purposes only. The announcement that the deal for the acquirement of the older lighting companies had been completed seems to have been premature. There appears to be good reason, however, for the belief that the new company will have secured the controlling interest in them all by January 1 next. It is stated that negotiations are now pending between the new company and the Mount Morris Company, but that no definite settlement has yet been arrived at.

PHILADELPHIA NOTES.

MR. LAWRENCE W. FRANK has purchased the business carried on under the name of the [illegible] Electrical Works, at [illegible] New Street, Philadelphia, and will continue at the same address. Mr. R. L. [illegible] will act as manager. With increased capital, modern equipment and carrying of good stock, Mr. Frank and Mr. [illegible] hope to do even a larger business than was done by the former [illegible] Electrical Works. THE ELECTRICAL WORLD wishes them every success in their new departure.

ELECTRICAL GOODS IN BRAZIL.—A traveling representative of the Philadelphia Commercial Museum has just returned from Brazil, and makes an interesting report on the trade in electrical goods in that country. He states that the trade is growing by leaps and bounds, it being only a few years ago that electric railways, lighting, power, etc., were unknown in any part of the country. [illegible] town and city within [illegible] miles of the coast is either lighted by electricity or has the project under consideration. Many of the mining companies and cotton cloth mills through the interior have plants now in operation, supplying them with both light and power. Several of the large plants have come from England. It is well known that the trade is controlled as regards supplies almost exclusively by England and Belgium. The United States comes in for a fair share of the trade in electrical machinery. Arc and incandescent lamps, fittings, carbons, wire of all kinds, electric bells, batteries, electricians' tools and gloves, zincs, sal ammoniac, etc., are in demand in the towns along the line of the Central Railroad, between Rio and Sao Paulo, and Rio and Bello Horizonte, as these towns at present rely on the Rio merchants for their supplies. Along the line from Rio to Sao Paulo are many towns in which it might be advantageous to have agents. A competent salesman, familiar with the Portuguese language, traveling through this section could do wonders in the way of securing orders and appointing responsible agents. This may also be said of nearly all the interior cities, as attention so far has seemingly been paid only to the large cities on the coast, and even there not to the extent the trade possibilities deserve.

BUFFALO AND NIAGARA FALLS NOTES.

THE REVIVAL of the Pan-American Exposition scheme cannot fail to be of interest to electrical people. As it looks now the exposition will go through with a rush, as the city fathers of Buffalo have indorsed it and will do what they can for it.

THE WOOD-WORKING FACTORY of Messrs. Alcott, Ross & Scully, at Dunkirk, has been furnished with 700 incandescent lights in order to permit running all night as well as day. The current comes from the new incandescent system installed in the city last year.

THE RECENT STORMS have interfered with the transmission of the electric power from Niagara Falls to Buffalo. For some time the street railway company was obliged to use its own power. It is supposed that the heavy snow and winds of the past week or two have proved too much for the overhead line. The managers of the company in Buffalo have not explained the cause and an effort to find it failed.

THE PROJECTORS of the power line to Depew from Niagara Falls have not been able to do any work this season beyond the securing of the right-of-way, which is reported to be complete except in case of corporations where signatures are dependent on meetings held at long intervals. The plan is to tap the line to Buffalo at the transformer station at North Tonawanda, or bring up a separate line to that point from the power house and lead it off from there to Depew. It will be easy to modify the current at that station. Negotiations with the Buffalo Valley trolley line, which is to be built next year, are in progress. It is the plan to build a line something over three miles long southward from Depew to connect with the line of this road. Inquiry for power at Depew is sufficient to warrant the building of the line as early in the spring as possible.

CHICAGO NOTE.

A TEMPEST IN A TEAPOT.—The talk about lynching and mobbing of aldermen and others in connection with the fight over the street railway franchises came from hot-heads, and the excitement was greatly exaggerated by the newspapers. The trouble is largely a newspaper creation. The opposition in the City Council to the ordinance granting a fifty-year extension of franchises to the street railway companies seems to be strong enough to defeat the measure for a year at least. Mayor Harrison thinks that the joint committee on streets and alleys will not recommend the passage of the ordinance. It is thought that Mr. Yerkes and his street railway associates will fail to secure the enactment of the measure, and that a compromise may be effected later on a basis of twenty-year franchises. The present franchises expire in 1903. It is stated that several aldermen who favored the extension have received threatening letters. Many public meetings have been and are being held in various parts of the city to protest against the franchise extensions.

ST. LOUIS NOTES.

TO BURY THE CITY'S WIRES.—E. Ruebel, secretary, and Charles E. Sharp, treasurer of the Southern Electrical Supply Company, who have been awarded the contract for burying the city's wires, say it will be impossible to complete the contract by December 21. It will be near the end of January, as they are allowed ten days for filing a bond and beginning work, and have six weeks in which to complete the contract.

NO CAUSE OF ACTION.—In the case of the Cass Avenue & Fair Grounds Railway Company, which asked an injunction in the Circuit Court to restrain the St. Louis & Suburban Railway from using the tracks of the plaintiff, violation of the Julian law was alleged as the cause for the injunction. The judge held a day or two ago that, inasmuch as the Julian law had been annulled by the Supreme Court, there was no cause for granting the injunction asked for. This case becomes interesting in view of the sale of the line seeking the injunction to the stockholders of the Southern Electric line, over whose tracks the Suburban loop will also run. It has been stated that the Southern Electric Company and the Suburban had reached an agreement as to the joint use of tracks and the action of the former company with regard to its newly acquired tracks.

STREET RAILWAY DEALS. Mr. Corwin H. Spencer and Charles F. Orthwein, representing the stockholders of the Southern Electric Railway Company, have purchased the property of the National Railway Company, known as the Hamilton Syndicate. The price said to have been paid was $3,000,000. The deal was made in Chicago, and resulted in the transfer of an important property from an outside corporation to St. Louisians. The property sold includes the Northern Central, Cass Avenue & Fair Grounds, Union, Citizens, Baden and Southwest lines, all electric, and the St. Louis line or Broadway Cable. The aggregate mileage represented is 80.37 of electric and 14.67 of cable. The second and greatest transaction was the sale of the Lindell and the Missouri Railway System to the Metropolitan Street Railway Company, of New York. The consideration is said to be [illegible]. The deal was completed in New York, and by it a valuable property passed from the control of St. Louis men to outsiders. There were reports that the Scullin system had also been sold, or was being negotiated for, also the Suburban Company's properties. Both the latter rumors were denied. It was stated at the office that the Union lines had not been sold, and that no offer had been made for the property. At the office of the Suburban Company it was emphatically declared that no offer had been made for the road.

PACIFIC COAST NOTES.

THE MOUNT WHITNEY TELEPHONE COMPANY, of California, after passing through many vicissitudes, is doing a growing business under the management of J. H. McFarland. The American Electric Telephone Company, of Chicago, supplies the instruments now being installed.

THE UNION IRON WORKS COMPANY, of San Francisco, has installed a 100-ton electric hoist under its large shears in the shipyard. It is a double hoist, operated by two 25-hp motors. A third motor operates a "gipsy," and a small motor is used to turn the screw. The electric work was done in the shops of the electrical department of the works.

THE SUNSET TELEPHONE & TELEGRAPH COMPANY recently announced that its Pacific States telephone companies now have in operation 21,000 miles of lines, serving 44,000 subscribers in 1400 cities and towns. Rates from San Francisco are, for quarter-minute switches, to Southern California points, 50 cents; to Puget Sound cities, 75 cents; to Eastern Washington and Idaho, $1.

THE SUBMARINE CABLE WORK in the San Francisco Bay, most of which is recent, was inspected by Chief Signal Officer Greely while on his tour of the Pacific Coast. He made a thorough examination of the electrical installations at the Coast fortifications. A complete system of telegraphic and telephonic communication will be established between San Francisco and the adjacent forts. The Columbia River and Puget Sound fortifications will have similar connections with neighboring cities.

CANADIAN NOTES.

THE CITY COUNCIL of Toronto has requested the electric street railway company to make a trial of various fenders, with a view to the adoption of the one found most efficient.

ON DECEMBER 17 the ratepayers of Galt, Ont., will vote on a by-law to raise $67,750 to purchase the gas and electric light plants. The company owning these plants has offered to sell at that figure.

IT IS PROPOSED to extend the Ottawa Electric Street Railway to the town of Britannia, about eight miles from Ottawa. The people along the route are endeavoring to bind the company to an agreement giving them city rates.

OWING TO the small number of tenders received by the city council of Toronto, Ont., for the installation of a municipal electric light plant it has been decided to accept none. From the tenders submitted it was found impossible to arrive at even an approximate cost of an electric plant. No tenders were received from Canadian manufacturers. In this connection the Anglo-American Electric & Supply Company has made a proposition to supply electricity to the city. Power is offered at cost after paying a dividend of 10 per cent. to the shareholders upon a capital stock of $5,000,000. It is guaranteed that the cost to the public will not exceed 1 cent per horse-power per hour.

NOTICE IS GIVEN on behalf of the Quebec, Montmorency & Charlevoix Railway that application will be made at the next session of the Dominion Parliament for an act amending the act incorporating the railway in the following particulars: To change the name of the company to the Quebec Railway Light & Power Company, to ratify the purchase of the property and franchise of the Quebec District Railway Company by deed passed at Quebec on June 29, 1898; the issues of bonds and stock made for the purpose of paying the purchase price thereof, and to authorize the company to build a line of railway or tramways in the counties of Levis, Bellechasse, Dorchester, Beauce and Lotbiniere; to ratify the purchase of the property, works, plant, buildings, machinery and capital stock of the Montmorency Electric Power Company, and the issues of bonds and stock made by the Quebec, Montmorency & Charlevoix Railway Company in connection with the purchase.

FRENCH NOTES.

INDEMNITY FOR INTERRUPTION OF TELEGRAPH SERVICE.—Owners of private wires have hitherto been made to pay the entire amount of the dues required by the state, notwithstanding any interruption which their service might happen to suffer. Following the practice in use in the telephone service M. Marnéjouls, Minister of Commerce, has recently decided that any interruption in the service of a private line exceeding fifteen days will entail a diminution of the royalty to be paid (which is 15 francs per kilometre), proportional in amount to the length of the interruption.

ELECTRICITY IN THE NAVY.—Following up the circular letter of September 12 last, regarding the acquisition by the navy of electrical workmen under a three years' volunteer enlistment provision, the Minister of the Navy has sent to the vice-admirals, the army corps commandants and the naval prefects a set of examination papers on theoretical and practical points, which all candidates will be required to pass. The manual tests will consist of three pieces of work, to be selected from each of the three groups denoted by the letters A B and C. A (1)—To make up a joint in a stranded conductor; (2) splice two conductors together; (3) prepare a wire brush; (4) bevel a brush; (5) restore a brush, the wires of which have been bent. B (1)—Put together a switch; (2) put together a push button; (3) make a fuse; (4) make a terminal; (5) make a socket to fit a given incandescent lamp. C (1)—Take a Leclanché cell to pieces and set it up again; (2) take a vibrating bell mechanism to pieces and set it up again; (3) to cut a bell or a galvanometer into a given circuit; (4) being provided with a battery, a bell and a push button, to arrange them properly in circuit.

POWER FROM THE RHINE.—The great Niagara enterprises of the United States and Canada are being imitated in some of the Swiss cantons along the Rhine. The actual work has been for some time under way, and will reach completion before long, when there will be some 1600 horse-power developed by twenty turbines ready for distribution. The greater part of the output is already contracted for by private individuals and companies, who will consume it in their own service. Simultaneously with the completion of the hydraulic developments it is expected to complete a large aluminum factory, which will absorb some 2000 horse-power. This industry has assumed considerable volume in Switzerland, and may even come into competition with similar works in the United States. The falls of the Rhine are also to furnish electric power for a railway from Frich to Aarau. The hydraulic work, which will be at Rheinfelden, has been started. The application of electricity to power work is bound not only to make great changes in the operating conditions of existing industries, but it should open up an industrial future of a magnitude scarcely conceivable at present for countries like Italy and Switzerland, where water courses are numerous and may be readily utilized for the production of cheap electrical power.

ELECTRIC TRACTION ON CANALS.—Experiments have been going on with a new electric towing machine built at the shops of the firm of Detombay & Delange, at Hoboken-lez-Anvers, after drawings made by M. Maurice Delange. The dimensions of the boat are: Length, 50 feet; breadth, 11½ feet; depth, 8 feet; draught, 5 feet 9 inches. A Jaspar-Melotte motor is mounted directly on the screw shaft. Current is generated by gas engines fed by carburetted air, according to a system patented by the Aeropetrole Company. With electrical machinery having an efficiency of 85 per cent. better economy is obtained in this way than would be the case if the gas engines acted directly on the screw. Moreover, it is easier to arrange for change of speed. The gas engine is rated at 25 horse-power. This form of prime mover has the advantage of absence of boilers, coal bins and stoker. The boat can be got under way at a moment's notice, and intermittent working is possible without the necessity of keeping up the fire. These qualities, of course, carry with them absence of smoke and smell and any superfluous weight. The simplicity, precision and economy of this machinery make the boat an almost ideal traction machine; it would seem to be the true solution of a problem that has long bothered engineers. The cost of operation is brought down to one-fifth cent per ton kilometer. The ability, when once started, to manufacture its own gas as needed renders this motor almost indispensable in places where overhead lines cannot be erected. The carburator weighs about 2200 pounds. The cooling of the cylinder and the carburator is accomplished by a stream of cold water, which circulates between them continuously. The exhaust gases are recarburetted and are used for lighting and heating the boat. The electrical part of the outfit was furnished from the Jaspar establishment at Liège. The generator runs at 550 to 600 r. p. m., and at 500 volts normally. The motor revolves 300 times per minute under full load; it has four poles and the armature is drum wound. The fields are of steel, and the winding, which is in series, is in sections. A controller arranged by M. Melotte, director of the Jaspar shops, provides a very heavy starting torque and a quick start. Reversal of direction is obtained by a switch, which reverses the current in the [illegible]

General News.

NEW INCORPORATIONS.

THE ACME ELECTRIC LAMP COMPANY, New Brunswick, N. J., has been incorporated with a capital stock of $500,000. Incorporators: Louis A. Jackson, Ralph W. Booth, Ralph W. Booth, Jr., New Brunswick, N. J.

THE CARTER-HAYS ELECTRIC COMPANY, Louisville, Ky., has been formed for the purpose of manufacturing, repairing and selling electrical apparatus. [illegible] J. D. Carter, J. W. Hays and H. C. Hays. [illegible]

THE DELAWARE COUNTY ELECTRIC LIGHT & POWER COMPANY, Clifton Heights, N. Y., has been formed to supply light, heat and power by electricity. Among the incorporators are C. M. Wagner, E. O. Kane, Lansdowne; R. S. Austin, Philadelphia; S. Haigh, Aldan, and J. S. Austin, [illegible]

THE ST. PETER TELEPHONE COMPANY, St. Peter, Minn., has been [illegible] telephone [illegible] H. P. Proctor, [illegible] Proctor, Frank A. Chase, J. H. Chase, Viroqua, Wis., and Walter S. Proctor, St. Peter, Minn. [illegible]

[illegible]

THE TELEGRAPH AND TELEPHONE.

[illegible]

[illegible]

[illegible]

[illegible]

DOYLESTOWN, PA.—The Standard Telephone Company will invite proposals for the extension of its line from Newtown to Doylestown and from Eden to Bristol. It is proposed to later extend the line from Newtown to Trenton via Yardley and Morrisville.

WAUKESHA, WIS.—The Wisconsin Telephone Company has commenced the erection of a metallic circuit line from here to Elkhorn by way of Genesee, Eagle and Mukwonago. The old grounded line between here and Mukwonago will be abandoned as soon as the new line is built.

NEW HAVEN, CONN.—The Southern New England Telephone Company has mortgaged its property to the New Haven Trust Company for $1,000,000. The money will be used to pay off the present mortgage and to make improvements on the line. Five per cent. fifty-year bonds will be issued to cover the amount.

SHARON, PA.—A movement is on foot to consolidate the Citizens' Telephone lines of Lawrence and Mercer counties and extend lines to Meadville, Oil City, Franklin, Erie and Youngstown. R. H. Adams, a capitalist of Baltimore, has assumed control of the New Castle lines, and he is at the head of the project.

NORTH VERNON, IND.—William N. Turner and Emma B. Turner, of Canton, Mo., have been granted a telephone franchise by the common council of this city. Business houses are to be charged $1.50 a month and residences $1 a month. Long-distance connection will be over the Independent line, now constructed as far as Elizabethtown.

NEW YORK, N. Y.—At a meeting a few days ago of the Merchants' and Manufacturers' Board of Trade the telephone committee reported a legislative bill making it unlawful for any telephone company to charge over $50 a year for a local telephone service of less than 1000 messages in cities of 500,000 population and over. Another section of the bill provides that in the same size cities not more than 5 cents shall be charged for each message in excess of 1000. It is provided that violation of the law shall be punished by a fine of $100.

BOSTON, MASS.—The Massachusetts Telephone & Telegraph Company has applied to the city government for franchise rights to open streets, lay and maintain wires, etc., and public hearings are to be given on the question. The company was incorporated Nov. 23, with a capital of $10,000, but the petitioners declare that this amount is merely nominal, and that they have unlimited capital behind them. They propose a telephone service at less than one-half the Bell Telephone Company's rates, and claim that they will put wires underground and use instruments of the latest style. The five incorporators are Zephaniah H. Holbrook, of Cambridge; Frederick A. Spear, of Lowell; Silas P. Chase, of Reading; Wilbur F. Lakin, of Quincy, and Paul Faber, of Boston.

CHICAGO, ILL.—The United Telegraph, Telephone & Electric Company, of Chicago, has just issued $500,000 6 per cent. twenty-year gold bonds for the purpose of extending its present plant and to also make connections with outside cities and districts for long service to meet the demands of the people in the southern part and suburbs of the city. The proposed district to be embraced by this company contains more large factories than any territory adjacent or within the city's limits. The district embraces South Chicago, Hammond, Hegewich, Pullman, West Pullman, Kensington, as well as every other manufacturing district in this section of the city. The directors are Thomas W. Sennott, John G. Earle, James S. McConnell, W. B. Owen, James D. Lacey, Edward P. McConnell, Joseph N. Hagins, Hugh A. Holmes, J. E. Smith, mechanical superintendent and electrical engineer for P. D. Armour & Co.

PHILADELPHIA, PA.—Councils' electrical committee has agreed to report favorably to councils the ordinance to amend the ordinance granting privileges to the Standard Telephone Company, under which the company is held by the city authorities to be in default, and on account of which alleged default the city solicitor has brought suit for the forfeiture of the company's bond of $100,000, with the bankrupt Chestnut Street Trust Company as surety. The principal "amendments" to the bill, which was assumed to have become defunct through failure to comply with its provisions within the specified time, give the company the right to erect wires "over and across" the streets of the city, to purchase or lease conduits belonging to the city or other corporations, to mortgage its property and franchises to secure its bonds, and extending to ten years the time in which it must be prepared to furnish 2000 telephones to subscribers.

WASHINGTON, D. C.—The Cuban telegraph lines will be operated and controlled by the United States Government, inasmuch as they belonged to the Spanish Government and were not private property. They cover about 2000 miles. General Greely has ordered Colonel Dunwoody of the Signal Corps to go to Cuba and take charge of the lines. Colonel Dunwoody will make his headquarters at Havana. The lines will be repaired by Cubans, under the direction of the Signal Corps. All the military camps are to be connected by telegraph. Several lines have been constructed in Santiago province and [illegible] del Rio, and the work of constructing a line from Puerto Principe to [illegible]. Companies of Signal Corps men are at Santiago, Puerto Principe, Pinar del Rio and Havana, but it is proposed to considerably augment this force when the Government takes charge of all the lines.

CLEVELAND, OHIO.—The Cleveland Electric Illuminating Company has [illegible] against the Home Telephone Company, the Reserve Construction Company and Maxine Reber to enjoin the defendants from carrying out their [illegible] in the erection of the lines of the Home Telephone Company. The petition says that the defendants are proposing to erect poles near the poles of the plaintiff, upon the same side of the street, and to string wires in [illegible] which, it is claimed, will endanger the lives of the employees and of the general public. It is also claimed that the [illegible] will be in danger. It is further claimed that the proposed [illegible] a violation of the plaintiff's rights, [illegible] to erect poles without interfering [illegible]. Judge [illegible] granted a temporary restraining [illegible] in the sum of [illegible]

ELECTRIC LIGHT AND POWER.

FLINT, MICH.—The People's Electric Light Company, of Flint, will double the capacity of its plant at a cost of about $25,000.

CRAWFORDSVILLE, IND.—Messrs. Carr & Niestadt, of this city, have just completed a 100-light plant for the Yount Woolen Mills, Yountsville, Ind.

ROCHESTER, N. Y.—Mayor Warner intends to send a communication to the Council in which he will recommend the establishment by the city of an electric plant to furnish light for the streets and all the municipal buildings, including the public schools.

CLINTON, ILL.—At a regular meeting of the City Council the question of municipal ownership of electric lights was discussed. The light committee was instructed to investigate municipal ownership and report as soon as possible. The electric light company would be willing to let the city purchase its plant.

ST. AUGUSTINE, FLA.—The Florida East Coast Hotel System is now wiring and installing a new plant at the Royal Victoria Hotel, Nassau, N. P., Bahama Islands. A new plant will be installed in the Hotel Ormond at Ormond, Fla., iron conduit being used in the wiring. All this work is being carried on under the supervision of Mr. A. T. Best, electrical engineer for the hotel system.

HAGERSTOWN, MD.—The City Council unanimously passed an ordinance to establish a municipal electric light plant, and providing for the sale of $60,000 of bonds to pay for the plant. The present contract for lighting the town is with the Hagerstown Railway Company. The city contends that the contract expires two years hence. The company claims it runs for seven years longer. Mayor E. M. Schindel signed the ordinance.

WESTERVILLE, OHIO.—On December 1 the lights of the new Westerville Electric Company were turned on for the first time, and the forty-six 32-cp incandescents and ten arc lights illuminated the town far better than anyone had expected. Mr. E. S. Aldrich, the manager, says that the demand for private lighting is great, and several hundred lights will be immediately wired into stores and houses. The contract with the town is for five years at $1200 a year, twenty-five nights each month.

WASHINGTON, D. C.—One of the naval surgeons has reported against the present system of lighting warships by electricity. The protest is contained in a report submitted to Surgeon-General Van Reypen by Passed Assistant Surgeon E. P. Stone, who has been stationed on board various naval ships, and who is now on duty in Washington. He notes that medical literature is beginning to furnish cases of eye affections, and even blindness, resulting from the improper use of electric lights. The subject is a serious one, Dr. Stone says, and should engage the attention of the authorities. He adds: "I have myself seen several cases in the service which I considered directly due to improper use of electric lights, and which were relieved by using the light properly placed. This subject is the more important in that it is so easily remediable. Ground glass bulbs and proper position of the lights will do away with all the bad effects. As yet laymen do not appreciate the importance nor understand the principles of this subject. In officers' rooms, which are furnished with portable lights, it is rare to see the lights placed properly. This subject of the location of the lights in the living spaces of a ship, being of so much hygienic importance, should be determined by a board of medical officers."

THE ELECTRIC RAILWAY.

WARREN, OHIO.—The Cleveland & Chagrin Falls Electric Railway Company has bonded its line for $300,000, and will build an extension to Warren at once.

HARRISBURG, PA.—A charter was granted to the Allentown & Slatington Electric Street Railway, which is to be operated between those two points with 17 miles of track. The capital stock of the corporation is to be $200,000.

WASHINGTON, D. C.—The large, barn-like car-shed of the Eckington & Soldiers' Home Railroad Company, at the corner of Fourth and T Streets, northeast, was totally destroyed by fire. About thirty cars were destroyed in the fire. The total loss is estimated at $65,000.

BALTIMORE, MD.—It is stated that the controlling interest in the Baltimore City Passenger Railway Company has been secured by the Baltimore & Northern road. The latter was a suburban feeder for the City Passenger Railway. It is stated that the price paid per share was $90.

NEW YORK, N. Y.—The Union Railway Company has started to run cars between One Hundred and Twenty-ninth Street and Third Avenue and Yonkers, on which passengers are only charged a fare of 5 cents. The company declares that this is the longest ride to be had in the country for a 5-cent fare, the distance being 14 miles.

NEW YORK.—The stockholders of the Metropolitan Street Railway Company, of this city, at their meeting last week, re-elected the old board of directors, as follows: H. H. Vreeland, W. L. Elkins, Thomas F. Ryan, Charles E. Warren, Henry P. Whitney, P. A. B. Widener, Thomas Dolan, D. B. Hasbrouck, and H. A. Robinson.

NEW YORK, N. Y.—Deputy Commissioner Quinn of the Department of Street Cleaning has been trying to get the surface railroad companies in Brooklyn to pay their share of the expense in clearing snow from the thoroughfares in which trolley cars operated. He has failed to secure the co-operation of the companies, and has now placed the matter in the hands of Assistant Corporation Counsel Chittenden, who will bring an action against each of the companies to compel them to pay part of the expense in clearing the snow from the streets, as is required by an ordinance adopted by the Common Council in Brooklyn in December, 1895.

NEW YORK, N. Y.—Before the Municipal Assembly, on December 22, residents of New York city north of the Harlem River will oppose the unconditional extension of the Third Avenue and Metropolitan Railway Companies' lines into the Bronx. These residents wish to exact from the corporations named an agreement to carry passengers from one end of their lines to the other for 5 cents each, and to construct all proposed lines within a reasonable time, not exceeding two years. They are opposed to granting any more franchises unless such an ironclad agreement is incorporated in the concession and a guarantee given that the contract will be faithfully carried out.

NEW YORK.—The Metropolitan Traction Company has begun to operate its Sixth and Ninth Avenue lines as far south as Canal Street. Electric cars will be run to the terminal at Canal Street and Broadway, and transfers will be given at that point to the Broadway cars. A date has been set for the change in motive power on the Broadway line. It is now said that June 30 will see the electric cars in use there. It was at first thought that the line would have to cease operations for several days while the change is being made. The engineers have overcome this by a device in the construction of the conductor bars, so that the cable and electric power can be operated at the same time. In this way the change will be a gradual one, and will embarrass neither the company nor its patrons.

TAUNTON, MASS.—At a meeting of the directors of the Taunton Street Railway Company, H. Frank Bassett was chosen president, George A. Washburn treasurer, and Fred S. Hall attorney. The company is contemplating putting in storage batteries in its power station in this city, not because the power at present is overtaxed, but in the interest of economy. At present the two engines run in such a manner that much power is wasted. The engines in that period will probably run ten or fifteen minutes and will do nothing for the rest of the hour. When the storage batteries are put in it will be possible to discontinue running one of the engines, while the other will then have enough work to keep it running all the time. The storage battery will furnish the rest of the power needed.

WILMINGTON, DEL.—About January 1 the Wilmington and Chester Traction Company expects to open its through line between Wilmington and Philadelphia. This company, which acquired control of the street railway systems of Chester and Wilmington a year or more ago, has reconstructed a portion of the lines in both cities, and put the systems in good physical condition. The link connecting Chester and Wilmington is almost completed. The time between Fourth and Market Streets, this city, and Broad and Chestnut Streets, Philadelphia, will be about two and one-half hours, more than twice as long as the time trains on the Pennsylvania and Baltimore and Ohio Railroads require to make the trip between the stations in the two cities. The fare will probably be 30 cents for the single trip, which includes the fare on the Union Traction cars from Darby into Philadelphia, and 3 cents more if it is necessary to get an exchange. This will be 60 cents for a round trip. The fare on the steam roads for a round trip is $1.

HARRISBURG, PA.—Reports received at the Department of Internal Affairs show that ninety-four street railway corporations, with a total capital stock outstanding of $100,909,335, are operating in Pennsylvania. Of this amount about $24,500,000 is issued by the Traction Company of Allegheny county. In addition to the amount of stock of lesser companies there is $56,027,922 of corporations whose lines are operated by lesser companies. The total stock capitalization of street railway corporations in the State is $156,937,257. The bonded indebtedness of operating street railway companies is $32,440,850, and the current liabilities are $14,229,491. The funded and unfunded debt of non-operating railways is $40,810,690, showing a total of bonded and floating debt of $87,481,031. The total capitalization, including bonds and floating indebtedness, is $244,418,288. The total operating expenses of street railway companies of the past year were $9,486,573. In addition there was paid $1,211,135 in taxes, $2,250,797 interest on funded debt, $6,089,871 rentals, $256,367 other expenses and $804,169 dividends, or a total of $20,096,912. This aggregate does not include any disbursements of lesser corporations. The total mileage of street railway tracks is reported at 1,422.84, and the aggregate length of tracks operated at 1,708.32. The number of cars owned is 6,616; number of employes, 12,680; total compensation of employes, $6,542,840, and number of passengers carried, 432,779,314. The total number of passengers killed during the year was fifteen, and the number injured 506. The total number of passengers, employees and others killed was 106, and injured, 1,101. The Secretary of Internal Affairs condemns the methods of capitalizing street railways by some companies. He also calls attention to the consolidation and merger of some companies without sanction of law. He suggests that additional legislation providing for better supervision of street railways should be passed in order to prevent capitalization at three or four times the probable cost of the road.

EDUCATIONAL NOTE.

THE ANNOUNCEMENT of the college of engineering of the West Virginia University, Morgantown, W. Va., gives complete information regarding the course of instruction at this university. The instruction in electrical engineering possesses some unique features. It is conducted on the four-quarter system by which students may prosecute their work uninterruptedly and to equal advantage in summer and winter. Another feature is the two-year electrical certificate course for those students who want to have a thorough grounding in elementary theory and practice of electrical engineering work, without being required to meet all the conditions for admission and graduation of the regular four-year courses. The fourth or senior year in the regular four-year mechanical engineering course is made elective, the students having the option of taking either the electrical or mechanical alternative that year. There are also elective electrical engineering studies for students pursuing scientific branches in the regular four-year courses in the university. The only preparation necessary for the two-year electrical certificate course is in those branches of English, physics and mathematics necessary to intelligently pursue the course. This brings it within the reach of many young men engaged in daily work who have not had the advantages of high school or college training. Students who enter these courses are not obliged to lose the summer vacation between sessions, but may carry on their work at the university during the summer quarter as at any other time in the college year. Under this new system of university organization students may enter upon their work on January 1 next or at the beginning of any other quarter.

Legal Notes.

THE SERIES PARALLEL CONTROLLER CASE.—The preliminary injunction ordering the Nassau Electric Railroad Company, of Brooklyn, to cease using four types of railway controllers manufactured by the Steel Motor Company (see The Electrical World, September 3, page 251) has been sustained on appeal to the Circuit Court of Appeals, by Judge Shipman, the text of the opinion having been filed December 7.

CONTRACT BY TELEPHONE.—In reply to an inquiry the "New York Journal of Commerce and Commercial Bulletin" prints some facts based on legal decisions concerning bargains made by telephone, which are of sufficient general interest to justify their republication in this department. "A contract for the sale of goods made over a telephone," it states, "stands upon the same footing as a verbal contract made without the intervention of the telephone. No part of the purchase price being paid, and no part of the goods delivered, the contract is not enforceable if the price of the goods sold is $50 or more; if the price is less than $50 the contract is as valid as if it were written. The statute of frauds of this (New York) State provides, in case where there is no delivery and no payment or part payment, that every contract for the sale of any goods * * * for the price of $50 or more, shall be void unless a note or memorandum of such contract be made in writing and be subscribed by the parties to be charged thereby."

Trade and Industrial Notes.

MESSRS. HUEBEL & MANGER, Brooklyn, N. Y., are carrying a large assortment of standard cast-bronze push buttons in oxidized copper finish, and report that they are selling a great many of them.

THE SIOUX CORLISS ENGINE at the Omaha Exposition has been awarded the gold medal. This engine was built by the Murray Iron Works Company, of Burlington, Ia., and it was in continuous operation, twenty-four hours per day, during the greater part of the Exposition.

ENGINEER'S POCKET DIARY.—The "Mechanical World," which is published in Manchester, England, has issued a Pocket Diary and Year Book for 1899. It is substantially bound in cloth, and contains a collection of useful engineering notes, rules, tables and data. The diary feature gives space for every day in the year.

"LIGHT" is the title of a little pamphlet issued by the Westinghouse Electric & Manufacturing Company, on the subject of arc lamps of the long-burning type. The Westinghouse Company is manufacturing long-burning arc lamps for both direct and alternating current. The direct-current lamps are designed for 110, 220 and 500 volt circuits. Those for alternating-current work are said to [illegible] and to give a steady light.

MEDAL FOR TELEPHONE APPARATUS.—The Pennsylvania Electric Company, of Marietta, Pa., announces that it has received the highest award—a medal—from the Trans-Mississippi and International Exposition at Omaha on its telephone apparatus. The company is naturally elated over its good fortune. It is busy just now filling an order from the Independent Telephone Company of Lancaster County, Pa., for 2000 telephones.

THE LA ROCHE CIRCUIT BREAKER.—The circuit breaker manufactured by Messrs. F. A. La Roche & Co., New York, is the subject of patent No. 615,395, issued December 6, to Mr. F. A. La Roche. This breaker, which is now quite well known, embodies two knife switches running in vertical slides with following carbon breaks, their latches controlled by two triggers, both struck by the armature of the solenoid between them.

PHOSPHOR-BRONZE CASTINGS.—The Standard Brass Works, Kalamazoo, Mich., are making a specialty of phosphor-bronze castings for manufacturers of dynamos, motors and engines, both steam and gasoline. The works [illegible] manufacturers. Those concerns who have no brass foundry of their own will do well [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] country.

[illegible]

Trade School has recently placed in operation two 70-hp engines of its make, each being direct connected to a Siemens & Halske generator. It also reports that the electric plant at St. Agnes' Hospital, Philadelphia, which is equipped with two Ball engines, direct connected to Eddy dynamos, is now in operation. The Billings Water Power Company, Billings, Mont., has recently placed in operation a 150-hp tandem compound engine of the Ball Engine Company's make.

STANLEY INDUCTION MOTORS.—The Western Electric Company, Chicago, for the purpose of promptly filling orders, now carries a complete stock of Stanley induction single-phase and two-phase motors. The former are made only in two sizes, viz., one-fourth and one-half horse-power, for either 50 or 100 volts and for 8000 to 16,000 alternations. The two-phase motors (for either 8000 or 16,000) range in sizes from 1 to 40 horse-power. A complete stock of motor transformers is also carried. Full description and prices will be sent to those who are interested.

THE SAFETY THIRD-RAIL ELECTRIC COMPANY has just issued a pamphlet very completely describing and illustrating the Murphy sectional-conductor system. The difficulties encountered in many of the earlier systems of this class and how they are overcome in the Murphy system are pointed out. The various systems referred to are illustrated, thus enabling a better comparison between them and the Murphy system. Some important improvements have been made in the details of the Murphy system, the principal features and the operation of which were described and illustrated in The Electrical World of January 29, 1898.

MR. D. W. PHELAN, 280 Broadway, New York, dealer in ties and poles, reports a very successful year. The use of octagonal yellow pine poles appears to be increasing. Mr. Phelan furnishes these direct from his own mills in the South, either painted or treated with a creosote preparation which doubles the life of the pole, while adding only a trifle to the cost. He has handled many of the largest contracts that have been placed the past year, and looks forward to an increase of business in 1899. In addition to the above Mr. Phelan represents the Michigan Pipe Company in New York and vicinity for the sale of its creosoted wood conduit.

MESSRS. MACHADO & ROLLER, 203 Broadway, New York, state that their business is showing a marked and very steady increase in volume. Their new dead-beat Whitney portable and switchboard instruments are being used and specified by a large number of the most prominent consulting engineers in the city, and reports of very flattering character on the performance of their A. E. G. lamps are being received almost daily. A large stock of both is carried by the firm so that their clients' orders may receive prompt attention. They are always glad to have their friends call to see them and inspect the various new appliances that they bring out from time to time.

THE D. M. STEWARD MANUFACTURING COMPANY, Chattanooga, Tenn., has every reason to be satisfied with existing trade conditions. It reports that the volume of its business is now greater than ever before, and that it has of necessity been running its factory night and day for a long time. This refers to all departments of the company's work, but especially to the lava insulator department. The lava electric insulators manufactured by this company have a high reputation for quality and serviceability. In a recent competitive test between this company's Special Union Jet Burner and a well-known burner of English make the result was decidedly favorable to the American burner.

MONTAUK MULTIPHASE CABLE has received the careful consideration of the Boston Fire Department, which has made an official investigation into the merits of this type of cable. The report of Mr. B. S. Flanders, superintendent of the fire alarm, Boston, the gentleman who conducted the experimental investigation, states that the cable appeared to him to be a valuable adjunct for use in any automatic fire-alarm service dependent on the action of thermostatic devices for its operation. He based his opinion on the fact that the cable is so constructed as to be thermostatic throughout its entire length. He believes that this cable is superior to the isolated thermostats used in the present automatic systems.

THE ERIE GAS ENGINE COMPANY, Erie, Pa., has just finished the building of a two-cylinder 200-hp gas engine for the McCoy Plate Glass Company, of Kane, Pa. This engine was recently shown in operation at the Erie company's works, and was developing its rated horse-power on a consumption of [illegible] feet of natural gas per horse-power hour. The company is doing a [illegible] in the manufacture of gas engines, and has several orders in hand now being filled for delivery to various parts of the country. One of these includes a 100-hp engine to go to the Empire Mills at Olean, N. Y. It is stated that the difficulties of starting large gas engines have been satisfactorily overcome by the Erie company.

A WEATHERPROOF BELL.—Messrs. [illegible] & Co., [illegible] Street and [illegible] Avenue, New York, have perfected a bell which is designed for use in exposed places, such as mines, railroad stations, factories, etc. It is the invention of [illegible] of the firm, and is claimed to meet all the requirements of a bell for use under such conditions. The motion of the hammer is direct [illegible], and does not [illegible] on a pivot. It is made either single [illegible] or vibrating, and the vibrations are so rapid that when used to give signals they are more positive than when given by single strokes. The case [illegible], and the hammer is adjusted from [illegible]. The bell will work in any position, and is [illegible]

[illegible] one branch of an important industry in the mechanical [illegible] the degree of special consideration in the [illegible] "Dies and Die Making," and published by Messrs. [illegible], Providence, R. I. The author, Mr. J. L. [illegible] and punches for [illegible]. A good deal of [illegible] and the work will no doubt [illegible] hand, and [illegible] bound in cloth.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., calls attention to the fact that its improved induction sewing-machine motor makes a useful and acceptable Christmas present in any household. These motors are particularly adapted for use by inexperienced persons, and the entire device is easily attached to any make of family sewing machine. By a slight movement of the sewing-machine treadle the motor may be started, stopped or the speed regulated. This motor is said to be thoroughly practicable, and is fully guaranteed to give perfect satisfaction in every way. In order to fill orders promptly, however, it is necessary when ordering to state the voltage and alternations of the current to be used, the direction in which the hand wheel of the sewing machine revolves and the style of plug and socket.

THE INTERNATIONAL ELECTRIC COMPANY, 76 Beekman Street, New York, has been busy during the past year in the manufacture of large coils for X-ray apparatus. It has been carrying on considerable work in the construction of apparatus for the production of ozone for use in the purification of liquids and the preservation of solids. The company states that this work is of great consequence, and claims that it will open up new lines for thought and business possibilities. The company is constantly called upon to work out theoretically as well as practically many knotty problems in the experimental line, some of which having merit may be heard from sooner or later. The International Electric Company does a great variety of work, such as conducting experiments, designing, manufacture of small machinery, motors, fans, cigar lighters, milling machine work, etc., etc., and has added some new machinery in order to better handle its business, which is constantly growing. It reports that it will soon be necessary to secure larger quarters.

LIGHTING SHOW WINDOWS.—At this time, when the streets are thronged with holiday crowds, it is interesting and instructive to note the difference in effect between store windows lighted at night in the ordinary way with incandescent lights in full view and those lighted by the Frink store window reflector, where no lamps show, but where there is an abundance of light. The comparison is unquestionably favorable to the Frink system, for exposed incandescents, by their greater brilliancy, distract the eye from the goods displayed, and often make it impossible to see the goods effectively. In order that an object may be seen with the least strain upon the eyes, the source of light should be behind the person, and this is the cardinal principle of the Frink system. It consists of a hood-shaped reflector running along the side of the glass at the top of the window. Inside the reflector the incandescent lamps are placed. The shape of the reflector shields the lamps from outside view and reflects all the light within the windows. Full information regarding this method of lighting windows may be obtained by addressing I. P. Frink, 551 Pearl Street, New York.

QUICK WORK IN FURNISHING BELTS.—A remarkably quick piece of work was recently accomplished by Messrs. Charles A. Schieren & Co., belt manufacturers, New York City. On December 1 a steam pipe burst in the station of the Virginia Electric Light Company at Norfolk, Va., and the escaping steam ruined the belts. Mr. Peter Wright, the superintendent of the station, at 10 o'clock on the morning of December 2, telephoned to Messrs. C. A. Schieren & Co. that he wanted 77 feet 8 inches of 36-inch three-ply leather belt, 120 feet of 10-inch double leather belt, 220 feet 12-inch leather belt, and 120 feet 17-inch double belt, stating that he must have it all immediately. All of the belts were shipped by express on the same afternoon, and that night a man was sent down from New York to put them in. On the night of December 3 all the belts had been placed and were in running order. Messrs. Schieren & Co. have recently fitted up the new municipal electric light station at Madison, N. J., with a complete equipment of belts, including one 48-inch, one 42-inch, two 18-inch and one 13-inch double belts and numerous single belts. The firm is doing a large business with Cuba, Australia and Hawaii, and its export trade is rapidly increasing.

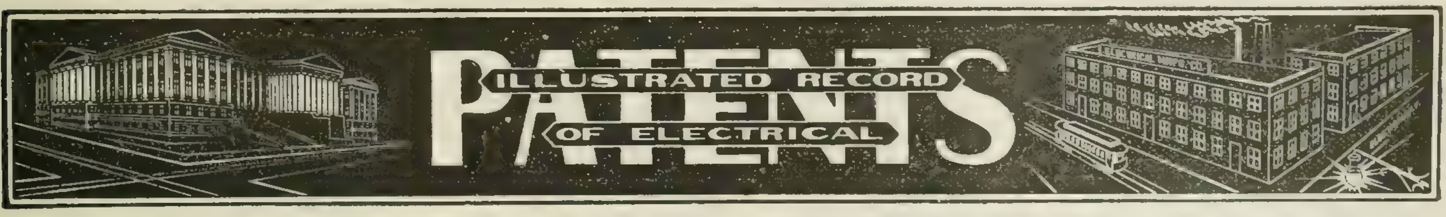
CABLE TESTING APPARATUS.—Mr. James G. Biddle, 910 Drexel Building, Philadelphia, has recently issued a new catalogue of electrical measuring instruments, in which are described apparatus for testing resistance, insulation and capacity of aerial, underground and submarine cables. Portable outfits, as well as equipments for station use, are carefully described and should be very interesting to all who have occasion to make measurements. Mr. Biddle's experience in this line of business covers ten years or more. Among his recent customers for cable-testing equipment may be mentioned the following: The Union Traction Company, Central District & Printing Telegraph Company, Hartford Electric Light Company, St. Anthony Falls Water Power Company, Postal Telegraph Cable Company, Valley Telephone Company, Safety Insulated Wire & Cable Company, Borough of Manhattan Electric Company, Washburn & Moen Manufacturing Company, Central Union Telephone Company, District Engineer, Washington, D. C.; Tucker Electrical Construction Company, St. Louis Electric Construction Company, New York Telephone Company, Cataract Power & Conduit Company, War Department United States Government, San Francisco Fire Alarm & District Telegraph, Delaware & Atlantic Telegraph & Telephone Company, etc., etc.

THE WESTINGHOUSE MACHINE COMPANY, Pittsburg, Pa., has just issued a 96-page pamphlet on its compound engine, which is unique in the line of catalogue work. It gives a description in detail of the construction of the Westinghouse engine, and makes extremely interesting reading. The pamphlet makes the following interesting observation on the subject of direct connection with dynamos and generators: "The company believes that from an engineering standpoint the spring-coupled outfit furnishes the best solution of the problem. The question of perfect alignment of bearings is eliminated, contributing to cool running and making the effect of unequal wear in engine bearings and dynamo bearings negligible. The cushioning effect of the spring transmission in absorbing shocks due to sudden changes of load or to accidental short circuits must of necessity be beneficial both to engine and generator. There exists, however, partially on account of greater compactness, partially because of the difference in cost between a complete dynamo and a simple armature and field frame without shaft or bearings, and partially on account of individual preference, for which it would be difficult to assign a reason, a demand for a construction involving the extension of the engine shaft carrying the armature and supported by a single bearing at the outer end." The pamphlet is very completely and artistically illustrated, many of the cuts showing the details of the engine. Very rarely, indeed, is a subject so thoroughly covered in trade literature as has been done in this case, and the reading matter in connection with the illustrations cannot fail to give to those entirely unfamiliar with the engine a very thorough comprehension of its construction and operation.

Business Notices.

THE ILLUSTRATIONS in this issue were made by the Photo-Engraving Company, 9-15 Murray Street, New York City.

AN UNPARALLELED TIME RECORD was made every day during the period of the Omaha Exposition by the trains of the Chicago, Milwaukee & St. Paul Railway on its Chicago & Omaha Short Line. Although its trains hauled from ten to thirteen well-filled sleeping cars and coaches each night, yet schedule time of arrival at Omaha and at Chicago was an accomplished fact—a record to be proud of, and which has resulted in establishing the Chicago, Milwaukee & St. Paul Railway in the minds of the traveling community as the shortest, best and most reliable route from Chicago to Omaha, as well as to California. All coupon ticket agents sell tickets via the Chicago, Milwaukee & St. Paul Railway. For information regarding the line address William Kelly, Jr., General Eastern Passenger Agent, 381 Broadway, New York.



UNITED STATES PATENTS ISSUED DECEMBER 6, 1898.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

615,209. ELECTRICAL HINGE CONTACT; C. Baxter, of New York, N. Y. App. filed Nov. 21, 1895. In an electrical connection for hinges, the combination with one flap of a hinge, of a spring contact located thereunder and having a portion thereof curved over the roll of said flap, and a contact located under the other flap and in rubbing engagement with the curved portion of the spring contact. (This patent was issued November 29, 1898.)

615,419. RHEOSTAT; Charles Wirt, of Philadelphia, Pa. App. filed July 26, 1897. In a rheostat, the combination with a casing, of a continuous electrical conductor folded within said casing, fixed contact pieces intermediate of said folds, a movable contact member mounted upon said casing, and means to shift said member in direct contact with the successive folds of said conductor.

615,246. ELECTRIC BATTERY; O. T. Bugg, Jr., of New York, N. Y. App. filed March 15, 1898. An electrical battery having a containing vessel of conducting material, in combination with a perforated interior cylinder also of conducting material, and a mass of active material, such as flaky lead, packed between the inner wall of said vessel and the cylinder, together with a zinc electrode rigidly secured to the cover of the vessel, which latter is constructed of insulating material, substantially as described.

615,265. ALTERNATING-CURRENT DYNAMO-ELECTRIC MACHINE; S. Ziani de Ferranti, of Hollinwood, England. App. filed Dec. 28, 1897. In an alternating-current dynamo-electric machine having a disc armature, the combination with the bobbins composing the armature, of separately insulated supports for said bobbins, and means for adjusting the armature radially and compressing the sections after the machine has been in use.

615,292. ELECTRIC BATTERY; M. Maas, of New York, N. Y. App. filed Sept. 7, 1897. In an electric battery, the combination of a zinc, a hollow carbon provided with a longitudinal recess, a binding post provided with a shank fitting said recess and with an opening in that end, a binding wire passing around the carbon and through said opening in the shank, and a copper-plating covering the upper part of the said carbon, binding-post and binding-wire, substantially as described.

615,244. TELEPHONE; F. Burger and H. M. Williams, of Fort Wayne, Ind. App. filed Aug. 16, 1897. A telephone apparatus, comprising a bar, a slidable handle mounted on the bar, contacts controlled by said slidable handle, and a crosspiece supporting the telephone instruments, substantially as described.

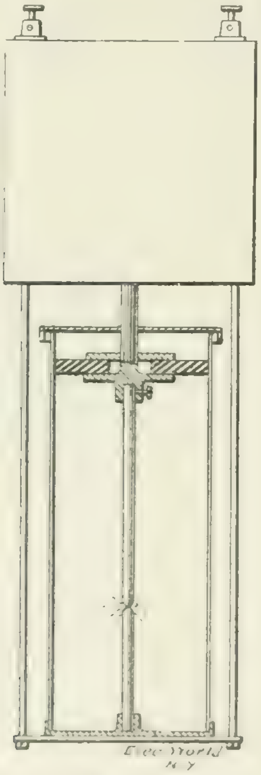
615,347. ELECTRIC SWITCH; W. Ely, of Providence, R. I. App. filed Aug. 14, 1896. In an electric switch having a rotatable shaft and a crank or crank arm rigidly secured thereon, and supporting means, combined with said parts, an arm open-slotted at one side and rotatably fitted upon said shaft and crank concentrically therewith and capable of partial rotation without reference to the movements of the same, a pivoted guideway adapted for oscillating movement, a crosshead adapted for reciprocating movement in said guideway and for oscillating movement therewith, and pivotally connected with the free end of said arm, and an extensible spring connecting said crosshead and the free end of said rigid crank or crank arm.

615,349. ELECTRIC CABLE CONDUCTOR; S. D. Field, of Stockbridge, Mass. App. filed Dec. 24, 1897. A cable conductor composed of the insulated wire or wires of an electrical circuit, and one or more iron companion wires or rods not included in such circuit, the said insulated wires and iron wires being interbraided or interlaced.

615,351. DYNAMO-ELECTRIC MACHINE; J. E. Fuller, of New York, N. Y. App. filed March 24, 1898. The combination with the field magnet, of an armature having a core and coil and an external circuit to a lamp, a governor at one end of the armature, and a spring to draw back the governor, such governor acting to lessen the magnetism in the armature when in contact with poles thereof.

615,365. ELECTRICAL APPLIANCE FOR ELEVATORS; J. H. Roberts, of Grand Rapids, Mich. App. filed Dec. 27, 1895. In electrical apparatus, the shafts, the arms and adjustably secured thereon, and the contacts on said arms, combined with the contacts for said contacts, and means for actuating said arms from the hoisting mechanism.

615,388. APPARATUS FOR OPERATING ELECTRIC SWITCHES; C. Hartdegen, of Newark, N. J. App. filed July 30, 1897. The combination with an electric switch, of a timepiece, its train of gear mechanism, its



No. 615,4[illegible].—Electric Arc Lamp.

[illegible] said [illegible]

615,4[illegible]. ELECTRIC ARC LAMP; [illegible], of New York, N. Y. App. filed June 3, 1895. In an arc lamp, a carbon operating rod or carrier, a carbon holder, an intermediate rod, and ball-and-socket joints at the ends of the intermediate rod connecting said carbon operating rod or carrier [illegible]

[illegible] therein with the upper carbon to retard the access of air to the arc.

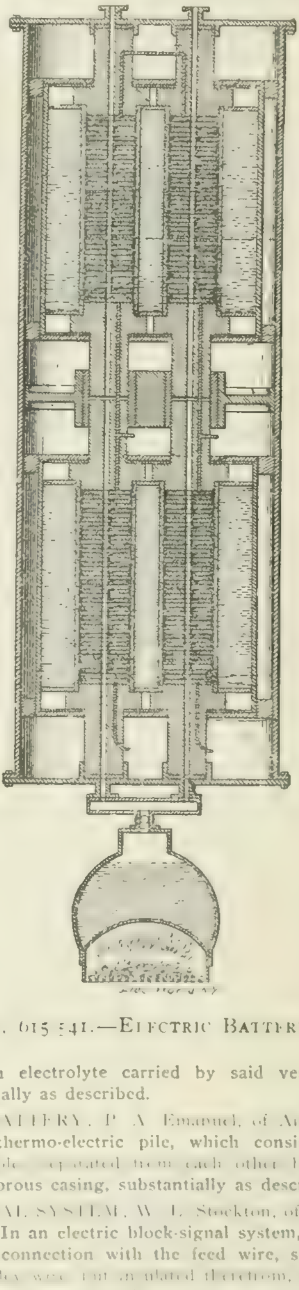
615,[illegible]. ELECTRICAL CONNECTION; W. E. Baker, of Chicago, Ill. App. filed July 13, 1896. In an electrical connection for railway cars, the combination with adjacent cars of a train, of a box mounted on the adjacent end of each car, a casting mounted therein, provided with a pair of contact-making devices, a link provided with co-operating contact making devices at each end thereof, one of said contact devices comprising a cylindrical [illegible]

[illegible]

[illegible]

615,5[illegible]. ELECTRIC BATTERY; P. A. Emanuel, of Aiken, S. C. App. filed May 17, 1898. A porous diaphragm for electric battery cells having enlargements upon each face thereof, said enlargements being impervious to the passage of fluids, substantially as described.

615,540. ELECTRIC BATTERY; P. A. Emanuel, of Aiken, S. C. App. filed May 17, 1898. The combination with a vessel, of a plurality of porous tubes passing through the said vessel, a voltaic pile carried within each of said tubes, and an electrolyte carried by said vessel and surrounding said tubes, substantially as described.



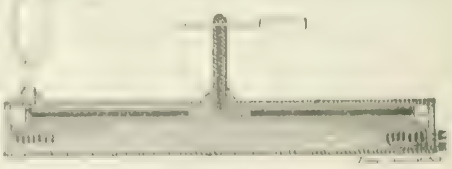
No. 615,541.—Electric Battery.

615,541. ELECTRIC BATTERY; P. A. Emanuel, of Aiken, S. C. App. filed May 17, 1898. A thermo-electric pile, which consists of a plurality of thermo-electric couples separated from each other by porous diaphragms and inclosed in a porous casing, substantially as described.

615,5[illegible]. BLOCK-SIGNAL SYSTEM; W. L. Stockton, of Trenton, Ohio. App. filed Dec. 20, 1897. In an electric block-signal system, a feed wire, a trolley wire having shunt connection with the feed wire, switch trolley wires at the ends of the trolley wire but insulated therefrom, a wire connecting the switch wires, a shunt between said connecting wire and the feed wire, an electromagnet in circuit of the shunt, a signal circuit, and a switch operated by the electromagnet for cutting in and out a connection between the feed wire and the signal circuit, substantially as described.

[illegible]. HIGH-FREQUENCY APPARATUS; T. B. Kinraide, of Boston, Mass. App. filed May [illegible]. In an induction device, a primary having end portions of less resistance and extended area, said portions consisting of [illegible], substantially as described.

[illegible]. HIGH-FREQUENCY INDUCTION APPARATUS; T. B. Kinraide,



No. [illegible].—High-Frequency Induction Apparatus.

of Boston, Mass. App. filed [illegible]. An induction apparatus, comprising [illegible] per turn diminishes as its [illegible] and continued to [illegible] described.

[illegible]. [illegible], of Hartford, Conn. App. filed May [illegible] a plurality of arms, [illegible] between the sides of [illegible]

The Electrical World.

VOL. XXXII NEW YORK, DECEMBER 24, 1898. No. 26.

PUBLISHED EVERY SATURDAY BY

THE W. J. JOHNSTON COMPANY,

9 Murray Street, New York.

Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York.

New England Office, 620 Atlantic Ave., Boston.
Western Office, 936 Monadnock Block, Chicago.
Philadelphia Office, 929 Chestnut Street.

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RELIABLE ELECTRICAL SIGNALS.

According to the statements of both Mr. W. D. Weaver and Mr. F. W. Roller, in papers recently read before the New York Electrical Society, abstracts of which may be found in other columns, electrical signaling and indicating apparatus on board of warships proved itself a general failure under the disturbing conditions of battle. There are required on shipboard many signaling devices, each designed to give a large number of different signals; for example, the engine-room telegraph should be capable of indicating at least six different desired conditions, and preferably more, and signals from the bridge or conning tower to other parts of the craft, such as the gunners' positions, from the latter to the ammunition rooms, etc., should also be capable of transmitting a considerable number of signals with as nearly absolute reliability as can be obtained.

One plan quite generally used is the provision of an indicator on the galvanometer or ammeter principle, the deflection of which is caused by a variation of the current strength supplied to it by means of a rheostat or equivalent device operated at the transmitting end. This is altogether too delicate for the extreme abuse which it is liable to receive in an active engagement. Another plan involves the use of a magnetically operated ratchet wheel, giving the indicator needle a step-by-step movement from signal to signal. The fallibility of magnets, pawls, springs, etc., is a prohibiting objection to this class of apparatus.

The same speakers pointed out the remarkable success of heavier electrical apparatus, such as the lighting and motor systems, and paritcularly the searchlight. The great value of reliable signals suggests the use for signaling purposes of apparatus comparable with this successful machinery. There is no reason why—on a vessel where the supply of electrical power is rarely interrupted and may be made for signaling purposes absolutely continuous by such means as reserve storage batteries—lamps or motors should not be used for signaling. The incandescent lamp has been proven by telephone engineers a reliable indicator, and one which has almost as great a power of attracting attention as an audible signal. A bank of compartments, each with an order mounted on a translucent dial capable of being illuminated from behind, would be a simple piece of apparatus, and the illumination of the various lamps could be effectively controlled from a distance. Audible signals could be readily combined therewith.

In cases where the mechanical operation of signaling devices is necessary the development of the magnet of annunciator proportions into a machine closely resembling a small electromotor may be made to give a mechanism much less delicate and capable of developing forces which will overcome any ordinary obstructive derangement. The most promising device of this kind is one developed in Germany and resembling closely in construction a bipolar synchronous motor. The armature is provided with three collector rings connected to the winding much as are the collector rings of a rotary converter. The supply of continuous current between any two of these rings sets up a powerful armature magnetization, which reacts on the field magnetization, giving a strong force tending to force the armature to and hold it in a certain fixed angular position. The switching of the current across another pair of the three rings moves the armature forcibly to another position, and a movement of the motor armature may thus be obtained synchronous with that of the handle of a proper switching device at the transmitting end of the signaling circuit. Many other solutions of the difficulty suggest themselves, all dependent only on the continuity of supply of electric power in quantities greater than that obtained by the ordinary primary battery. This assured, electrical signals could be made as reliable as incandescent lamps or motors.

EXPIRATION OF THE MULTIPLE SWITCHBOARD PATENT.

On January 17, 1899, the fundamental patent No. 252,576, issued to Leroy B. Firman and covering broadly multiple telephone switchboards, will expire by limitation. The claim of this patent reads as follows: "The combination of two or more switchboards at the central office of a telephone exchange system, to each of which the same telephone lines are connected, whereby any two of these lines may be connected together upon either of the multiple switchboards."

This patent has been owned by the Bell Telephone Company, and its existence has absolutely prevented any independent manufacturer from making or any independent operating company from using a multiple switchboard. Many transfer systems—all involving the work of two operators to complete a telephone connection in all instances except where the line wanted might terminate within arm's reach of the answering operator—have been devised, and their advocates have claimed that they equaled or excelled in merit the multiple switchboard. This contention can hardly be sustained. The multiple board gives a more prompt and simple system in operation for exchanges accommodating between 500 and 5000 lines. Above the latter number the multiple board—especially if there are any series circuits through the jacks—involves such a mass of connections that its cost and complexity and liability of faults may overbalance the comparative promptness of service. It is well to note that the complexity increases as the square of the number of subscribers connected.

The expiration of the fundamental patent leaves, of course, many detail patents still holding, chief among which, perhaps, is the "busy test" used by the Bell companies; but these details are probably not sufficiently broad to prevent many non-infringing solutions of equal merit of the problems involved. The patents on a multiple arrangement of the instruments in a telephone line—that is, on the connection of the various jacks and drops of one line in multiple with each other between the two wires of that line instead of in series with each other, will necessitate independent boards being built with jacks all connected up in series, and bad contacts in this case will be more troublesome than with multiple connections. This difficulty is not very great, however, until the board [illegible] than eight or ten multiple positions, and [illegible] will not [illegible] reach this [illegible]

THE DECLINING USE OF RUBBER AS AN INSULATOR.

[illegible]

used, but treated or saturated with insulating compounds that increase its breakdown strength, and cables are now regularly put out with paper insulation of a thickness per thousand volts of 1-16 of an inch. For overhead series arc lighting and the primary circuits of alternating-current distribution systems rubber-covered wire is still largely used, although its depreciation is considerable, owing to the gradual vulcanization of the rubber by the sulphur contained in the atmosphere, especially in smoky districts. For interior wiring rubber is still used, and owing to the fact that lead sheathing is going out of fashion inside of the armoring of interior conduits, the use of paper insulation will be impracticable in this location.

Many substitutes have been found for hard rubber, notably vulcanized fibre, molded insulations and many imitations which closely resemble hard rubber in all its desirable qualities. It is well that the use of rubber is diminishing, as the material is rather an uncertain one, not so much due to the fault of manufacturers as to the difficulty of controlling the operation of those who gather the raw material. The supply is also rapidly becoming exhausted owing to the enormously increased demands of electrical and vehicle work, and the rubber plant will soon have to be cultivated to supply the market.

THE RUNNING AWAY OF INVERTED CONVERTERS.

As pointed out in the article on another page by Mr. C. P. Steinmetz, the rotary converter, when used to transfer power from direct-current to alternating-current circuits, is likely to have its field strength greatly weakened by lagging currents in the latter, in which case the machine will, of course, tend to run away as a direct-current motor. A simple way of avoiding this contingency is the excitation of the converter fields by a separate exciter driven either mechanically by the converter or by an alternating-current motor supplied therefrom. In case the converter tends to speed up, due to reduced field strength, the speed and consequently the voltage of the exciter rises, restoring the field magnetization of the converter and limiting the speed variation. The same steadying effect takes place in the less frequent and less dangerous case of leading currents and reduced speed.

A New Telephone Building in Brussels.

A consular report gives some details of a new building for telephone exchange purposes to serve 15,000 subscribers in Brussels. The lines of this new exchange will each have two wires, and will be carried through 100-pair underground cables with overhead housetop distribution from cable terminals. The building will be ventilated by air forced through a blower driven by a 3-hp gas engine. The report also states: "Below the massive concrete foundation a series of iron rafters has been laid to facilitate the flowing of electricity into the ground. Steel shanks are attached to these rafters and connected with the iron pieces of the building in all directions in such manner that the entire construction is united in a Faraday cage, which thoroughly protects it against lightning."

Progress of the Kinloch Exchange.

The mammoth telephone switchboard of the Kinloch Telephone Company, of St. Louis, is rapidly being wired up, about 100 lines per day going in at present. There are already 2000 lines in operation, and by the end of the year 4000 lines will be working.

The Effect of Silicon on the Magnetic Permeability of Cast Iron.

The article on the above subject by Mr. F. C. Caldwell in The Electrical World of December 10 should have been credited as a résumé of a paper read before the American Association for the Advancement of Science.

The Largest Contract for Electrical Work Ever Made.

The electrical equipment of the lines of the Third Avenue Railroad Company and the allied corporation, the Union Railway Company, both of New York city, has been contracted for as one undertaking by the Westinghouse Electric & Manufacturing Company. This contract, which calls for a payment of something over $5,000,000, covers the most extensive electrical equipment of any kind whatever ever designed, and the fact that it has all been undertaken by one company is a unique feature of electrical economics. The two roads named have about 100 miles of double track, the first operating on Manhattan Island and the second on the adjoining mainland in what is known as the Borough of the Bronx. The former lines are now operated by cable and horse traction and those on the mainland by overhead trolley. The former are now being re-equipped with open-conduit tracks and the latter will remain as before.

The power station will be by far the largest in the world. That now under construction for the Metropolitan Street Railway Company has enjoyed the prospect of this unique distinction, its proposed equipment consisting of eleven units with an economical rating of 4000 horse-power each, with an overload capacity bringing its maximum available output up to 70,000 horse-power. The track mileage of the Third Avenue and Union roads compares closely with the mileage of the Metropolitan system, and the traffic is considerably lighter. The contract for the new station, however, calls for sixteen units, with an economical rating of 4000 horse-power each and a 50 per cent. continuous overload capacity, giving the plant a maximum rated output of about 100,000 horse-power. The installation of these units is not to be carried on during a long term of years, but they will be built and installed as rapidly as the companies can conveniently finish the work, which will probably be completed in the course of about two years' time.

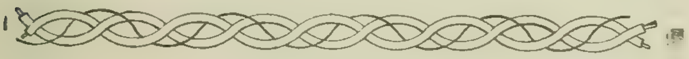


FIG.

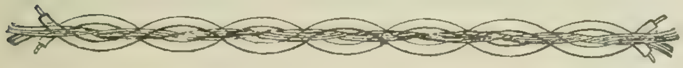


FIG. 2.

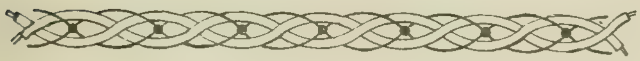


FIG. 3.

Although the contract has been given to the Westinghouse Electric & Manufacturing Company, all but the electrical work will be done by Westinghouse, Church, Kerr & Co., including the design of the structure and the installation complete of the boiler and engine equipments and accessories. The contract includes also the design of the sub-stations and the building and installation of their engineering equipments. The Westinghouse Electric & Manufacturing Company will also supply the car equipments, although their cost is not included in the sum above mentioned.

The station will be located on a plot of land on Manhattan Island, between Two Hundred and Sixteenth and Two Hundred and Eighteenth Streets, between Ninth Avenue and the Harlem River. This is now partly covered by a fair-sized power house, built for the Kingsbridge road, the tracks of which were never laid. This structure will be removed to make way for the large one, which will be about 250 by 320 feet in size. This will be divided into two rooms, each 320 feet long, one for the boilers and one for the engines. The boiler room will contain two double-decked rows of boilers, one on each side of the long room, which, if set in one continuous row, would give a battery about 1000 feet long. Coal will be stored in an enormous bin overhead, from which it will chute to the mechanical stokers. A complete equipment of economizers will be installed, and the draft will be handled by a combination of natural and mechanical draft, the escaping gases passing out through four tall stacks. The condensing apparatus will be concentrated into a central plant. Of course, the piping and auxiliary systems will be worked out with unusual elaboration, a separate isolated lighting plant being included in the plans, as well as a system of fire protection, cooling system, air-cleaning system, oiling system, coal and ash handling system, etc.

The engines will be made by the Westinghouse Machine Company of the vertical, two-crank type similar to those recently built for the Metropolitan Electric Supply Company, of London, but of a larger size. The latter are rated at 3000 horse-power condensing, and those for the new station will be 4000 horse-power. These will differ also from the Metropolitan engines in that the generators will be underhung between the two cranks instead of being mounted on one end of the shaft. The dynamos will be multiphase, high-tension alternating, supplying current to the trolley lines through rotary sub-stations, the apparatus for all of which is covered in the one contract.

Improvements in Telephone Cables.

An arrangement designed to facilitate the passage of telephone currents through cables without damping or distortion is the subject of patent No. 615,349, issued December 6, to Mr. Stephen Dudley Field. The arrangement, which at first sight would appear to defeat its own intended purpose, is the intermeshing of strands of soft iron wires with the pairs of conductors of a telephone cable, they being either braided, interwoven or interlaced with the insulated copper lines.

The patent states: "I have experimentally found that by employing cable conductors thus constructed and arranged the retarding and distorting effects of electrostatic induction are largely, if not wholly, remedied—an advantageous result which, keeping in mind the well-known fact frequently made available in practice that the adverse effects of either self-induction or electrostatic induction in a circuit may be compensated by arranging organizations adapted to introduce the other to an appropriate extent, I attribute to the magnetic changes of the iron wire caused by the following electromagnetic condition of the electric circuit conductors and to the reactive influence exercised by such magnetic change upon said circuit conductors, the currents conducted thereby and the tendency to static charge and subsequent discharge found therein." This sentence apparently means that by increasing the distributed self-induction of the pair the harmful effect of the distributed capacity may be partially neutralized.

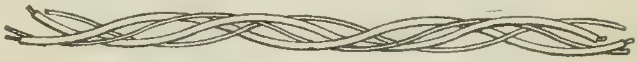


FIG. 4.

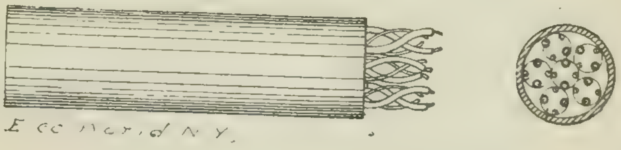


FIG. 5.

Fig. 2 shows a pair of conducting wires interlaced with several soft iron wires, and Fig. 3 shows a braided combination of two iron wires with two copper wires. Fig. 4 shows a simple twisted pair of iron and pair of conducting wires, Figs. 5 and 6 showing the cross-section of a multi-pair cable of this design. The first claim of the patent is as follows: "A cable conductor, composed of the insulated wire or wires of an electrical circuit, and one or more iron companion wires or rods not included in such circuit, the said insulated wires and iron wires being inter-braided, or interlaced, substantially as specified herein."

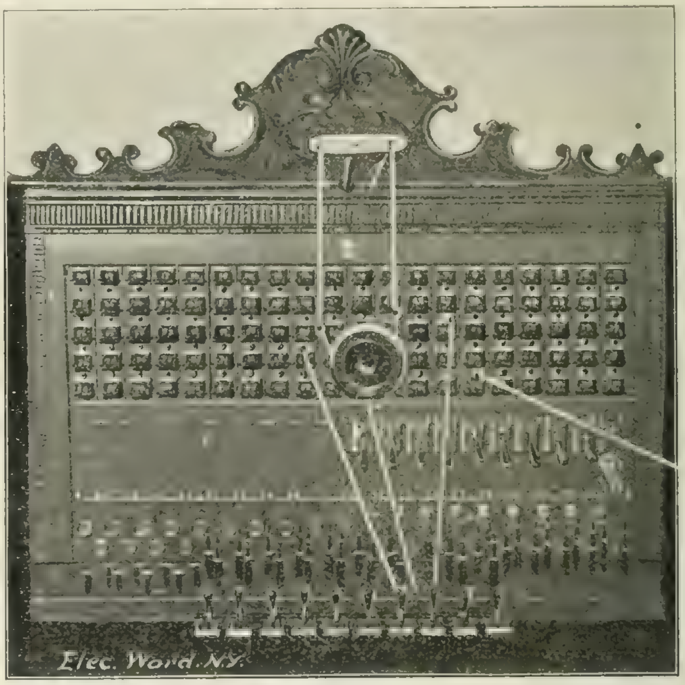
Enamel Insulators.

In a paper on insulating enamels recently presented by M. Saglio to a French society, it is stated that either zircon, silica, kaolin or petalite, when added to the enamel, decreases its rate of expansion with heat, while calcium phosphate increases this expansion, as does cryolite, fluospar or rutile, the latter three also increasing the fluidity of the melted enamel.

The New Exchange of the Home Telephone Company, Trenton, N. J.

An independent telephone exchange, built to give good service rather than to be used as a club to compel its sale to the Bell interests, is that of the Home Telephone Company, of Trenton, N. J. Organized two years ago, and starting out with fifty subscribers, the system has grown until now the Home company, with a capital of $150,000, has 950 subscribers, and orders sufficient to bring the number of lines up to a round thousand. The Bell company's subscribers in the same city and during the same time have fallen off in number from 650 to about 450. The new company charges for unlimited service $3 per month for business places and $2 for residences, these being its only prices, there being no measured service rates, toll lines or pay stations. The Bell company, in the same city, has been forced down to the same tariff.

The Home company is just completing a new exchange, with many interesting features. Its lines, which consist almost entirely of No. 14 copper, are all two wires to each instrument, there being no party lines. They run out from the exchange for six or seven miles in several directions, being brought in through aerial cables supported on heavy 65-foot poles stoutly guyed and "hog-chained" through the business section. Twenty of these fifty-pair lead-covered cables enter the central office, all of them with dry-core paper insulation made by the John A. Roebling's Sons Company. They are pot-headed under the floor immediately at the foot of the distributing board. This consists of three parallel panels of solid cherry, with heavy newel post corners, each panel about 7 feet 6 inches wide by 6 feet in height. Two of these are the distributing panels on which the pot-head pairs from the incoming cables fan out, the third being the cross-connecting board cable to the main switchboard. The connections between the incoming panels and the cross-connecting panel run overhead. Protection against lightning and sneak currents is obtained [illegible] paper [illegible] mounted [illegible] which protect the cherry board [illegible] danger of [illegible]. There are no lightning [illegible] outside. [illegible] the [illegible] board are mounted [illegible] for the [illegible] supply and the ringing generators. The former consists of four 75-ampere-hour Chloride cells connected up in two duplicate series pairs for the operators' transmitters, and four 150-ampere-hour cells connected also in two duplicate sets of two cells in series to give the four volts needed for the visual-signal lamps. The ringing current is obtained by means of a small Crocker-Wheeler motor-generator, taking 220 volts direct current at one end and giving 75 volts alternating at the other. This is connected to the 220-volt mains through an automatic motor starter provided with seven different speed positions.



The main switchboard is located in a room about 32 feet by 20 on the upper floor of the building, and is splendidly lighted by a skylight in the roof above, the space between the ceiling and the roof being flared out funnel-shape, giving most perfect ventilation and light distribution. The board is J-shaped, having twelve operators' positions, with a capacity for 1200 lines and with space sufficient on the trunk sections of the panels for the apparatus required for 2000 lines, which capacity the board will have when extended to a complete U-shape. The board is of the latest type, made by the American Electric Telephone Company, of Chicago, and for the benefit of electrical engineers not immediately connected with the telephone field a description of its meritorious features will be given here.

The board is not of the multiple type, but each operator's position has two trunk wires to each of the other operators' positions, thus giving four trunks between each two panels, two outgoing and two incoming from any position. The outgoing ends terminate in jacks and the incoming ends in plugs. Each operator has a set of cams, one for each of the other operators, the depression of any one of which connects her talking and listening set with the set of another operator corresponding with that cam. In this way a call received for a number not within the reach of the answering operator is transmitted to the operator in whose section the line called for terminates by means of a repetition of the call over the operators' sets, connection being made by means of the cam just mentioned. The calling line is then connected by the cords to the jack of one of the two transfer lines terminating in the section wanted. This connection lights the visual signal at the other end, and shows the other operator which of the two lines to plug in on. The board is, however, arranged so that after the expiration of the fundamental patent on multiple board multiple panels can be added, and the wiring of the drops and jacks is such that a change to a multiple system can be readily made. The drop and jack of each line are mounted together, thus doing away with all the wiring from the banks of drops to corresponding banks of jacks, and the plug is ingeniously made, so that its insertion in the jack automatically restores the shutter, which is then free to be dropped again by the magnetic release, the main drop thus serving as a ringing-off drop. On pulling out the plug the shutter is again restored. Ringing is effected simply by pushing the plug in deeper than its normal position. There are thus no ringing cams, no ringing-off drops in the cords, and as the ringing circuit is brought in to the jack and not to the plug there are only two conductors in the cord.

The combined jack and drop constitutes a little draw, which is inserted into its compartment in the board from the front and locked in place by two bolts projecting through the back of the board and fastened by lock nuts, these two bolts making contact with clips soldered to the line terminals and drawing four contact springs in the drop and jack back against four bus bars, two for the ringing circuit and two for a circuit which is closed by the dropping of the shutter, much as is the ordinary night circuit, its purpose, however, being to illuminate a visual signal on the chief operator's board, one of these signals being provided for each operator's position. Thus, if any operator does not promptly answer her calls, it is instantly indicated by the persistence of light on the corresponding signal at the chief operator's desk.

The board, for patent reasons, is not wired on the multiple system—that is, the jacks, drops, listening sets, etc., are not in multiple across the two lines, but run entirely on the series system. This, with the transfer plugs, involves the danger of leaving the lines open; for instance, if a connection through the transfer system is taken down by removing the plug of the transfer trunk, the station making the original call will be connected with the two terminals of that plug, and will be left on open circuit. If the operator at the other end of the transfer trunk fails to disconnect, the subscriber will be unable to ring up central, and will be practically helpless. To avoid such a contingency the sockets into which the transfer plugs fall when out of use are provided with plug switches, which short-circuit the plug contacts when the plug falls into the socket. The ringing circuits to each section pass to a buzzer, which, in case it fails to sound when the plug is pressed in to the ringing position, indicates to the operator that the line wanted is on open circuit, and also indicates faults in the other direction, such as short circuit by the sticking of the buzzer, due to excessive currents.

The subscribers' sets are well-designed instruments, supplied by Stanley & Patterson. They are fitted with extra large, solid-back transmitters, designed to give the primary circuit an extremely low resistance. Current is supplied by two salamoniac cells, and the induction coils are high-wound, with a secondary resistance of 500 ohms.

The company is handling a very lively business, requiring ten operators at the board, besides the chief operator's board, and expects soon to be obliged to enlarge its switchboard to the maximum capacity of the room. The financial part of the work is closely looked after by Mr. L. D. Risdon, the engineering branch being in the hands of Mr. J. B. Sinkhorn, chief electrician.

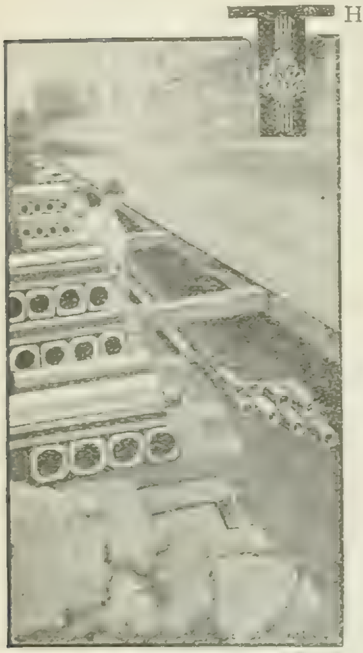
A Hysteresis Meter.

An instrument for recording the energy wasted in hysteresis while passing a sample of iron through a magnetic cycle has been described by Mr. J. L. W. Gill, in patent No. 615,695, issued December 13, 1898. The instrument consists of a magnetizing solenoid surrounding a cylindrical iron core, which is the specimen, and capable of being moved axially along it from a position in which the specimen is entirely outside of and at one end of the solenoid to a corresponding relative position at the other end. The solenoid being energized, it attracts the core and is then slipped over and past it, the mutual attraction as the core emerges being less than that when it enters, owing to hysteresis. The current in the solenoid is then reversed, and the parts of the apparatus restored to their first relative position in order to pass the iron through a complete cycle. The residual mechanical work done is measured by an apparatus resembling that used with some planimeters, a disc whose rate of rotation is proportional to the movement of the solenoid being pressed by a wheel, the position of which is dependent upon the force acting upon the core, the wheel pressing on the centre of the disc when this force is zero. The apparatus thus does not measure the hysteresis directly, but automatically records the small difference between two comparatively large amounts of work done.

For Lower Telephone Rates in Washington.

Bills have been introduced in the United States Senate and House providing that after their passage rates for telephone service in the District of Columbia shall not exceed $50 per annum for places of business, or $36 per annum for homes, this to cover unlimited service. If the Chesapeake & Potomac Telephone Company does not agree to this limitation its franchise will be revoked, and the District Commissioners will be, if these bills pass, empowered to advertise for bids for telephone service, each bidder to deposit $1000 as a guarantee, the company getting the privilege to give $25,000 security for faithful performance and to have its service in operation within six months.

Consolidations and the Subways in New York City.

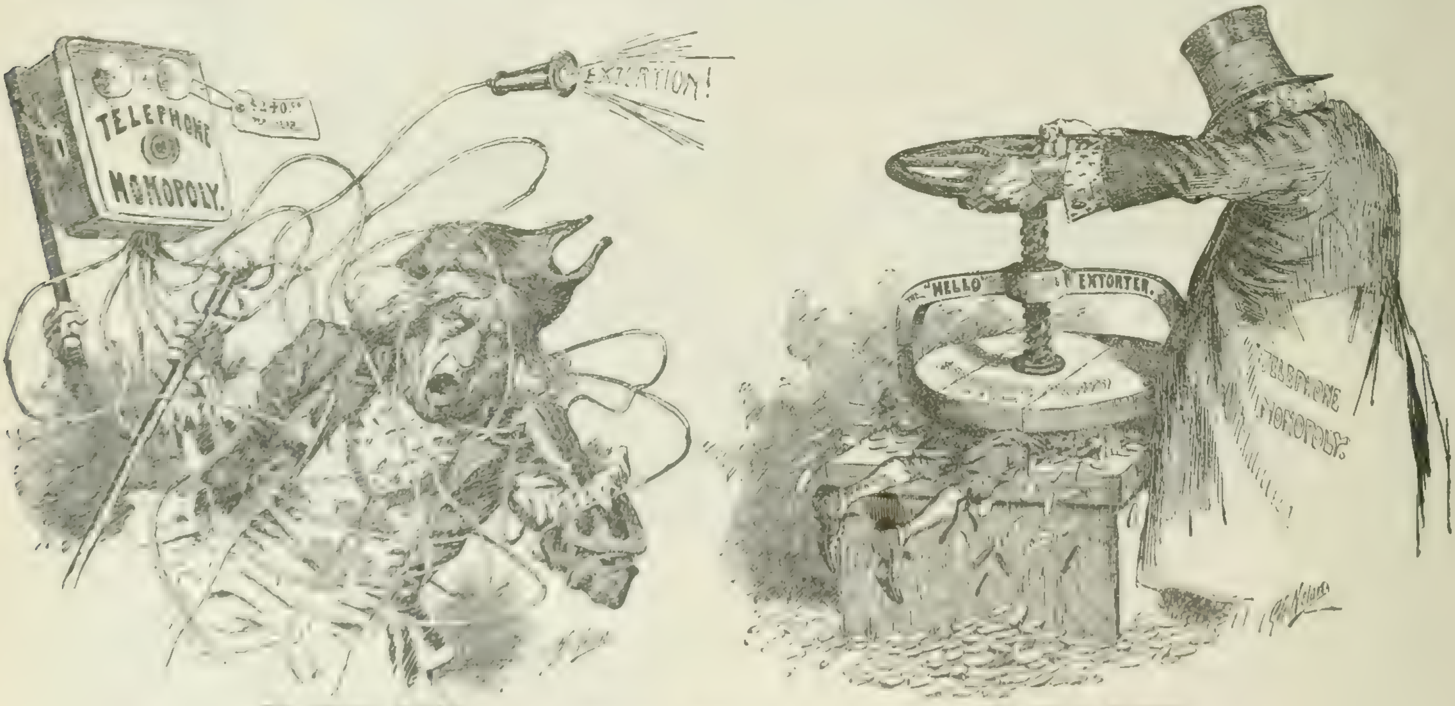


THE financial, industrial and particularly the political situation of the one controlling element of all public electrical systems in New York City, namely, the subways, is at the present time the most perplexing problem for all except those immediately involved in the recent reorganization, the reports of which, day by day, have been of a most kaleidoscopic character. One thing appears to have been definitely accomplished, and that is the organization of a company known as the New York Gas, Electric Light, Heat & Power Company, which was recently incorporated with a capital of $25,000,000, with the backing of William C. Whitney, Roswell P. Flower, Anthony N. Brady and—if the statements of the newspaper reporters who have been industriously attempting to ferret out the plans of the company can be believed—also of P. A. B. Widener and P. H. Flynn.

That this company is working with the Metropolitan Street Railway Company there is no doubt. The latter company is, as is well known, now constructing a 70,000-hp generating station, all of which power it cannot possibly use on its existing lines. It has practically admitted that the Mount Morris Electric Light Company is also in the deal, and the Edison Electric Illuminating Company, of New York, with its various allied companies, is negotiating for a place in the consolidation. Developments in another direction may be looked for owing to the fact that the capitalists controlling the matter have strong political influences, and there has suddenly appeared a leaning on the part of Mr. Richard Croker toward the construction of the proposed rapid-transit tunnel lines by private capital.

With it all there has been a renewed agitation in the daily press of the independent telephone question, the New York "Herald" particularly taking up the cudgels against the Bell Company. There are shown herewith two of the expressive cartoons with which the latter publication has attempted to emphasize its statements. The People's Telephone Company has been actively canvassing for applications, promising a service, but not making any very satisfactory statements as to how or where its lines will be laid, its only answer to interrogations on this point being the statement that the subway companies are compelled to give service to all alike, and failing this, other companies are permitted by law to build subways. This, of course, is nominally true, but the subway companies, by making extortionate rates to all alike, transfer from one pocket to another the payments of their allied electrical companies and keep out competition. The main end of the agitation appears to be the development of a public opinion which will compel the passage this winter of a State law limiting the telephone rates.

Another element that keeps outsiders guessing is the purpose of the 100,000-hp plant contracted for by the Third Avenue Railroad Company, an account of which may be found in another column. The lines of this company cannot possibly use this power; in fact, it would carry about all the electrical loads likely to exist in the Boroughs of Manhattan and the Bronx during the next few years.



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THE "HELLO" SQUEEZER

Cartoons on the Telephone Situation Reproduced from the New York "Herald."

also rushed down conduits for which it has no immediate use, and [illegible] along Broadway, where no track changes have been made or announced for the immediate future, a conduit has been installed under the yokes at either side of the track, some illustrations of the work on which [illegible] company, as the New York Gas, Electric Light, Heat & Power Company has come to be called, the former name being somewhat shorter than the latter, is reported to have gained control of the two subway companies, namely, the Empire City Subway Company, which controls the low-ten- [illegible] been controlled heretofore by the New York Telephone Company, and the Consolidated Telegraph & Electric Subway Company, which controls most of the conduits used by the lighting companies. It is The only possible load of any great magnitude not now provided for is the electrical driving of the Manhattan Elevated Railroad, and it is natural to surmise that part of this great power may be used on that system. The whole situation promises developments surpassing anything yet known in the direction of the consolidation of enormous interests.

An Honor Granted to Professor Eric Gerard.

Professor Eric Gerard, director of L'Institut Electrotechnique Montefiore, University of Liege, Belgium, was recently admitted to the Order of Leopold. Professor Gerard's work is known and appreciated in this country, particularly through his works which have been translated, notably one on "Electricity and Magnetism."

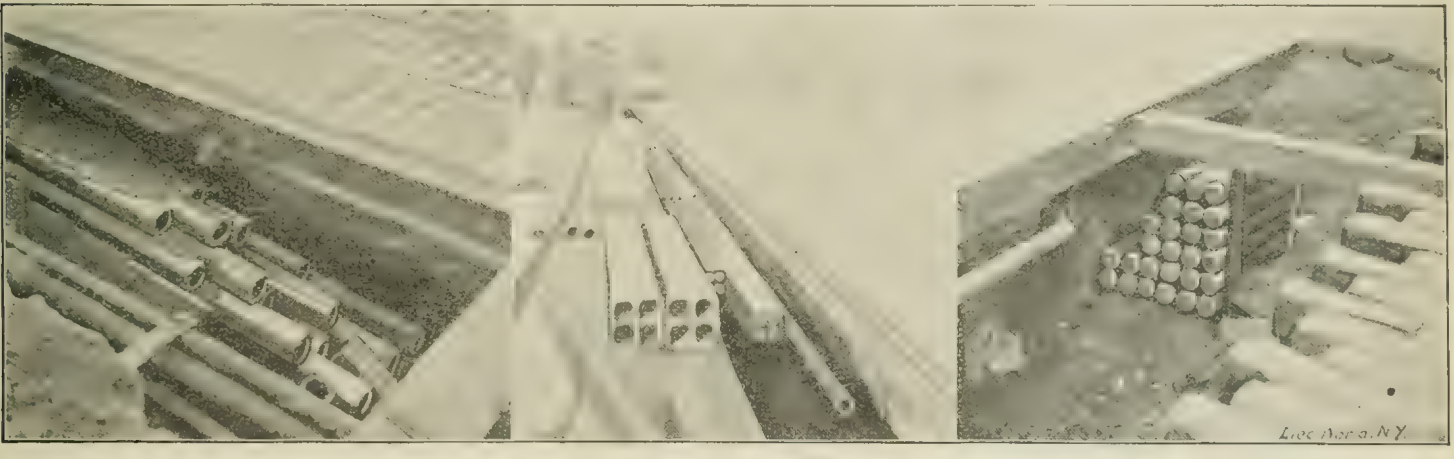
Centralized Sources of Energy in Telephone Exchanges—I.

BY KEMPSTER B. MILLER.

In an article published in these columns nearly three years ago* I described briefly a few of the methods for supplying current to the transmitters at the subscribers' stations from a source of current at the central office. Since the time of writing that article a great development has taken place in this line of work, resulting in the centralization of not only transmitting batteries but also of the calling current sources, thus removing from the subscriber's station all generators for whatever purpose.

The scope of this article includes the centralization of both calling and talking batteries. Some of the matter contained in the former article will be treated of in this one in order to preserve clearness and continuity as well as to throw the light of more recent experience upon the comparatively old systems.

As stated in the previous article, the advantages to be derived from such a complete centralization of energy sources are great and numerous. The electrical efficiency of the plant is greatly increased by having a few large units in operation practically all of the time instead of a multitude of small units in operation but a small portion of the time. The amount of idle capital represented by the local battery and the calling generators is rendered nil, no small consideration in large exchanges, because the magneto generator is in itself the most expensive piece of apparatus connected with a telephone instrument The labor of visiting subscribers' stations in order to repair and replenish batteries is done away with. The subscribers' sets are made neater and more compact. The labor on the part of subscribers to obtain a connection or disconnection is reduced to a minimum. Lastly, no freezing of the local batteries occurs; there is no spilling of acids or other chemicals, and no corrosion of various parts by the fumes therefrom.



Views of the Laying of the Conduits in Broadway.

Naturally the first attempt in this line of work was to place transmitter batteries at the central office and directly in series with the line wires and talking instruments. This was in the days when grounded circuits were considered the proper thing, and the solution of the problem involved merely the placing of the battery in the cord circuit or in the temporary connecting loop used to complete the circuit between two subscribers.

In 1881 George L. Anders invented a system in which the transmitter batteries were placed in the loop used to connect two lines at the central office. The switchboard was of the old crossbar type, wherein the subscribers' lines terminated in vertical conducting bars. Across the faces of these bars extended a series of horizontal bars arranged in pairs, the bars in each pair being connected in each case through a battery and a single stroke bell. The connection between any two subscribers was made by connecting the vertical bar of one of them with one of the horizontal bars and the vertical bar of the other subscriber with the other horizontal bar of the same pair, the connection between the bars being made in each case by a metallic plug inserted at their intersecting points. The transmitter was of the Hunnings type, connected in series with the receiver in the line wire at each subscriber's station. The transmitter battery was thus included serially in the circuit of any two connected lines, and the transmitters were, therefore, forced to vary the resistance of the complete circuit formed by the two lines in order to produce the desired changes in current.

A system embodying the same ideas, applied to a switchboard of more modern construction, shown in Fig. 1, was devised by Messrs. C. W. Price and A. Barrett. In this a transmitter battery, *B*, was connected in circuit between the answering and calling plugs *t* and *t'* of each pair; so that while two subscribers' lines—as, for instance, 1 and 2—were connected by means of these plugs in the ordinary manner, the current from the battery *B* would flow through the circuit of the two lines, and be acted upon by the transmitters, as already described. In this system, probably in order to reduce the line resistance, the receivers *R* and *R'* at the subscribers' stations *S* and *S'* were connected in the secondary circuits of induction coils *C* and *C'*, the primaries of which were directly in the line circuit. A better way to have accomplished the reduction of the line resistance would have been to wind the receiver coils to a low resistance and include them directly in the line circuit. This system and that of Anders required a separate transmitter battery for each pair of plugs and cords, an obvious disadvantage.

A system devised by Chichester A. Bell in 1886 contained the germs of some successful later systems, and was, I believe, the first to use one common battery for the simultaneous excitation of a large number of transmitters. The principles upon which this system was based are shown in Figs. 2 and 3, in which *B* is a battery described as having high e. m. f. and low internal resistance. In the circuit connected, as in Fig. 2, changes in the resistance of the transmitter *E* at one station will produce no effect in the receiver *D'* at the other station, because all such fluctuations will be short circuited through the short wire *d* and the low resistance battery, and will not, therefore, pass through the comparatively high resistance circuit, including the line wire *a*, transmitter and receiver *D* and *D'*. In Fig. 3, however, where a resistance, *R*, is interposed in the short wire *d* the conditions are changed, and while the battery *D* supplies current to both stations on the lines *a* and *a'*, through the resistance *R*, the fluctuations due to one of the transmitters, say that at *E*, will produce changes in potential at the point *b*, which changes in potential will affect the current flowing in line wire *a*, because of the high resistance *R*, which takes the place of the short circuit in the former case. The operation of either transmitter *D* or *E* in Fig. 3 will, therefore, produce effects in the receivers of both lines. These principles are further exemplified in Fig. 4, in which the two lines *a* and *a'* are so arranged as to be in communication, as also are the other pairs of lines, *b* and *b'*, *c* and *c'*, etc. By virtue of the high resistance coils *R*, *R'*, etc., the conversations being carried on on any pair of lines produce no effect on any other pair, because but a small portion of the current changes set up by any transmitter will find its way through the high resistance coil, and what portion does pass through will be short circuited to ground through the common battery *B*.

This idea was applied to one of the old cross-bar switchboards, which will not be here described, as it contained nothing whatever of practical value save the principles already pointed out.

A similar idea was, however, applied in 1890 by Mr. Anthony C.

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*See The Electrical World, January 11, 1896, page 51.

White, the inventor of the world-famous solid-back transmitter, to a complete metallic circuit exchange. This system is shown in Fig. 5, where four metallic circuit lines, L, L^2, L^3 and L^4, are shown connected to jacks, j, and drops, Z, on a switchboard. The battery B is of low resistance, and is included in one side of the cord circuit of the various pairs of metallic circuit plugs P and P^2. The lines L and L^2 are shown connected by means of one pair of plugs, one side of the cord circuit of which is formed by the conductors 9 and 10, which include between them the battery B, the other side of the same cord circuit being formed by the wire n. It will thus be seen that the battery B supplies current to the transmitters at the two stations thus connected, and if the other pair of plugs p and p^2 were used to connect another pair of lines, L^3 and L^4, the circuit of these two lines would be in multiple with those of the first two. Fluctuations in current set up by the transmitter in line L pass through wire n to one side of the line L^2, then through the instruments on that line and through the wire 10 to one terminal of the battery. Here these fluctuations might pass by means of the wire 11, and the second pair of plugs, p and p^2, to the circuit of the lines L^3 and L^4, were it not for the fact that these lines possess a very high resistance in comparison with the resistance of the battery B, and therefore [illegible]

This same principle is made use of in the common battery arrangement for supplying current to the operators' transmitters in central offices, which is shown in Fig. 6. This system was devised by Mr. J. J. Carty, chief engineer of the New York Telephone Company, and is now widely used in central offices of the American Bell Telephone Company throughout the country. In this a and b are two low resistance storage cells, placed in multiple so as to make their joint resistance still lower. The primary circuits of the operators' sets, each including a transmitter, e, e^1, e^2, etc., and the primary winding h, h^1, h^2, etc., of their respective induction coils, are connected in multiple between the two heavy bus bars c and d leading from the terminals of the battery. If the resistance of the battery is very low, and the bus bars are extremely heavy and short, no cross talk will be noticed between the various operators' sets, because the resistance of the battery and bus bars is so low in comparison with that of the different transmitter circuits that the drop of potential due to the battery resistance will be inappreciable, and therefore a fluctuation in the instance of one of the transmitters will cause no change in the potential at the battery terminals. This is an important phenomenon in common battery work, and should therefore be thoroughly understood. It may be more readily grasped by a simple application of Ohm's law.

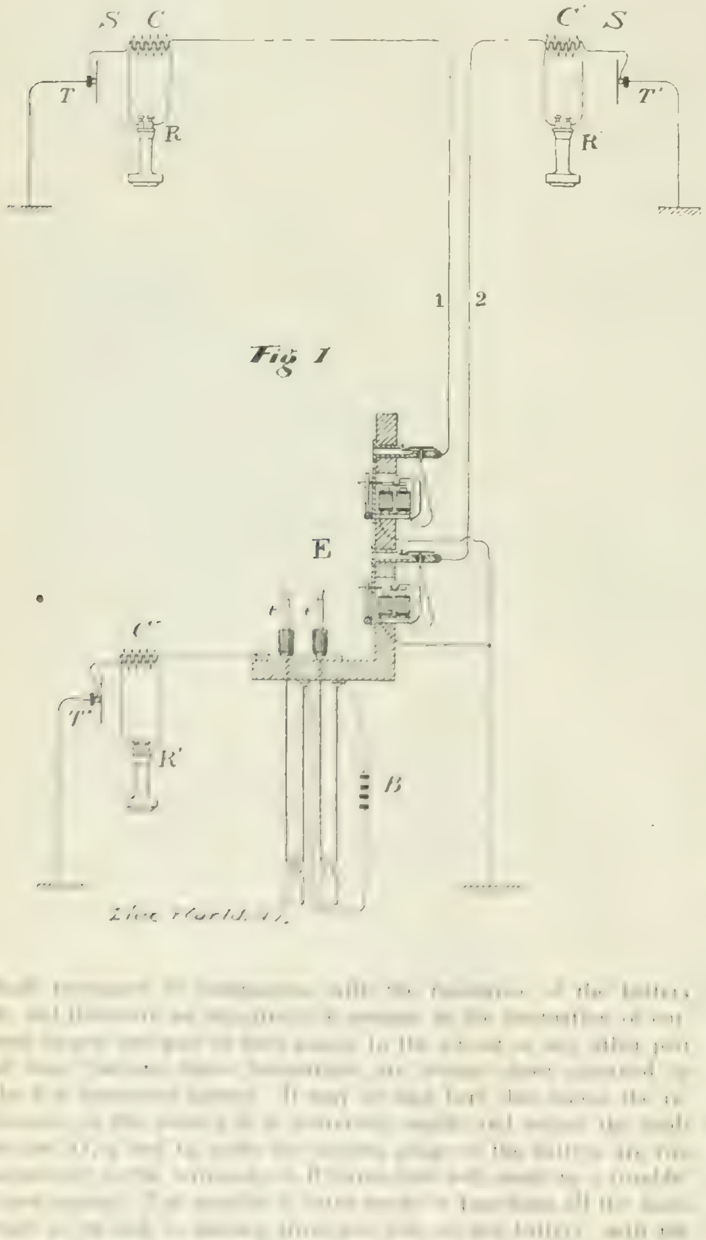

Fig 1

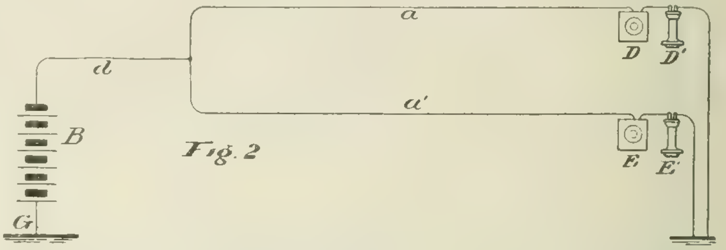

Fig. 2

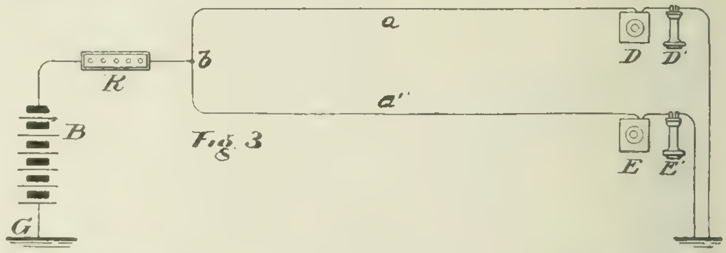

Fig. 3

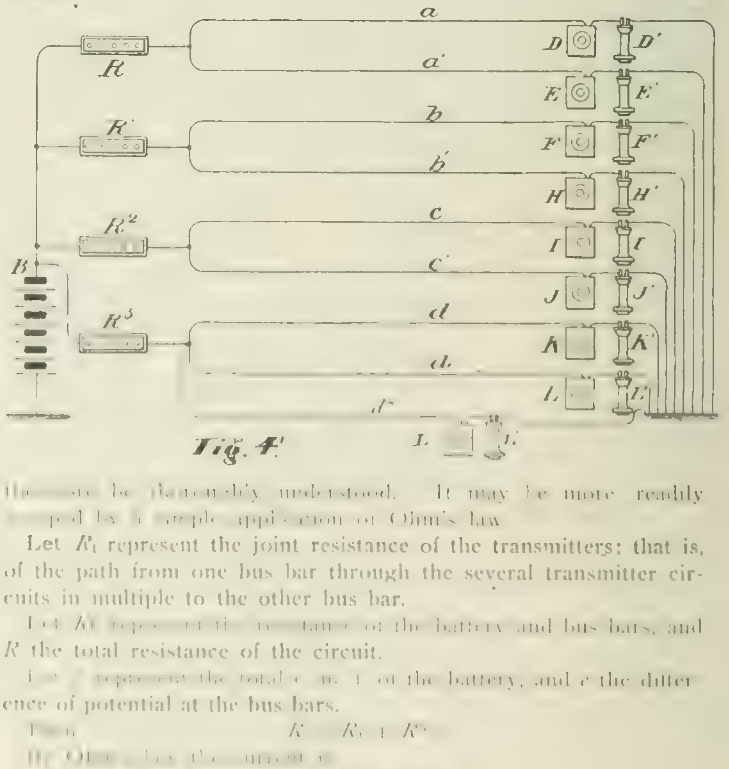

Fig. 4

Let R_t represent the joint resistance of the transmitters; that is, of the path from one bus bar through the several transmitter circuits in multiple to the other bus bar.

Let R_b represent the resistance of the battery and bus bars, and R the total resistance of the circuit.

Let E represent the total e. m. f. of the battery, and e the difference of potential at the bus bars.

Then,
$$R = R_t + R_b.$$

By Ohm's law the current is
$$C = E/R = e/R_t.$$

Solving for e we obtain
$$e = E R_t/R = E R_t/(R_t + R_b).$$

[illegible] it is clear that e, the difference of potential between the bus bars, must be constant. From this it follows that the ratio $R_t/(R_t + R_b)$ must remain constant since E, the e. m. f. of the battery, is unchanging. When the resistance of any transmitter circuit is varied by the operation of its transmitter, the resistance R_t will also be varied, and in order for the ratio $R_t / R_t + R^b$ to remain constant during these variations R^b must be infinitely small.

Of course it is impossible in practice to obtain a battery with an internal resistance equal to zero, but a 150-ampere hour cell in good condition will give a sufficiently close approximation for practical purposes.

In actually installing a system of this kind it is well to run the individual wires of the transmitter circuits directly to the terminals of the storage battery, thus practically eliminating all resistance due to bus bars. I had an intimate acquaintance with a case where serious cross talk occurred under the following conditions. The battery was a single 200-ampere-hour cell of the American type, and there were ten transmitters, each having a resistance of about 10 ohms, the resistance of the primary coils being in each case 0.38 ohm. The bus bars were each 7 feet long and each composed of two No. 6 B. & S. gauge copper wires in parallel. Serious cross talk existed, and was only removed when the bus bars were made of 000 trolley wire 18 inches long.

In 1882 and 1893 Mr. John S. Stone devised several common generator systems, which are worthy of interest. The one illustrated—in principle only—in Fig. 7 is adapted for "house" or "intercommunicating" systems, and depends for its action on the placing of a coil having high impedance and comparatively low resistance in series with the common generator, and in multiple with the several stations to be in communication. Thus in Fig. 7 the battery S is placed in series with the retardation coil R. To the terminals y and z, which include between them the battery and retardation coil, are connected the terminals of the various telephone circuits. The retardation coil is used to bring about the very conditions which Carty and others tried to avoid. They are used to prevent the fluctuations in current, due to the transmitters, from passing through the generator, thus confining them to the line circuits, and also to prevent the fluctuations in generator current from passing to the lines. By this means it is said that a dynamo may be employed instead of the battery S, the impedance coil effectually blocking the way of the troublesome fluctuations always present in the current from dynamo machines.

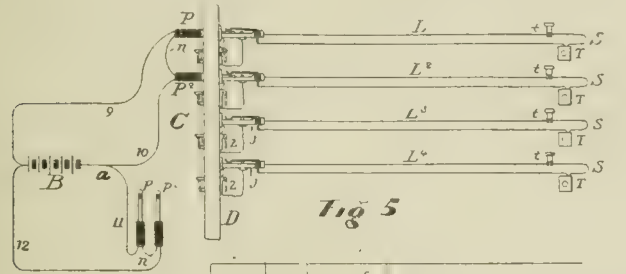

Fig 5

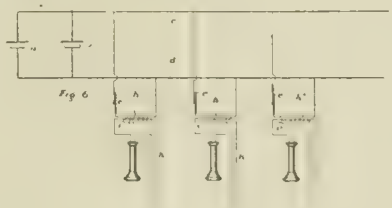

Fig 6

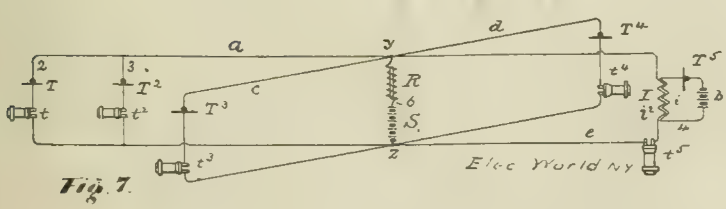

Fig. 7.

Of course in the arrangement shown in Fig. 7 all of the fire telephone stations would be in communication at once, so that fluctuations set up in the current by one transmitter would affect the receivers at all the stations. In applying this principle to a house system several independent talking circuits, a, c and d, are provided as shown in Fig. 8. Each of these circuits runs through all of the sub-stations, D, E, F, G, and is provided at each station with springjacks, j, serially connected to enable any two stations to introduce their respective apparatus into any desired circuit for communication. At each of the stations the telephone apparatus is for this purpose arranged in a loop, h, having a terminal lop plug, p, adapted for insertion in the jacks, j.

Each of the telephone circuits, a, c and d, is permanently connected by paired conductors, a^2, c^2 or d^2, extending through the retardation coils R, R^2 or R^3 to the mains A and B of the common generator S, in this case a dynamo machine. In the figure stations E and F are shown in communication over the circuit c. The retardation coils serve to individualize the separate circuits, and confine fluctuations due to the sound waves in each case to the circuit in which they are intended to exist.

The system just described, while admirably adapted to the purposes set forth, was not well adapted to ordinary exchange systems. Fig. 9, however, shows a modification of it, by which various subscribers' lines, radiating from a central office, might be connected through a common generator without interference. In this the generator is connected in a common branch across the circuit of all subscribers, and a retardation coil, R, R^2, R^3, R^4, is placed in each subscriber's circuit, so as to be in series with the common generator and the talking apparatus of that particular circuit. All subscribers' circuits, however, form multiple branches of the generator circuit. The generator S is included alone between the two points y and z, the retardation coils being in each case in the line circuits between the points y or z and the subscribers' station. In order to connect two subscribers' circuits for communication the two retardation coils of those two circuits are bridged across by a conducting wire, 5, extending between the points w and x, on the wires a and b, respectively, of the stations H and J. This puts these two stations into communicative relation with each other; for it will be seen that no impedance coils are included in the talking circuits between them. In order to reach the two stations, however, current from generator S must pass through the two coils R and R^2 in multiple, and thus the fluctuations of the generator current are weeded out. Again, the fluctuations set up in the circuit of the two lines a and b, while perfectly free to pass through these two particular lines, cannot find a path to any other lines, as, for instance, c or d, without passing through the retardation coils R and R^2, and also R^3 and R^4.

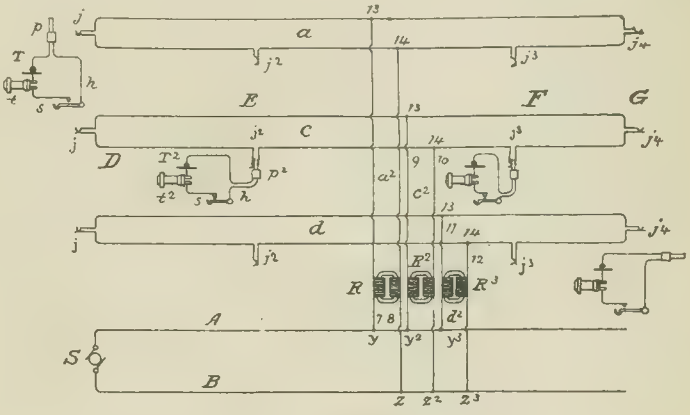

Fig. 8.

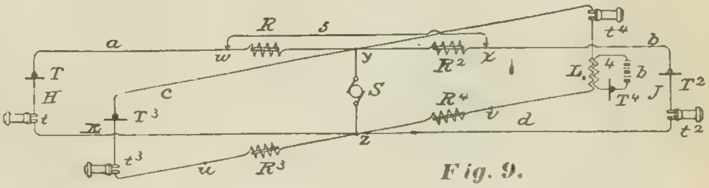

Fig. 9.

This latter system is certainly ingenious, and coming, as it does, from one of our best telephone engineers, is well worthy of consideration. It has not, however, I believe, come into extended use, because of another system better adapted for universal service, which will be described later in this series.

So far only those systems in which the source of current is included directly in the circuit of the subscribers' lines have been considered. It will be noticed that in this line of telephone work, as in almost every other line, the tendency has been from the series method of connection to the multiple. This same tendency has been especially marked in the construction of multiple switchboards, and also in the arrangement of instruments on party lines.

(To be continued.)

The Converter—II.

BY C. P. STEINMETZ.

6. WATTLESS CURRENTS AND COMPOUNDING.

FOR the reason that the polarization due to the alternating energy current of the machine motor is in quadrature ahead of the field magnetization, the polarization or magnetizing effect of the lagging component of alternating current is in phase with, and that of the leading component of alternating current in opposition to, the field magnetization. That is, in the converter no magnetic distortion exists, and no armature reaction at all if the current is in phase with the impressed e. m. f., while the armature reaction is demagnetizing with a leading and magnetizing with a lagging current.

Thus, if the alternating current is lagging, the field excitation at the same impressed e. m. f. has to be lower, and if the alternating current is leading the field excitation has to be higher than required with the alternating current in phase with the e. m. f. Inversely, by raising the field excitation a leading current or by lowering it a lagging curent can be produced in a converter (as well as in a synchronous motor).

Since the alternating current can be made magnetizing or demagnetizing according to the field excitation, at constant impressed alternating voltage the field excitation of the converter can be varied through a wide range without noticeably affecting the voltage at the commutator brushes, and in converters of high armature reaction and relatively weak field full load and overload can be carried by the machine without any field excitation whatever, that is, by exciting the field by armature reaction by the lagging alternating current.

Such converters without field excitation—or "reaction converters" —must always run with more or less lagging current, that is, give the same reaction on the line as induction motors, which, as known, are far more objectionable than synchronous motors in their reaction on the alternating system.

Inversely, however, at constant impressed alternating voltage the continuous-current voltage of a converter cannot be varied by varying the field excitation (except by the very small amount due to the change of the ratio of conversion), but a change of field excitation merely produces wattless currents, lagging or magnetizing with a decrease, leading or demagnetizing with an increase of field excitation.

Thus, to vary the continuous-current voltage of a converter the impressed alternating voltage has to be varied. This can be done either by a potential regulator or compensator, that is, a transformer of variable ratio of transformation, or by the effect of wattless currents on self-induction. The latter method is especially suited for converters, due to their ability of producing wattless currents by change of field excitation.

The e. m. f. of self-induction lags 90° behind the current. Thus, if the current is lagging 90° behind the impressed e. m. f., the e. m. f. of self-induction is 180° behind, or in opposition to the impressed e. m. f., and thus reduces it. If the current is 90° ahead of the e. m. f., the e. m. f. of self-induction is in phase with the impressed e. m. f., and thus adds itself thereto and raises it.

Thus, if self induction is inserted into the lines between converter and constant-potential generator, and a wattless lagging current is produced by [illegible], the e. m. f. of self induction of this lagging current in the line lowers the alternating impressed voltage at the converter, and thus its continuous-current voltage, and if a wattless leading current is produced by [illegible] the e. m. f. of [illegible] the impressed alternating [illegible]

In this manner by self-induction in the lines leading to the converter [illegible] or in [illegible] voltage or even constant generator excitation with increasing load, and thus increasing resistance drop in the line; or the voltage can even be increased with increasing load; that is, the system can be overcompounded.

The change of field excitation of the converter with changes of load can be made automatic by the combination of shunt and series field, and in this manner a converter can be compounded or even overcompounded as can a direct-current generator. While the effect is the same, the action is different, and the compounding takes place, not in the machine as with a direct-current generator, but in the alternating lines leading to the machine, in which self-induction becomes essential.

7. STARTING.

The polyphase converter is self-starting from rest, that is, when connected across the polyphase circuit it starts, accelerates and runs up to complete synchronism. The e. m. f. between the commutator brushes is alternating in starting, with the frequency of slip below synchronism. Thus a continuous-current voltmeter or incandescent lamps connected across the commutator brushes indicate by their beats the approach of the converter to synchronism. When starting, the field circuit of the converter has to be opened, or at least greatly weakened. The starting of the polyphase converter is essentially a hysteresis effect, and entirely so in machines with laminated field poles, while in machines with solid magnet poles, induced currents in the latter contribute to the starting torque due to their demagnetizing effect. The torque is produced by the attraction between the alternating currents of the successive phases upon the remanent magnetism or induced currents produced by the preceding phase. It necessarily is comparatively weak, and from full load to twice full load current to required to start from rest without load. Obviously, the single-phase converter is not self-starting.

In the moment of starting, the field circuit of the converter is in the position of a secondary to the armature circuit as primary, and since in general the number of field turns is very much larger than the number of armature turns, excessive e. m. fs. may be induced in the field, reaching frequently 4000 to 6000 volts, which have to be taken care of by some means. As soon as synchronism is reached, which usually takes from a few seconds to a minute or more, the field circuit is closed and the load put on the converter. Obviously, while starting, the continuous-current side of the converter must be open circuited, since the e. m. f. between commutator brushes is alternating until synchronism is reached.

When starting from the alternating side, the converter can drop into synchronism at either polarity, but its polarity can be reversed by exciting the field in the right direction by some outside source, as another converter, etc.

Since when starting from the alternating side the converter requires a very large and, at that, lagging current, it is preferable wherever feasible to start it from the continuous-current side as a direct-current motor. This can be done when connected to storage battery or direct-current generator. When feeding into a continuous-current system together with other converters or converter stations, all but the first converter can be started from the continuous-current side by means of rheostats inserted into the armature circuit.

8. INVERTED CONVERTERS.

Converters may be used to change either from alternating to continuous current or as "inverted converters" from continuous to alternating current.

While the former use is by far the more frequent, sometimes inverted converters are desirable. Thus, in low-tension continuous-current systems an outlying district may be supplied by converting from continuous to alternating, transmitting as alternating and then reconverting to continuous current. Or in a station containing continuous-current generators for short distance supply, and alternators for long-distance supply, the converter may be used as the connecting link to shift the load from the continuous to the alternating generators or inversely, and thus be operated either way, according to the distribution of load on the system.

When converting from alternating to continuous current, the speed of the converter is rigidly fixed by the frequency, and cannot be varied by its field excitation, the variation of the latter merely changing the phase relation of the alternating current.

When converting, however, from continuous to alternating current with no other source of alternating current—that is not running in multiple with engine or turbine driven alternating current generator—the speed of the converter as a continuous current motor depends upon the field strength, and thus increases with decreasing, and decreases with increasing field strength. As an alternating-current generator, however, the field strength depends upon the intensity and phase relation of the alternating current, lagging current reducing the field strength, and thus increasing speed and frequency, and leading current increasing the field strength and thus decreasing speed and frequency.

Thus, if a load of lagging current is put on an inverted converter, as for instance by starting a converter therefrom from the alternating side, the demagnetizing effect of the alternating current reduces the field strength and causes the converter to increase in speed and frequency. An increase of frequency, however, may increase the lag of the current and thus its demagnetizing effect, and thereby still further increase the speed, so that the acceleration may become so rapid as to be beyond control by the field rheostat and endanger the machine. Hence, inverted converters have to be carefully watched, especially when starting other converters from them, and some absolutely positive device is necessary to cut the inverted converters off the circuit entirely as soon as its speed exceeds the danger limit.

This danger of racing does not exist if the inverted converter operates in parallel with alternating generators, provided that the latter and their prime movers are of such size that they cannot be carried away in speed by the converter. In an inverted converter running in parallel with alternators, the speed is not changed by the field excitation, but a change of the latter merely changes the phase relation of the alternating current supplied by the converter. That is, the converter receives power from the continuous-current system and supplies power into the alternating system, but at the same time receives wattless current from the alternating system, lagging at under-excitation, leading at over-excitation; and can in the same way as an ordinary converter or synchronous motor be used to compensate for wattless currents in other parts of the alternating system.

9. DOUBLE-CURRENT GENERATORS.

Similar in appearance to the converter, which changes from alternating to continuous current, and to the inverted converter, which changes from continuous to alternating current, is the double-current generator, that is a machine driven by mechanical power and producing continuous current as well as alternating current from the same armature, which is connected to commutator and collector rings in the same way as in the converter.

Obviously the use of the double-current generator is limited to those sizes and speeds at which a good continuous-current generator can be built with the same number of poles as a good alternator.

The essential difference between a double-current generator and a converter is, however, that in the former the direct current and the alternating current are not in opposition, as in the latter, but in the same direction, and the resultant armature polarization is thus the sum of the armature polarization of the continuous and of the alternating current.

Since at the same output and the same field strength, the armature polarization of the continuous current and that of the alternating current is the same, it follows that the resultant armature polarization of the double-current generator is proportional to the load, regardless in which proportion this load is distributed between the alternating and continuous-current side.

The heating of the armature due to its resistance depends upon the sum of the two currents, that is upon the total load on the machine. Hence, the output of the double-current generator is limited by the current heating of the armature and by the field distortion due to the armature reaction, in the same way as in a direct-current generator or alternator, and consequently is much less than that of a converter.

In double-current generators, due to the existence of armature reaction and consequent distortion, the commutator brushes are more or less shifted against the neutral, and the direction of the continuous-current armature polarization is thus shifted against the neutral by the same angle as the brushes. The direction of the alternating-current armature polarization, however, is shifted against the neutral by the angle of phase displacement of the alternating current. In consequence thereof the reactions upon the field of the two parts of the armature polarization, that due to the continuous current and that due to the alternating current, are usually different in magnitude, although approximately in the same direction.

The reaction on the field of the continuous-current load can be overcome by a series field. The reaction of the alternating-current load on the field when feeding converters, or synchronous motors, can be compensated for by a change of phase relation by means of a series field on the converter, or motor, with self-induction in the alternating lines. Thus a double-current generator feeding converters on the alternating side can be considered as a direct-current generator, in which a part of the commutator, with a corresponding part of the series field, is separated from the generator and located at a distance, connected by alternating leads to the generator.

Obviously automatic compounding of a double-current generator is feasible only if the phase relation of the alternating current changes from lag at no load to lead at load in the same way as produced by a compounded converter. Otherwise rheostatic control of the generator is necessary. This is, for instance, the case if the voltage of the double-current generator has to be varied to suit the conditions of its continuous-current load, and the voltage of the converter at the end of the alternating lines varied to suit the conditions of load at the receiving end independently of the voltage at the double-current generator, by means of alternating potential regulators or compensators.

Compared with the continuous-current generator, the field of the double-current generator must be such as to give a much greater stability of voltage, due to the strong demagnetizing effect which may be exerted by lagging currents on the alternating side, and may cause the machine to lose its excitation altogether. For this reason it is preferable to separately excite double-current generators.

10. CONCLUSION.

Of the types of machines, converter, inverted converter, and double-current generator, sundry combinations can be devised with each other and with synchronous motors, alternators, continuous-current motors and generators.

Thus, for instance, a converter can be used to supply a certain amount of mechanical power as a synchronous motor. In this case the alternating current is increased beyond the value corresponding to the continuous current, by the amount of current giving the mechanical power, and the armature reactions do not neutralize each other, but the reaction of the alternating current exceeds that of the continuous current by the amount corresponding to the mechanical load. In the same way the current heating of the armature is increased.

An inverted converter can also be used to supply some mechanical power. Either arrangement, however, while quite feasible, has the disadvantage of interfering with automatic control of voltage by compounding.

Double-current generators can be used to supply more power into the alternating circuit than given by their prime mover, by receiving power from the continuous-current side. In this case a part of the alternating power is generated from mechanical power and the other converted from continuous-current power, and the machine combines the features of an alternator with that of an inverted converter.

Inversely, when supplying continuous-current power and receiving mechanical power from the prime mover and electric power from the alternating system, the double-current generator combines the features of a direct-current generator and a converter. In either case the armature reaction, etc., is the resultant of those corresponding to the two types of machines combined.

Outside the scope of this investigation is the use of the converter to change from alternating to alternating of a different phase, as, for instance, when using a quarter-phase converter to receive power by one pair of its collector rings from a single-phase circuit, and supplying from its other pair of collector rings the other phase of a quarter-phase system or a three-phase converter on a single-phase system, supplying the third wire of a three-phase system from its third collector ring.

Use of Single-Phase Motors.

In the city of Frankfort-o.-M., in Germany, single-phase motors with an aggregate capacity of 1400 horse-power are run from the town lighting mains.

Studying American Telephone Practice.

Two English Post Office officials, Mr. Gavey and Mr. Cooper, of London, are said to be making a thorough investigation of the telephone systems in the United States.

Electricity in the War.*

As my friend, Mr. Roller, had greater opportunities to observe the details of electrical engineering aboard naval vessels, and will doubtless give the meeting the benefit of his observations, I shall therefore confine my remarks to considerations of a general character. The lessons taught by the late war with respect to the employment of electricity aboard men-of-war are few in number, though important in their bearing. The most decisive result was the demonstration of the immense superiority of electricity over steam for the operation of turret training apparatus—a demonstration so decisive, in fact, that the question of the employment of electric power for this purpose is no longer an open one. The society is to be congratulated that one of its members is the inventor of the system whose application has led to this happy result. I refer to Mr. H. Ward Leonard.

Another question which the test of battle has settled definitely is the superiority of electric ammunition hoists, not only in efficiency in working, but in a convenience with respect to location and space occupied that will tend to greatly extend the application of electric power on shipboard generally.

Against the great success in the particulars just mentioned must be set the failure of electrical range-finding apparatus, and of electrical indicating apparatus in general. As to the first mentioned, the enemy gave so few opportunities for its use, and even then so little necessity existed for its employment in view of the leisurely manner in which our vessels could pick up their range, that possibly neglect had something to do in the case.

As to other indicating apparatus, it should be borne in mind that electrical apparatus of this nature requires a certain amount of expert care, which it is not always possible to obtain aboard ship, while the contrary is the case with the mechanical apparatus that it would displace.

The favorable experience with electric power in the important cases just mentioned should accelerate the extension of its application aboard ship, and while, unfortunately, the present bureaucratic tendency is not in that direction, I shall nevertheless refer to some other cases distinctly calling for such application.

The one of immediate importance, and which, in fact, can be considered a crying necessity, is that of electric ventilation. For warship ventilation, both with respect to coal economy and driving, the most efficient results in ventilation itself, the electric fan offers an ideal solution. The modern warship being divided into numerous compartments, each of these can be supplied with its own electric fan or fans, either for isolated ventilation or to supply a system of only such extent as will involve no sacrifice in efficient ventilation. The type of engine now employed with steam ventilators undoubtedly requires anywhere from 75 to 200 pounds, and even more, water per horse-power hour. In the case of a large electric plant, and with fan motors of the most ordinary efficiency, this would be reduced to considerably below 50 pounds, while at the same time the ventilation for a given expenditure of power would be greatly increased in efficiency.

Whether electricity should also be applied to furnace blowers for forced draught is an open question at the present moment, in view of the very infrequent use of such blowers and consequent large idle electric plant normally that would be entailed.

Other employments of electric power, so obvious that their adoption cannot be greatly delayed, are in driving the workshop and ice machine now installed aboard every warship. The engines of the latter are particularly inefficient, aside from their immense inconvenience through the heat given forth. In these cases the applica- [illegible] On the ship of which I was chief engineer there were six of these, [illegible] long lengths of steam supply pipes.

[illegible] auxiliary machinery connected with the propelling engines. While it [illegible] reply it may be said that the number of different engines at present employed to run the auxiliary machinery is in itself a great hazard, for the breaking down of almost any one would alone affect the operation of the main propelling machinery.

Among other probable applications of electricity in the future are to anchor hoists and steering gear. The navy has had a somewhat unfortunate experience with the latter, and this, by the way, carries a lesson with it for those interested in introducing new electrical machinery aboard warships.

The lesson is that in every case possible such machinery should first be tried aboard merchantmen, and all experimental work entirely completed before attempting to secure adoption by the navy. In many cases it would possibly not be a difficult matter to find opportunities for making the trial on coastwise or freight steamers, or on harbor vessels, though sometimes, however, at the expense of those putting the apparatus aboard.

Steering gear and anchor hoists now furnish good subjects for the electrical designer, and if previously tested in the manner described would undoubtedly stand an excellent chance of adoption for use in the navy in the near future.

As I have intimated, it must be reluctantly acknowledged that, notwithstanding the extremely efficient showing which electricity made during the late war, it is apparently at the present moment not in high favor at the Navy Department. The chief of the bureau having charge of electrical matters has recently reported very gloomily concerning the difficulty experienced aboard ship in keeping the generating plant in an efficient state; and the Naval Board of Construction has recently refused to further extend the application of electricity on shipboard, the decision being that the use of electricity has gone far enough for the present.

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* [illegible]

Alternating-Current Machinery.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

CHAPTER XXVII.

THE SINGLE-PHASE GENERATOR AND SYNCHRONOUS MOTOR.

If we connect a continuous-current generator of e. m. f. E volts and internal resistance R ohms in opposition with a pair of bus bars maintained at a steady pressure of e volts, then we know that the current which will flow through the armature of the generator will be $I = \frac{E - e}{r}$ amperes, and the activity of the generator will be $p = e\,I$ watts. Similarly, if we connect an alternating-current generator of e. m. f. E volts, and Z ohms apparent internal impedance, in opposition with a pair of bus bars maintained at a steady alternating pressure of e volts, of the same frequency as E, then the current which will flow through the alternator armature will be

$$I = \frac{E - e}{Z} \text{ amperes.}$$

This, however, is a vector equation and must be interpreted geometrically instead of arithmetically. The external activity of the generator will be $p = |\,e\,I\,|$ watts, where the vertical lines $|\ \ |$ indicate that the product of $e\,I$ is not the mere arithmetical product, but the co-directed product, or the product of the e. m. f. e, and the resolved portion of the current in phase with it. If α is the phase angle between e and I, $p = e\,I \cos\alpha$. Suppose that e, Fig. 155, represents 1000 volts at standard phase, the e. m. f. of the bus bars, and that the generator has an e. m. f. of 1000 volts at the same frequency, has an apparent impedance of $Z = 10 \angle 84° 15' = 1 + j\,9.95$ ohms, and is connected to the bus bars in synchronism. Then its e. m. f. E will be both equal and parallel to e, as shown in the figure. Under these circumstances there will be no current through the armature, and no work will be expended electrically by the generator upon the circuit. The engine driving the generator will, therefore, tend to accelerate it, and will advance its phase relatively to that of the bus bars. Suppose that under these circumstances the generator e. m. f. advances 20°, or becomes $E \angle 20°$, as shown in Fig. 156. Then $E - e = 347 \angle 100°$ volts, and the current

$$I = \frac{E - e}{Z} = \frac{347 \angle 100°}{10 \angle 84° 15'} = 34.7 \angle 15° 45' \text{ amperes.}$$

The current is, therefore, nearly in phase with the generator e. m. f. and the internal electric power expended by the generator will be

$$1000 \times 34.7 \times \cos (4° 15') = 1000 \times 34.7 \times 0.9973$$

$= 34{,}610$ watts, approximately, or

34.61 kilowatts. The mechanical power expended in driving the generator will be this 34.61 kilowatts plus the mechanical and electric frictions, or perhaps 40 kilowatts.

It is evident, therefore, that in order to make a continuous-current generator supply power to a circuit at a pair of bus bars, it is necessary to increase its e. m. f. until the drop in the armature neutralizes the increase. But in the case of an alternator which is run in synchronism it is not necessary to have its e. m. f. above that of the bus bars; it is only necessary to advance its phase angle, and the greater the angle of phase-advance, the greater, within certain limits, will be the power which it exerts electrically.

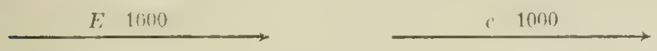

Fig. 155.—Generator in Phase with Bus-Bar Voltage.

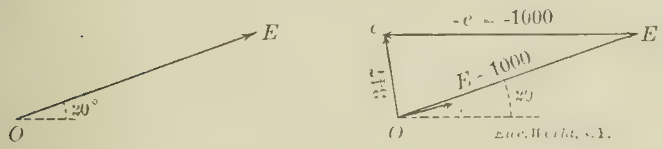

Fig. 156.—Generator Leading Bus-Bar Voltage by 20°.

Calling β the angle of the apparent armature impedance, the power electrically expended in the armature will be

$$p = \frac{E^2}{Z} \cos \beta - \frac{Ee}{Z} \cos (\alpha + \beta) \text{ watts.}$$

The maximum current strength which the armature could develop would be on short circuit, viz., $\frac{E}{Z}$ amperes, and the maximum power P, which this current could absorb, would be in the ideal case of co-phase with the e. m. f. or $\frac{E^2}{Z}$ watts. Consequently

$$\frac{p}{P} = \cos \beta - \frac{e}{E} \cos (\alpha + \beta).$$

For the case above considered of equality between the generator and bus-bar pressures, this becomes

$$\frac{p}{P} = \cos \beta - \cos (\alpha + \beta).$$

These may be regarded as forms of the fundamental equation of the synchronous generator. They enable the phase angle of the generator to be determined for any given electrical power developed in the armature, and from this the current strength may be found.

Since the angle of apparent impedance of a generator is in practice usually between 80° and 90°, its cosine is usually between 0.175 and 0, or a comparatively small quantity, so that, roughly,

$$\frac{p}{P} = - \cos (\alpha + \beta)$$

or the ratio of the electric power exerted in the armature to the maximum possible electric power is the negative cosine of the sum of the phase angle of the generator and the apparent impedance. This is a maximum when α is $(180^\circ - \beta)$ or nearly 90°, in which case $-\cos (\alpha + \beta)$ is, approximately, 1, and $p = P$, so that when the generator pressure is equal to and in quadrature with the bus-bar pressure, the electric power in the armature circuit is about equal to the possible maximum, or $\frac{E^2}{Z}$ watts. In practice a generator would be overloaded which supplied this amount of power, so that the lead at full load when supplying bus bars of equal pressure would be less than 90°. Thus, in the case of the generator above considered, with $E = 1000$ and $Z = 10\,\underline{/84^\circ\ 15'}$, $P = \frac{E^2}{Z} = 100{,}000$ watts, so that

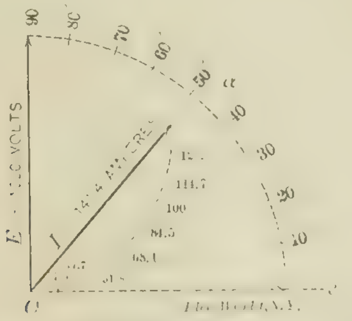

Fig. 157.—Relations Between Generated E. M. F. and Current. $E = e$.

$$\frac{p}{100{,}000} = \cos (84^\circ\ 15') - \cos (\alpha + 84^\circ\ 15').$$

With $\alpha = 90^\circ$ this becomes

$$\frac{p}{100{,}000} = 0.1 - \cos (174^\circ\ 15')$$
$$= 0.1 + 0.995 = 1.095$$
$$\text{or } p = 109{,}500 \text{ watts.}$$

The current strength in this case would be 141.4 amperes, which would be about three times the full-load current strength.

The relations for this generator between the conditions of co-phase and 90° lead in the generator e. m. f. with respect to bus bars is indicated in Fig. 157. It will be seen that the current I (drawn to an enlarged dimensional scale) increases from 0 amperes at co-phase, to $141.4\ /50^\circ\ 45'$ when the e. m. f. leads in quadrature. The full-load lead would be about 30° when $p = 0.511\ P$, or $\frac{p}{P} = 0.5$ approximately. The current I always leads the bus-bar pressure $E\,e$, but always lags behind the generator pressure $O\,E$, while the machine is operating as a generator, but the lag is small up to full load. The vector $O\,I$ describes the arc of a circle, while the vector generated e. m. f. $O\,E$ describes the arc of another circle.

In order that a generator may be able to keep in synchronism with the bus-bar pressure under the ordinary variations of load, it is necessary that the phase relations shall be stable. In other words, a small variation in the load, or in p, must not give rise to a large variation in the phase angle to be automatically adjusted. This stability is a maximum when the phase angle is the complement of the impedance angle, or in the case considered, 90° — 84° 15′ = 5° 45′. At this lead the stability is about 40 per cent. greater than at the condition of quadrature, but between no load and full load for the case of the alternator considered the stability would be practically constant.

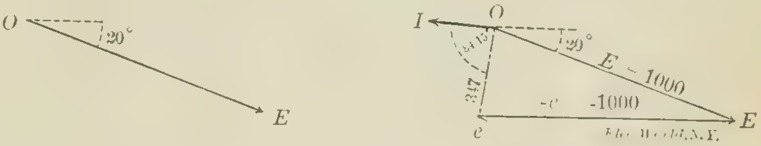

Fig. 158.—Motor Lagging 20° Behind Bus-Bar E. M. F.

We may next suppose that the generator, instead of being driven by power, is excited to the same e. m. f. as the bus bars, and is switched into connection with them in synchronism, at the condition represented in Fig. 155. At first there will be no resultant e. m. f. tending to force current through the armature. The friction of the armature will, however, tend to retard it, and the armature will tend to lag, so that the vector E will tend to lag behind the standard bus-bar vector e. We may suppose that the lag in phase has reached 20°, as represented in Fig. 158. Then the current in the armature will be

$$\frac{1000\ /20^\circ - 1000}{10\ /84^\circ\ 15'} = \frac{347\ /100^\circ}{10\ /84^\circ\ 15'} = 34.7\ /184^\circ\ 15' \text{ amperes.}$$

The current is nearly in phase with the bus bar e. m. f. e, and is nearly in opposition to the armature e. m. f. E. Consequently, the former will do work upon the current and expend power, while the latter will be worked upon by the current and absorb power. In other words, the machine will tend to operate as a motor. The power it receives from bus bars will be the co-directed product of I and e, or

$$p_e = |\,I\,e\,| = |\,1000\ /180^\circ\ 34.7\ /184^\circ\ 15'\,|$$

so that

$$p_e = 1000 \times 34.7 \times \cos 4^\circ\ 15'$$
$$= 1000 \times 34.7 \times 0.9973$$
$$= 34.610 \text{ watts} = 34.6 \text{ kilowatts.}$$

Similarly, the power received mechanically by the armature will be

the co directed product of I and $E. = | I E | = p$
so that
$$p = 1000 \times 34.7 \times \cos 164° \ 15'$$
$$= 1000 \times 34.7 \times - 0.9625$$
$$= - 33.405 \text{ watts} = - 33.4 \text{ kilowatts.}$$
Here the negative sign indicates that the power in the machine is negative, or is active power expended in driving it electrically. The difference between the power expended by the bus bars and the power absorbed mechanically in the armature is
$$p_e - p = 34.610 - 33.406 = 1204 \text{ watts.}$$
This is the power expended in the resistance of the armature as $I^2 R = 34.7 \times 34.7 \times 1 = 1204$ watts. The power which the machine will be capable of delivering at its shaft or pulley will, of course, be less than 33.4 kilowatts, owing to the mechanical and magnetic frictions in the armature, so that the output of the machine as a motor might be, say, 27 kilowatts.

If the load on the machine is less than 27 kilowatts, the motor will reduce the phase angle **α** to something between 0° and — 20°, whereas, if the load be greater than 27 kilowatts, the motor lag will increase. The vector current will retreat along the circle $O\ I$, Fig. 159, being 141.4 / 39° 15′ when E lags 90° behind bus-bar pressure. The armature current will be nearly opposite the armature e. m. f., but will always be behind the bus-bar pressure. The upper part of the diagram represents the conditions already examined in connection with Fig. 157 with a machine acting as a generator. It will be seen that the generator circle $O\ I'$ is not symmetrical with the motor circle $O\ I'$, the centre of the former being at P, while the centre of the latter is at P'. The current and power in the armature are, therefore, not the same for a given angle of lag in e. m. f. as they are for the same angle of lead.

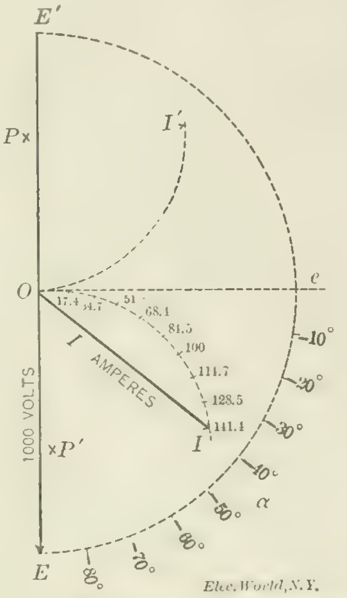

Fig. 159.—Relations Between Generated E. M. F. and Current. $E = e$. Direction of I Reversed.

The formula which expresses the power absorbed by the armature mechanically when running as a motor is as before,
$$\frac{p}{P} = \cos \beta - \frac{e}{E} \cos (\alpha + \beta)$$
or, in the case of equality between e and E, here considered,
$$\frac{p}{P} = \cos \beta - \cos (\alpha + \beta).$$
The angle α is, however, now negative, and = 90°
$$\frac{p}{P} = \cos 84° \ 15' - \cos (-90° + 84° \ 15')$$
$$= 0.1 - \cos (5° \ 45')$$
$$= 0.1 - 0.995$$
$$= - 0.895$$
[illegible] P [illegible] p [illegible] kilowatts.

Fig. [illegible] when I [illegible] I [illegible]
so that p, the co-directed product = p = [illegible] × 141.4 × cos [illegible]
[illegible]
[illegible] kilowatts.

[illegible]

[illegible] motor being usually less than 90°.

Efficiency of the Electrolytic Cell.

BY C. F. BURGESS.*

If an estimate for the future can be based upon developments at the present time, the electro-chemical industries promise to open up a field for the utilization of electrical energy in which the electrolytic cell will become a rival of the electric motor in transforming electrical energy for industrial purposes. If such condition is to exist, however, the electrolytic cell must receive as careful attention as regards efficiency as has been given to the electric motor; there is certainly a chance for improvement in this direction.

The electrolytic cell as an apparatus for utilizing electrical energy to effect chemical transformations is, in many of its features, comparable to the electric motor for transformation of electrical energy for mechanical purposes. A study of those points of similarity which might be of help in the investigation of electrolytic processes, especially to the student who is versed in the operation of dynamo-electric machinery. The electrolytic cell, like the electric motor, is an apparatus for transforming electrical energy into a form of energy having a direct industrial value. The efficiency of the motor is the ratio of the mechanical energy delivered by the motor, to the electrical energy given to it, while with the electrolytic cell it is the chemical energy which is stored up, divided by the electrical energy supplied.

The term "efficiency," as applied to electrolytic processes, is frequently used with different meanings, and as a result it is usually difficult to determine just what is meant by a statement that a substance is produced electrolytically at a certain percentage of efficiency.

The passage of a direct current through an electrolyte causes certain chemical changes, and the final chemical products contain a different amount of energy than do the chemical substances before being subjected to electrolysis. As it is this difference in the amount of potential energy which causes differences in chemical substances composed of the same elements, the energy efficiency of an electrolytic cell may justly be defined as the ratio of the difference in energies (chemical) of the substances before and after treatment to the energy (electrical) supplied in effecting the change.
$$\text{Efficiency} = \frac{\text{chemical energy}}{\text{electrical energy}} = \frac{P_c}{P_w}. \qquad (1)$$
Considering for example one of the simplest cases where an aqueous solution of cupric chloride, $CuCl_2$ between insoluble electrodes, is decomposed by the current, the resultant products being metallic copper and gaseous chlorine. A current of C' amperes at a pressure of V' volts for a duration of time of h hours is required to effect the decomposition of 133.92 grams (molecular weight) of $CuCl_2$, liberating 63.18 grams of copper and 70.74 grams of chlorine. From thermo-chemical data it is known that there is a difference in energy of 62,710 calories between 63.18 g. of copper and 70.74 g. of chlorine in the free and the combined states; 62,710 calories = 62,710 × 4.2 joules = 73.16 watt hours.
$$\text{Efficiency} = 73.16 / C' \times V' \times h. \qquad (2)$$
This expression is more properly termed efficiency of transformation of electrical into chemical energy, or, *electrical efficiency.*

Another efficiency sometimes used in describing an electrolytic process is that derived from a consideration of Faraday's law, which says, in substance, that a coulomb of electricity passing through an electrolyte either sets free or transfers to other combinations an amount of substance which is equal to its atomic weight, divided by the valence and multiplied by a constant.

An ampere second will cause to be decomposed .00069 g. of $CuCl_2$ with a liberation of .000329 g. of copper and .000364 g. of chlorine, supposing that the copper chloride is the only substance in the electrolyte acted upon by the current. This would be the case very closely if the electrolyte were made up of pure water and pure $CuCl_2$, and a suitable current density be used. If, however, other conducting compounds exist in the solution, together with the copper salt, the amount of copper deposited may not equal that given above. Also, the current density may be such that hydrogen will be liberated simultaneously with the copper, in which case a portion of the current must be expended in liberating the hydrogen, while the other part is expended in depositing copper. If copper is the product desired, hydrogen would be considered as a waste product, to produce which requires a consumption of energy. An efficient process would be one in which the waste product is as small as possible, and thus arises the second expression for efficiency which may be stated,

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*[illegible] Engineering, University of Wisconsin.

$$\text{Efficiency} = g'/g \qquad (3)$$

in which g' is the number of grams of the desired substance produced or transformed per coulomb, and g is the atomic weight of that substance divided by its valence and multiplied by .00001036.

It will be seen that this expression does not deal directly with the energy required, for there is only one of the factors of energy under consideration, the current. This, however, is a very useful expression in many cases, and should therefore have a name which will distinguish it from the term for efficiency implying energy. A suitable name by which it is sometimes designated is *current efficiency* or *chemical efficiency.* The current efficiency for the production of chlorine from an aqueous solution of sodium chloride would be stated as so many grams of available chlorine actually produced per ampere hour divided by number of grams of available chlorine which would be produced were all the current utilized in producing this useful substance.

The total efficiency of an electrolytic process would be a combination of the above efficiencies, which gives us another expression for designating the economy of a process.

$$\text{Efficiency} = \frac{P_c}{P_w} \times \frac{g'}{g} \cdot \qquad (4)$$

This expression would show how near the process under consideration approaches the ideal process in which there are no losses.

The losses which occur in an electrolytic cell may be classed as follows:

C^2R in metallic conductors.

C^2R in electrolyte (including diaphragms).

Energy consumed in producing undesired products.

The efficiency of conversion, or electrical efficiency, may be expressed in a different manner from equation (1).

$$\text{Electrical Efficiency} = \frac{C' \times E' - C'^2R}{C \times E'} = \frac{E' - C'R}{E'} = \frac{E''}{E'} \qquad (5)$$

in which R is the resistance of electrolytic cell; E'' is the applied pressure minus the drop caused by the resistance through which current C' flows, and it is also equal to the counter e. m. f. of polarization, and to the so-called e. m. f. of decomposition.

It will be observed that equation (5) is the same equation which would be used to express the electrical efficiency of a series motor, where E' would be the pressure applied at its terminals, and E'' the counter pressure set up by the armature.

Combining equation (3) with (5) we have as total efficiency

$$\text{Efficiency} = \frac{E''}{E'} \times \frac{g'}{g} \cdot \qquad (6)$$

The terms of this equation might be figured from theoretical considerations, but there are very few cases in which all the terms could be calculated with any degree of accuracy on account of the many varying conditions, which are difficult to predetermine. This is especially true for the determination of current efficiency from theoretical data.

One of the most satisfactory methods of studying the efficiency of an electrolytic process is to make detailed measurements during actual operation, and from data thus obtained conclusions may be reached as to how improvements may be made.

The total energy supplied to the cell may be most readily obtained with the ammeter and voltmeter while the cell is in operation. The current efficiency can be obtained from the current reading and by a quantitative chemical analysis. The term E'' may be determined more or less accurately in several different ways, and it is with various methods for determining this important quantity that the following has principally to deal.

If the circuit supplying a continuous-current motor be suddenly opened, the counter pressure set up by the armature will not immediately drop to zero, as could be shown by a voltmeter connected to the armature terminals. There is a similar phenomenon in the electrolytic cell, by means of which the counter pressure of polarization may be measured by noting with a voltmeter the pressure between the electrodes immediately after an interruption of current through the cell. This pressure, which is sometimes called the "after effect," is due to conditions existing at or near the electrodes produced by the current, which cause them to act just as do the plates in a primary battery, setting up an electrical pressure in opposition to that applied externally for the purpose of effecting electrolytic decomposition.

If an aqueous solution of hydrochloric acid be electrolyzed between two carbon electrodes, a measurement by a voltmeter between the plates immediately after interrupting the current will show that the plate at which hydrogen had been evolved has the property of a zinc plate in an ordinary primary cell, while the electrode at which chlorine had been evolved has the property of the copper or carbon pole. Thus the two plates of the same material act as the plates of a voltaic cell, and are capable of setting up an appreciable current in the external circuit, an explanation being that the gases evolved by electrolysis are absorbed by the respective plates, and an equivalent of a gas cell is thereby produced.

We thus have the voltaic cell, which will quickly "polarize," however, the e. m. f. rapidly decreasing upon the flow of even a small current set up by it. Consequently, to get the maximum value (that which exists during the normal flow of current) it is necessary to take it very quickly after interrupting the current. A voltmeter is not an entirely satisfactory instrument to use for this purpose, for the current flowing through it will assist in the depolarization of the plates, and, in addition, the internal resistance of the cell being in series with the voltmeter resistance, and being an unknown quantity, may introduce an appreciable error in the determination.

A method which has been in use to some extent in obtaining polarization pressures employs a rapidly rotating switch which automatically breaks the circuit and at the same time makes connection of the voltmeter to the electrodes. This method, aside from requiring rather complicated apparatus, will introduce errors, from the fact that the readings depend upon the speed with which the contact maker is revolved, and the values of current and pressure are the average values of an interrupted current, instead of the maximum values, which it is desirable to obtain.

The error introduced by the unknown electrolyte resistance in series with that of the voltmeter may be obviated by employing a potentiometer method where the unknown pressure is balanced by a pressure of known value.

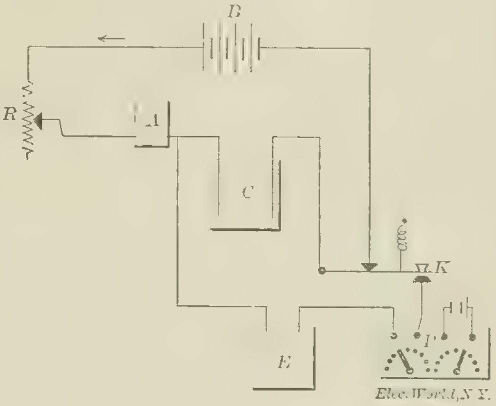


Fig 1

The following method used in the electro-chemical laboratory of the University of Wisconsin has been found very satisfactory, both from the convenience and rapidity with which readings may be made and the comparative simplicity of the apparatus required. A considerable degree of accuracy may also be attained with the method.

Fig. 1 is a diagram of connections of instruments for this measurement; B is the battery of storage cells or other source of current; R is a rheostat for regulating the strength of current flowing through electrolytic cell C, the current being measured by ammeter A. On depression key K the main circuit is broken, and a connection is simultaneously made which places the potentiometer in communication with the two electrodes. The potentiometer box, P, is an arrangement whereby an electric pressure of such a value as to balance the pressure due to the electrodes may be readily obtained by moving the two arms shown. An instrument for detecting the balance is shown by E.

A capillary electrometer is the ideal instrument for this work, for the movement of the meniscus is instantaneous upon closing the electrometer circuit if a lack of pressure balance exists, and the movement is attended by no vibration, so that many more readings can be taken in a given length of time than could be taken were a galvanometer employed. The direction of movement of the meniscus is noted upon depressing key K, giving the information which is desired in order to adjust the balancing pressure. The key is depressed and almost instantly released, for if it were left down for any appreciable length of time depolarization of the cell would prevent the maximum value being obtained. The electrometer which has been used for this work is very portable and can be tipped in any position without injury, will stand a considerable amount of rough usage, is uninfluenced by mechanical vibration or varying magnetic field, and will respond to a pressure of about .001 volt.

The accuracy with which measurements of polarization may be made by this method depends somewhat upon the size and kind of electrodes and on the electrolyte, but it may ordinarily be measured within .01 volt and estimated to the thousandths place.

Polarization in an electrolytic cell may exist almost entirely at a single electrode, or it may be the sum of pressures set up at both electrodes, and a counter pressure may even be set up in the body of the electrolyte itself, though usually of an inappreciable amount. Some means of separating the total pressure of polarization into its component parts, that at the anode and that at the cathode, is very desirable, and the following method will offer a means of so doing.

In order to measure the polarization at a single electrode the electric pressure between the electrode and the electrolyte must be measured, which necessitates the making of another contact with the liquid. This may be done by dipping the end of a wire into the liquid, but there is a pressure set up at this point whose value must be known in order that the single potential at the electrode may be derived. There are some metals whose potentials in certain electrolytes are known, but the values vary greatly with temperature and character of the electrolyte, and they are hardly available for the purpose. There is fortunately a way out of the difficulty, however, by using the so-called normal electrode, one form of which consists of a layer of pure mercury in a glass vessel, the mercury being covered with a layer of mercurous chloride. The vessel is then filled with a normal solution of potassium chloride, and this solution is connected to the electrolyte under measurement by means of a tube filled with the potassium chloride solution. The pressure set up between the mercury and the solution is known to be very nearly .56 volt, the mercury being positive to the electrolyte. There is some question as to the exact value of the pressure of such electrodes, but it is not very far from .56 volt, and this is generally accepted as a value to work with.

By measuring the potential between the mercury and the individual electrode of the electrolytic cell, at the instant of interruption of the current, just as is done in the operation shown by Fig. 1, a value of pressure may be obtained, which, by adding or subtracting .56 volts, as the case may be, will give the polarization at each electrode. The diagram, Fig. 2, shows the arrangement for this test, being similar to the first diagram, with the exception that the normal electrode *N* and the key *K'* are added. To measure polarization at the anode, *K'* is used, and *K* serves the same purpose for the cathode.

This measurement is hardly as accurate as that for the total polarization, from the uncertainty as to the value of the normal electrode, but the error cannot exceed a few one-hundredths of a volt, [illegible] the method will [illegible]

[illegible] representative example of a large

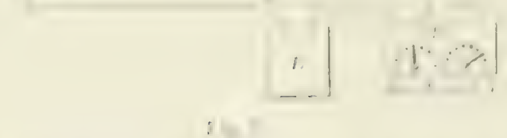


Fig. 2.

[illegible]

[illegible]

rates of working, in addition to giving considerable information as to the internal working of the cell. If the electrolytic process is such that the product at the cathode alone is desired, then it would be desirable to make the curve showing anode polarization as low as possible as regards economy of power. This might be done by choosing suitable materials for the anode, and in other ways, though the saving in electrical energy may be overbalanced by the cost of materials or process necessary to decrease the polarization.

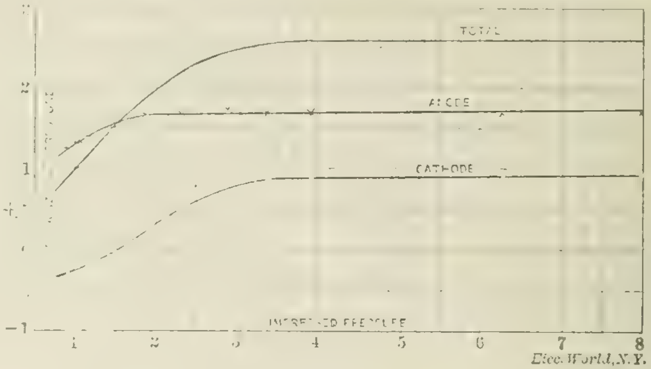


Fig. 3.

The curves in Fig. 3 seem to show quite clearly that there is a maximum value of polarization, which fact has been questioned by some authorities.

A Method of Changing the Frequency of Alternating Currents.

A system designed to vary the frequency of alternating currents delivered is the subject of patents Nos. 615,673, 615,952 and 615,953, all issued to Mr. Charles S. Bradley, December 13, 1898. As is well known, the speed of alternating-current motors, whether of the synchronous or induction type, can be most satisfactorily varied by varying in the same proportion the frequency of the current delivered to them. The voltage should also vary in about the same ratio. This is accomplished in the method proposed in these patents by the use of what is called a motor generator, more properly described as a multiphase transformer with either the primary or the secondary capable of rotation, such a machine resembling in structure an induction motor with a wound secondary and having already come into some use in motor-driven combinations as a frequency changer to raise the frequency of transmission lines to a higher value, suitable for distributing circuits.

It is pointed out in the patents that such a machine, when loaded, tends to drive its secondary at a speed less than that of the rotating field set up by the primary by an amount called the "slip," which can be varied by changing the power factor of the circuit which the secondary supplies. This slip is such that the transformer tends to give electric resonance in the primary circuit. If the secondary circuit is non-inductive or contains a capacity or its equivalent of negative self-induction, the secondary of the transformer tends to rotate practically at synchronism, delivering to its circuit currents of very low frequency. By increasing the self-induction of the circuit the slip may be increased, increasing therewith the frequency of the currents delivered. The secondary circuit is connected to synchronous motors, and the powerful excitation of their fields gives a capacity effect and thus keeps down the frequency of the currents delivered to them. By weakening their fields the slip of the transformer can be increased and the frequency of the alternating currents can be correspondingly increased. Thus, for starting such motors, their fields should be powerfully excited, in which case they will get currents of very low frequency, which gives them a high torque per ampere and a high economy. By reducing the field excitation and consequently the capacity effect, the frequency may be made to rise and the motor speed with it. The method is also applicable to induction motor work with a separate, free running synchronous machine to give the capacity, although, of course, in this case the machine must be of sufficient size to neutralize by its leading currents the lagging current of the induction motors connected to the same circuit.

It is pointed [illegible] method may be used with no variation [illegible] the transformer being simply allowed to rotate [illegible] low and retarded by means [illegible] convenient mechanical device when higher speed is desired, until the transformer secondary is brought [illegible] the frequency impressed upon the motor is equal to that in the supply line.

DIGEST OF CURRENT ELECTRICAL LITERATURE

AMERICAN AND FOREIGN

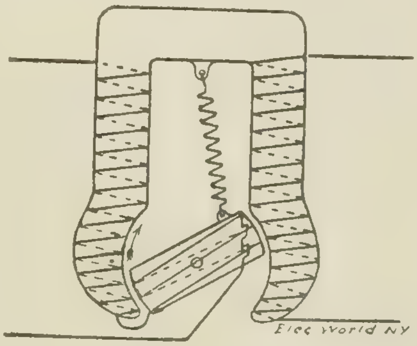
By Carl Hering

Dynamos, Motors and Transformers.

ROTARY CONVERTERS. S. P. Thompson. Lond. "Elec. Eng.," "Elec." and "Elec. Rev.," Dec. 2.—The conclusion in the first two journals and continuation in the latter, of the reprint of his long paper (see "Digest" last week). He continues, giving data and some illustrations of various forms of converters in use, chiefly American. One of the difficulties experienced in operating converters on a large scale is the tendency, when grouped in parallel, to set up a see-sawing interference of low period, probably in consequence of armature-reactions similar to those which in certain types of alternators affect their parallel running. Another puzzling defect is a similar tendency to hunt when the converters are arranged in series at the two ends of a long three-phase line for the purpose of feeding continuous currents from one point to another. The cure of these troubles will probably be found in an analogous treatment to that adopted for securing good running in alternators, namely careful design, so as to prevent armature reactions from unduly distorting the magnetic field. In conclusion he refers briefly to another class of machine, one devised by Sahulka and another by Hutin and Leblanc, both of which have been referred to in the "Digest"; in these a revolving commutator is used. In the discussion, which is published in full in the "Elec. Eng." and abstracted briefly in the "Elec. Rev.," Mr. Field gives, at some length, further particulars concerning the 30-kw converter mentioned in the paper; he also gave his experience with it while running an installation. Esson, among other things, remarked that rotary converters were no doubt good for tramway work, but they were not so good for lighting, because the rise and fall in the voltage made the lights unsteady; for high voltages he did not think rotary converters were as good as two distinct machines. Hobart suggested that the cure for all erratic tendencies, such as hunting, was found in using steam engines which had a very uniform angular velocity; there is now no necessity for tolerating the phenomenon of hunting; triple concentric cables have also been found to induce troublesome unbalancing of the voltage, and it is preferable not to use them with rotary converter installations; symmetrically arranged single cables were satisfactory; the chief argument in favor of transforming by means of rotaries, as compared with the motor-generator method, was the lower first cost and the higher combined efficiency. Mordey remarked that the hunting action might be lessened if a short-circuited copper coil were put around the field; this should be used with laminated coils, as the loss was then a minimum. Carus-Wilson referred to the question of heating, saying that the load at which an alternating-current motor would fail and stop depended on the heating of the armature: it is obvious that it was an entirely different question to the heating of a continuous-current machine; the hunting difficulty might be remedied by increasing the inertia; it is the current required to give the torque which alone reacted on the magnets; a synchronizing or wattless component of the current did not distort the field; hence the reaction in a rotary converter depends only on the amount of energy required to overcome the frictional losses of the machine. Thomas remarked that there seemed to be an idea that the hunting action was impossible to overcome; it is, however, not hard to get rid of; the reactions only occurred when the machines were under or over excited; he found that the load might vary considerably without altering the voltage very much; he prefers the three-phase to the two-phase system; the formen requires only three-fourths of the amount of copper as compared with the latter.

SINGLE-PHASE MOTORS.—Lond. "Elec. Rev.," Dec. 2.—A brief, illustrated description of the application of such motors in a confectionery factory at Hammersmith, which is said to be the most notable use of single-phase motors in that country; the energy is derived from the city mains. The factory has been newly erected, and was then provided with motors for each machine, instead of countershafts and belts. There are fourteen motors, which, with one or two exceptions, all drive separate machines; they vary from 7 to 0.25 horse-power; the current is at 110 volts and a frequency of 50; they are all of the Brown-Boveri type, full descriptions of which have already been given; the smaller ones are started with a resistance, while with the larger ones the usual condensers are used; they are said to be started in a strikingly easy manner, and with some of them there are loose pulleys; the elevator motor of 2 horse-power starts up with all the belting and gearing thrown on, and the starting current does not exceed the full load current; the load on this one has sometimes been doubled without causing it to break out of step. A speed-reducing gear which is used consists of a countershaft, which is mounted so that it can be readily moved to tighten or loosen the belts, thus enabling very short belts to be used; the latter are loosened so as to enable the motor to start. This is necessary only when the full load is on. Separate motors for each machine were used, so as to get as much light as possible, and because the machines are scattered; moreover, most of the motors are idle during long periods. The Andrews safety concentric system of wiring is used, each motor and group of light having its own circuit to the main switchboard, thus avoiding scattered fuses.

TRANSFORMER WITH VARIABLE RATIOS.—"Elek. Rundschau," 15, p. 177; noticed briefly, with the illustration, in "Science Abstracts," Nov.—A description of the Nicolaysen device to secure constancy of the secondary voltage when the secondary current varies, thus compensating automatically for the drop in the transformer and the mains connected to it. The arrangement is shown in the accompanying figure.



ALTERNATING-CURRENT MOTOR.—Lond. "Elec.," "Elec. Rev.," and "Elec. Eng.," Dec. 2.—An illustrated description of the Langdon-Davies motor and the factory where it is constructed. The two disadvantages of an alternating-current motor—namely, the inability to start under a heavy load, and the power factor—are claimed to be counterbalanced to some extent in this motor by the absence of brushes. The motor itself was described in detail two years ago; the rotating part consists of short-circuited coils on an iron core, while the position and proportions of the stationary coils are such as to produce a rotating field, a starting winding being added, which is switched off as soon as the motor has attained its full speed; they are all fitted with double-width pulleys, so that they may be started on a loose pulley on the countershaft.

CAUSE OF SPARKING. Dick. "Elek. Zeit.," Dec. 1.—A long, mathematical article in which he develops a number of formulas to be used in making certain calculations in connection with dynamos. He had noticed in constructing dynamos that under the assumption that there is a sufficiently strong field at the forward edge of the pole-piece there will be sparkless collection by the brushes only when the latter were replaced by brushes of different material, as in replacing copper by carbon, and even the reverse. This led him to investigate the relations and dimensions in a machine, and the article gives the results of these investigations. It has been supposed that a relatively strong field is required for commutating the current in the short-circuited coil; he gives a formula by which this field may be calculated, and this shows that in comparison to the main field it is, even for toothed armatures, very small. Sparking and armature reaction, he shows, have no direct connection with each other. Among other things he shows that the short-circuited coil must move in a field which has the same strength as that which is produced by the ampere windings in the short-circuited coil. Also that for sparkless collection there must be a certain very definite resistance in the circuit of the short-circuited coil; formulas are given for calculating this. He then discusses the connection between the formation of sparks and the armature reaction. Formulas are deduced for calculating the dimensions of carbon brushes. A summary of the formulas is then given and their application to specific cases is illustrated by examples. In an appendix he states that in spite of sparkless collection of the brushes and the correct dimensioning of the contact surface, there may be bad heating of the commutator; the limits of continuous-current machines may therefore also depend on the heating of the commutator; the use of carbon brushes for producing a certain relation of resistances is allowable only to a certain degree. The effect of the length of the surface of contact, on the characteristic of the machine, is briefly discussed; the armature reaction is shown to be dependent on this width of the brush.

SELECTION OF TYPES OF ARMATURE CORES AND WINDINGS. Rice. "Amer. Elec.," Dec.—Instructions are given fixing the style of winding for a given purpose and on the selection of the type of armature. In general lap windings are used for bipolar machines, wave windings for multipolar, multiple windings for medium voltages and medium currents, series windings for high voltages, and the telescope windings for low voltages and large currents. The smooth core is almost entirely abandoned at the present time. The toothed core provides a firm, mechanical support for the conductors, protects them from injury and makes it possible to cut down the distance between the core and the poles to that which is needed for mechanical safety; overhanging teeth will reduce heating of the poles, which may also be avoided by using laminated pole pieces or narrow slots cut in the pole-face parallel to the laminations of the armature core; field distortion can be eliminated by using teeth of such small cross section as to be nearly saturated at normal load. Bar or cable windings are generally put into tunnels made by punching holes in the armature discs.

INEFFICIENCY OF SMALL MOTORS.—"Amer. Elec.," Dec.—It is stated that since 1894 the efficiency of small motors has remained about 40 per cent. for ¼ kw to 50 per cent. for 1 kw and 60 per cent. for 3 kw; these efficiencies are said to be lower than they should be, and among the suggestions whereby they may be increased are the following: Increasing the width of the armature teeth and decreasing the number of turns per coil; changing the shape of the pole shoes and reducing the length of the air gaps; increasing the area of the magnetic path in the armature core; extending the pole shoes and decreasing the number of turns per armature coil; increasing the cross section of the field magnet yokes and decreasing that of the magnet core, at the same time increasing the depth of the field winding and decreasing its length along the core.

DESIGN OF A 1-HP MOTOR. Poole. "Amer. Elec.," Dec. —Instructions, accompanied by working drawings, are given for the design of a 1-hp bipolar motor with a drum armature.

HOW TO DESIGN A DYNAMO.—"Amer. Elec.," Dec.—The present installment of this series deals with the field of force and calculation of windings.

TRANSFORMING DIRECT AND ALTERNATING-CURRENT MOTORS. Brown. "Amer. Elec.," Dec.—Directions are given for transforming a direct-current into an alternating-current motor, and transforming a fan motor designed for 125 cycles so that it will run properly on a 60-cycle circuit.

PREVENTION OF SPARKING. Rice. "Amer. Elec.," Dec. —The various factors leading to sparking are considered and means for prevention given. The several forms of winding to reduce sparking are illustrated, such as the Sayers and the Ryan.

CONNECTING TRANSFORMERS. Keator. "Amer. Elec.," Dec.—He gives his experience in connecting the primary of two transformers in series, with the secondaries in multiple.

Lights and Lighting.

SEARCHLIGHTS.—Lond. "Engineering," Dec. 2.—In this installment of the long article descriptive of the works of the late Schuckert Company, the searchlights made by that company are described with the aid of very good illustrations. This is the company which made the searchlight which was at the Chicago Exposition, and is now at Sandy Hook. The reflectors are parabolic mirrors, as distinguished from the Mangin spherical mirrors.

DECORATIVE INCANDESCENT LAMPS.—"Amer. Elec.," Dec.—It is suggested that for decorative purposes incandescent lamps may be made by stretching a filament in a straight line in a tube; this construction is claimed to be cheap and practically very feasible; such a lamp, it is said, would have a longer life, would be much more applicable to display illumination, and would cut down the cost of wiring, the number of connections and the cross section of the conductors.

Power.

VERY LONG DISTANCE TRANSMISSION. Forbes. Lond. "Elec. Eng." and "Elec. Rev.," Dec. 2; a long abstract is published in "El'ty," N. Y., Dec. 14.—The beginning of a reprint in full of his recent Society of Arts paper, a brief reference to which was noticed in the "Digest" last week. The paper is devoted chiefly to advocating very long distance transmission of power electrically in all cases where it pays, and he claims that it will yield a splendid return in many cases that have come under his notice. The chief [illegible] and [illegible] other power at the exact locality where it is wanted is very expensive; or, [illegible] be paid for at [illegible] are often without any mechanical means of getting power except by electrical transmission; in these cases it is even profitable for a miner to pay a high price for his power; the distances which he has had to deal [illegible] In one [illegible] per ton of ore per day would be only about $1.40, while the value of the ore may be $15 or more per ton. There are other cases besides gold mines in which there is a continuous demand for power; the electric lighting of Cairo, in Egypt, could be done cheaper by power from the Nile cataract, a distance of 400 miles, than by steam engines at Cairo. He believes that before long the cataracts will be harnessed and will assist in developing Egypt and the Soudan, as, for instance, for irrigation.

The next portion of the paper is addressed to financiers and answers some of their usual questions. He then proposes the issuing of a mortgage on the line, as described in the "Digest" last week. The reprint is to be continued.

CANON CITY TRANSMISSION PLANT. Mershon. "Amer. Elec.," Dec.—A description of this long-distance electrical transmission of power generated by steam. The Mershon compensator system of indicating line voltage is used; this consists of an apparatus at the station by means of which the voltage at the receiving end of the line is indicated without employing a pressure wire, account being nevertheless taken of current, power factor, reactance and resistance.

ELECTRIC POWER DEVELOPMENT IN CALIFORNIA. —"Elec. Rev.," Dec. 14.—A reprint of an article from the "New York Sun" referring briefly to some of the existing plants and their effect on the development of that country.

ELECTRIC PLANT ON THE BATTLESHIP "OREGON." Dickie. "Amer. Elec.," Dec.—An illustrated description of the electrical equipment of this celebrated warship. Referring to the advance of electrical transmission of power on board ship since the construction of the "Oregon," it is said that in the new battleships of the "Oregon" class there are 8 units of 32 kw, instead of 3 of 24 kw. In these battleships nearly all the ventilation will be accomplished by electric power. Motors will drive all the ammunition hoists and will be used to train the turrets.

Traction.

STEERING OF AUTOMOBILES. Sahulka. "Zeit. fuer Elek.," Nov. 27.—A short article in which he suggests an electrical method of steering. He points out that it is better to drive the front wheels than the latter, as the vehicle is then pulled instead of being pushed. When the two front wheels are driven by separate motors he suggests steering by varying the speeds of these motors; this has the advantage that it requires no power to be exerted by the operator; when series motors are used each must be supplied from a separate battery, and the connections are so made that they include a regulating resistance in the form of a bridge, so that as resistance is added on one side it is taken out on the other, by means of a simple lever. Or else the speed of one motor may remain constant and that of the other varied. Shunt motors, and with any system of connections, may also be used. (This is apparently a mere suggestion, for if he had tried it he would have found that the steering apparatus has two functions, first, to steer; and second, to lock the axle, so that an obstruction in front of one of the wheels would not turn the axle; this latter he has overlooked entirely. The result would be that when one wheel meets with an obstruction or travels over a rougher road than the other, the vehicle would turn, as the corresponding motor would undoubtedly slow down a little. Moreover, steering in streets and at high speed must be done more accurately than could be done by means of the change of speeds of the motors. The same suggestion was made long ago, but has been abandoned for the above mentioned reasons.)

LIVERPOOL MOTOR VEHICLE TRIALS. Rocket. Lond. "Engineering," Dec. 2.—A brief discussion of some of the tables of the judge's report, which has just been published, in which an attempt was made to predict the annual expenditure involved in running the vehicles. An amended estimate under certain conditions for some of the vehicles is given by the present author.

ELECTRIC RAILWAYS IN HUNGARY.—"Zeit. fuer Elek.," Nov. 27.—Brief, tabulated statistics concerning the operation of these for 1897.

STREET RAILWAYS IN PENNSYLVANIA.—"Elec. Rev.," Dec. 14.—A brief abstract of the official report by Brown, of the State Bureau of Railways. Some statistics are given, referring chiefly to the cost of operation.

JUNGFRAU RAILWAY. Brand. "Sc. Am. Sup.," Dec. 17.—A translation of a well-illustrated article from the German on the opening of the first section of this famous mountain railway; the illustrations are different from those which have been so frequently published.

Installations, Systems and Appliances.

BRIGHTON BREAKDOWN. [illegible] Lond. "Elec.," Dec. 2.—A [illegible] describing similar occurrences which have followed short circuits of shunt-wound dynamos used for traction purposes in the installation of which he is in charge. In one case there were two shunt-wound dynamos in parallel, each having a separate exciter and a [illegible] cut-out. Short circuits in the mains occurred frequently, [illegible] an hour being a not unknown number; a heavy short circuit almost invariably resulted in both cut-outs opening and in the demagnetization of the field of either one or the other of the dynamos and its exciter. An extra heavy short circuit often caused a total reversal of one or the other of the machines and its exciter; this was so frequent that pole indicators were attached to the [illegible]. In more recent cases the dynamos were provided with minimum cut-outs, but short circuits had the same effect, with the exception that sometimes both machines were demagnetized or reversed; the trouble was to a certain extent, but not wholly, obviated by compounding these dynamos. He found experimentally that a current of 1000 amperes momentarily, the normal being 400, does not result in either demagnetization or reversal. The obvious remedy is "not to have severe short circuits." It is clear that the minimum cut-outs will not act on the faulty machine, the reason being that the time required for their operation is appreciable, and the reversal current in the armature circuit is practically instantaneous before the cut-out has time to act, and it is again held up by the reverse current. He discusses the case of a short circuit to earth, one earth connection being in the armature and the other on the same pole as the minimum cut-out, but on the lamp side of it; there will then be a pulsating uni-directional current with a frequency equal to the revolutions of the dynamos; the current is not reversed. He then considers the case in which the earth connection is external to the armature, and on the opposite pole to that on which the minimum cut-out is attached; the results are not greatly different except that an alternating current will be produced, although not necessarily symmetrical. The only conclusion which he arrives at is that minimum, maximum or both kinds of cut-outs do not act in practice as armature protectors. With faults external to the armature and between it and the cut-out, the latter may reasonably be expected to act, but this is not the case with faults giving rise to pulsating or alternating currents, especially when generated by high-speed dynamos.

METERS AND SYSTEMS OF CHARGING. Arnot. Lond. "Elec. Eng.," Dec. 2.—A long abstract of a recent paper read before the Institution of Engineers and Ship Builders. He calls attention to the importance of having meters certified and inspected. Some figures are given comparing the costs of operation at the Edinburgh and the Glasgow stations, including a load curve for each. The various systems of charging are discussed. While the paper appears to contain a good discussion of the subject, the author does not seem to advance anything new.

LARGE ACCUMULATOR INSTALLATION. — "L'Ind. Elec.," Nov. 25.—A note stating that what appears to be the largest battery at present installed is one in the Levallois Sector (presumably in Paris). It consists of 140 cells of Tudor accumulators, having a capacity of 11,040 ampere hours at a ten-hour rate, or in case of emergency it would give 5000 amperes, developing 1250 kw.

VIENNA. Kaula. "Elek. Zeit.," Dec. 1.—A long, illustrated description of the lighting plant of a railway through Vienna. The continuous current is used in connection with accumulators and the minimum yearly output is 1,300,000 kw hours.

CHATEL-SAINT-DENNIS.—"L'Ind. Elec.," Nov. 25.—A short description of this installation in Switzerland, which supplies 1600 lamps.

PROJECTED LIGHTING AND TRACTION PLANTS.—Lond. "Elec." and "Elec. Eng.," Dec. 2.—A list of the notices of proposed stations for the year 1899 for England.

LIGHTNING ARRESTERS. Raymond. "Amer. Elec.," Dec.—An installment of a serial article descriptive of the types of American lightning arresters.

Wires, Wiring and Conduits.

LEAKAGE FROM NEGATIVE LINE.—Lond. "Elec. Eng.," Dec. 2.—Several answers to the question why there is always an excess of earth leakage from the negative than from the positive side of a system of low-pressure bare strips supported on porcelain insulators in culverts. One writer states that it is due to the white encrustations which form on the negative mains. An analysis shows that this consists almost entirely of sodium and potassium carbonate; it is produced by the electrolytic decomposition of the alkaline salts derived chiefly from the soil and conveyed by moisture to the insulators of the negative wires. Electrolysis also affects the positive wires, but in that case the copper is corroded away. Another writer says this excess leakage is due to what is known as electric osmosis; the cause is that moisture creeps to the negative conductor and away from the positive one, leaving the latter dry.

INTERIOR WIRING. Knox. "Amer. Elec.," Dec.—The subject of feeders and mains is considered, directions being given for calculation and for the laying out of horizontal, vertical and combination mains.

Electro-Physics and Magnetism.

VACUUM TUBES THAT CAN BE REGENERATED. Villard. "Comptes Rendus," 126, p. 1413; noticed briefly in "Science Abstracts," Nov.—The abstract of this paper, which was noticed in the "Digest" some time ago, was not very clear. He attaches a platinum tube to the Crookes tube; the whole is exhausted to a high degree and sealed; the platinum tube is then heated for two or three seconds in a Bunsen flame, when hydrogen will travel through the platinum, while air will not; five minutes of this action will make the vacuum so low that the tube will not even act like a Geissler tube. By heating the platinum tube while it is protected from the gases of the Bunsen flame the process is reversed, and the vacuum may become so high that discharges from a powerful coil will not pass through it. Platinum-iridium, palladium, nickel, and even iron will act in a similar way.

PHOSPHORESCENT SCREENS. Villard. "Comptes Rendus," 126, p. 1414; noticed briefly in "Science Abstracts," Nov.—If a portion of the barium-platinum cyanide screen be sheltered from Roentgen rays, and if the intervening obstacle be then removed the part recently sheltered is now more brightly fluorescent than the remainder of the screen; a shadow picture may thus be obtained when the object is removed. In full light it can be seen that the exposed portion is darkened as compared with the other parts, but this disappears on exposure to daylight, together with the power to produce these shadow pictures; it persists, however, if the screen is kept in the dark, and therefore such screens should not be put away in darkness after use.

CHARGE CARRIED BY ROENTGEN RAYS. J. J. Thomson. "Phil. Mag.," Dec.—A long article describing some experiments made to determine the magnitude of the charge of electricity carried by the ions which are produced when Roentgen rays pass through a gas. The paper does not admit of being abstracted here.

DIELECTRIC CONSTANTS AND TEMPERATURE. Pellat and Sacerdote. "L'Ind. Elec.," Nov. 25.—A long abstract of an Academy paper describing experiments made to determine the variation of the dielectric constants with the temperature. They conclude that for paraffin this constant diminishes as the temperature increases, and that the mean coefficient of diminution per degree (C.) is 3.6 × 0.0001 between 11° and 22°, and 5.6 × 0.0001 between 11° and 33°. For ebonite the dielectric constant increases with the temperature, and is nearly proportional to the rise of temperature; the mean coefficient per degree is 8.8. × 0.0001. The application to an ebonite condenser is made, and it is shown that the energy of such a charged condenser exceeds by more than one-fourth the value as generally calculated when the temperature is 27° or 300° absolute. If the charge and discharge take place rapidly the phenomenon, instead of being isothermal, will be more nearly adiabatic; for an ebonite condenser an adiabatic charge would lead to a cooling, while an adiabatic discharge would lead to a heating; the latter appears to be smaller than the cooling effect.

HIGH FREQUENCY DISCHARGES IN GAS. Ebert. "Annal. Phys. Chem.," 65; p. 761; abstracted in "Science Abstracts," Nov.—A discharge in a vacuum tube consists of two distinct parts, one a conducting discharge, which develops Joulen heat, the other is the partial or complete breaking down of a dielectric capacity; with high-frequency currents the latter is more emphasized in comparison with the former. He describes experiments made with such currents; in most of these the frequency was 1000 per second, and the e. m. f. varied from 700 to 3000 volts; all the luminous phenomena were very intense; an analysis by means of a revolving mirror showed two discharges in the opposite directions, superposed; there were no partial discharges. The energy in the discharge tube was measured and found to be 9.2 watts.

ELECTRICAL OSCILLATIONS IN WIRES. Pocklington. Cambridge "Phil. Soc. Proc.," 9, p. 324; abstracted briefly in "Science Abstracts," Nov.—The paper deals with electrical oscillations about perfectly conducting wires of circular cross-sections. From the abstract is appears to be a mathematical paper.

ELECTRIC WAVE DETECTORS. Pochettino. Lond. "Elec. Rev.," Dec. 2.—A brief abstract of the classified list noticed in the "Digest" Nov. 5.

SELENIUM COHERERS. Agostini. "Nuovo Cimento," Aug.; abstracted in Lond. "Elec.," Dec. 2.—He investigated the properties of such coherers, but so far obtained negative results.

ELECTROLYTIC THERMO-PILES. Duane. "Annal. Phys. Chem.," 65, p. 374; noticed briefly in "Science Abstracts," Nov.—He deals with thermo-piles in which both electrodes are kept at the same temperature, and in which, therefore, the thermo-electric forces are developed in the electrolytes themselves. A second electrolyte is introduced between two portions of the first, which adjoins the electrodes, and the two liquid junctions are kept at different temperatures. He used only dilute solutions, so as to remain within the assumption of Nernst's theory, and he used different or the same concentrations; the results were in close agreement with that theory.

CONTACT ELECTRICITY. Heydweiller. "Wied. Ann.," No. 11; noticed briefly in Lond. "Elec.," Dec. 2.—Cohen recently claimed that contact electrification is determined by the dielectric constants of the two bodies, those having a higher constant being positively charged by contact with one having a lower constant. This furnishes a means of determining dielectric constants. The present author followed up the question by introducing minutely subdivided metals into a narrow tube containing an electrode, and confirmed this rule to a certain extent, but in other cases obtained different results.

THEORY OF GALVANISM AND HEAT. Riecke. "Goettingen Nachrichten," 1, p. 48; abstracted in "Science Abstracts," Nov.—He expresses the view that the older or pre-Maxwell theory of electricity, due to Coulomb, Ampere and Weber, is likely to acquire new importance in the treatment of electrolysis and the theory of ions. In the present paper he holds that the conduction of electricity and of heat in metals takes place in a way not different in principle from electrolysis.

THEORY OF AN ELECTRIFIED SYSTEM. Pellat and Sacerdote. "Comptes Rendus," 126, p. 817; noticed briefly in "Science Abstracts," Nov.—A discussion of the excess of energy considered as seated in the dielectric, of a system of conductors and dielectrics, due to their electrification.

TWO PHYSICAL HYPOTHESES.—"L'Ind. Elec.," Nov. 25.—Two communications, one by Brylinski and another by Juppont, continuing the discussion of this subject; (see "Digest," Nov. 19).

ELECTROLYTIC CONDUCTIVITY OF DILUTE SOLUTIONS. Schaller. "Zeit. Phys. Chem.," 25, p. 497; noticed briefly in "Science Abstracts," Nov.—He describes experiments made to determine these at temperatures up to 100.

CONDUCTIVITY OF THIN SHEETS OF SILVER. Vincent. "Comptes Rendus," 126, p. 820; abstracted briefly in "Science Abstracts," Nov.—Descriptions of experiments with chemically deposited films of silver.

GRAPHIC REPRESENTATION OF STATIC ELECTRIC FORCES. Robertson. Lond. "Elec. Eng.," Dec. 2.—A note describing a method which he uses in his instruction to classes. With a Wimshurst machine, and leading wires to a glass plate, he electrifies dry sawdust or tea leaves and then photographs the curves of force; such illustrations can then be shown as lantern slides to a large audience.

ROTATION OF INSULATORS IN A MAGNETIC FIELD. Benndorf. "Wien. Akad. Sitzber.," 106, p. 1075; abstracted in "Science Abstracts," Nov.—He challenges the conclusion arrived at in a recent paper by Campetti, and proves the fallacy of the latter's conclusions; he shows that the damping observed by Duane can never be accounted for by dielectric hysteresis.

MAGNETIC PROPERTIES OF NICKEL STEELS. Dumont. "Comptes Rendus," 126; p. 741; noticed briefly in "Science Abstracts," Nov.—He continued the work of Guillaume. He found that at an equal distance from the point of total loss of magnetism all the reversible alloys have the same magnetic permeability. At the same temperature the permeability of alloys containing 27 to 44 per cent. of nickel increases with the proportion of the nickel.

SELF-ADJUSTING COHERER. Lawrence. "Science," Dec. 9.—A note describing such a coherer. Van Gulik showed that when an oscillating discharge takes place across a minute gap between the ends of fine platinum wires, the latter are drawn together and remain clinging together after the discharge has ceased. In repeating these experiments in a modified form Lawrence was led to the conclusion that such adherence does not always result if the gap is between dissimilar metals, and he takes advantage of this to construct a self-readjusting coherer. If a Branly tube is filled with a mixture of tin and aluminum filings, it acts normally when subjected to the influence of electric waves, its resistance diminishing greatly; but when this radiation has ceased the resistance rises again, unaided by any tapping. A similar result, although more sluggish, is obtained with a pile of alternating discs of aluminum and tinfoil.

MATHEMATICAL THEORY OF ELECTRICITY AND MAGNETISM. Webster. "Science," Dec. 9.—A report to an association (presumably the A. A. A. S.) on the state of the mathematical theory. It is highly mathematical in character.

CONTINUITY OF WAVE THEORIES. Kelvin. "Sc. Am. Sup.," Dec. 17.—A long abstract of his paper which was noticed in the "Digest" Dec. 3.

Electro-Chemistry and Batteries.

PURIFICATION AND BLEACHING OF SUGAR. Peters. "Zeit. f. Elektrochemie," Dec. 1.—A short article describing experiments made to compare the action of ozone, that of electric currents and that of both combined, in the purification and decolorizing of liquids containing sugar. After a brief reference to the various processes, the published descriptions of which are referred to, he describes his experiments, in which some dark-colored syrup was subjected to each of these three processes. The ozone produced electrically passed through the liquid in bubbles. In the treatment by the current the cathode was carbon and the anode zinc in one case and aluminum in another; in both cases the liquid was thoroughly stirred during the process. The results are given in detail, and they show very clearly that the action of both combined is very much better than when either is used separately; the decoloration is much more thorough; the inorganic salts are separated out to a [illegible] greater extent, and the organic impurities are easier and more thoroughly oxidized, passing over into the slime, which is easily separated; the taste of the syrup becomes purer; no mould or fermentation could be noticed after one to three weeks, but it was no-[illegible]

ELECTRIC REFINING OF COPPER.—"L'Ind. Elec.," Nov. 25.—[illegible] the Dumoulin process.

AMALGAMS OF ALKALI METALS. Schaeller. "Zeit. f. Elektrochemie," Dec. [illegible]

PRIMARY BATTERIES. [illegible] "Zeit. f. Elektrochemie," [illegible]

Units, Measurements and Instruments.

WHEATSTONE BRIDGE. [illegible] "Zeit. f. Instrumentenkunde," [illegible] "Science Abstracts," Nov. [illegible] tions, one to each strip. These strips are the end terminals; the middle terminal is a third strip inside the box, between which and each brass piece are connected eight resistances, two each of 1, 10, 100 and 1000 ohms. Thus either of the 1-ohm coils, for instance, can be connected to either strip, and any ratio can be obtained in four different ways. Further advantages claimed for this arrangement are that only two plugs are required, whose contact resistances, being always in circuit, can be allowed for in the adjustment of the coils; and that, by means of a third plug connecting two resistances in parallel, ratios of 1 to 5 and 1 to 20 may be obtained."

HOT WIRE AMPERE-VOLT-WATT-METER. Field. Lond. "Elec. Rev.," Dec. 2.—The conclusion of his article (see "Digest" last week). After concluding the theoretical investigation he states that the only error in the instrument is that due to observation, and this he believes is only half as great as that with any ordinary deadbeat instrument. He adds some data concerning one of the arrangements shown, and calls attention to the small losses involved.

INDUCTION COIL CONTACT BREAKERS. Izarn. "Jour. de Physique," 7, p. 342; noticed briefly in "Science Abstracts," Nov.—"When the contact-breaker is not an independent one the author finds that the results are more regular if the massive column is not rigidly, but to a certain extent elastically, fixed to the baseboard. He mounts it on a strip of brass 6 cm by 3 cm by 1 mm, fixed to the baseboard only at its two ends. The screw regulating the frequency must fit tight enough not to slip."

INFLUENCE MACHINE. Pidgeon. "Phil. Mag.," Dec.—A reprint in full, with the illustration, of his short Physical Society paper which was noticed in the "Digest" Nov. 26.

ACCURACY AND PERMANENCY OF SWITCHBOARD INSTRUMENTS. Stevens. "Amer. Elec.," Dec.—Exception is taken to the statement made in the November issue that the electrodynamometer principle is ideal for a switchboard instrument. He says that the dynamometer system is more susceptible to influence of external fields than any form of instrument he has ever tested, and on direct-current circuits it is necessary to take the mean of two readings; to shield such an instrument by an iron case will cause the instrument to be seriously in error in measuring alternating currents; on account of the necessity of making a moving coil of small weight, if the instrument is to be used as a voltmeter, the coil will become deformed and produce errors; for ammeter use it is necessary to place moving coils in series with a fixed coil, and a difficulty is encountered in providing a perfectly flexible and frictionless connector capable of carrying large currents; as a shunt instrument, this type is not a success, since the resistance is entirely too high for the quantity of current necessary to operate it. He does not believe it practicable to obtain an equally divided scale on an instrument on the electro-dynamometer principle. For portable instruments it is acknowledged that the dynamometer system is an ideal one for wattmeters and voltmeters, but it is not practicable for ammeters without the use of mercury and reversing screws.

The writer of the original statement replies by stating that the influence of the magnetic field can be largely eliminated by the use of the heavy iron casing, and for use with alternating currents no shield is needed. He also contends that the instrument can be made to withstand deflecting forces, and that a type can be selected in which the mechanism is so constructed that it can be built as a voltmeter, an ammeter and a wattmeter, and once properly installed will not require recalibration; it can also be made cheaply.

TWO-RATE METERING. Reed. "Amer. Elec.," Dec.—He suggests the use of two meters in parallel, having the load on each controlled by an automatic switch of simple design. In the case illustrated a 7.5-ampere meter is in parallel with a 100-ampere meter; when the load reaches 10 amperes the large meter is, by means of a solenoid, cut into the circuit; while for all loads under this amount the small meter is in circuit alone. Both meters then work under the same percentage of load with respect to their rated capacity, thus accurately registering all current consumed. The small, continuous loads are registered on the small meter, and the heavy load on both together; but as the ratio between the two is fixed, this fixed percentage would be deducted from the register of the small meter and added to the register of the large meter, in order to keep the large and small consumptions entirely distinct. A diagram of the connections is given. It is stated that the cost of installing two meters and an automatic switch is less than that of a two-rate meter.

RECORDING PYROMETERS. Munnock. "Amer. Elec.," Dec.—A type designed by Austen is described, records being made on rapid bromide paper by means of a spot of light. The thermocouple consists of platinum and platinum rhodium. In the case mentioned a switch operates every half minute by clockwork and gives records on one sheet of the temperature of two blast furnaces, a Holden d'Arsonval galvanometer being used.

Telegraphy, Telephony and Signals.

WIRELESS TELEGRAPHY ACROSS PARIS. Ducretet. "Comptes Rendus," 7; abstracted, with an illustration, in "L'Ind. Elec.," Nov. [illegible] noticed briefly in Lond. "Elec.," Dec. 2.—He describes experiments in transmitting messages from the Eiffel Tower to the Panthéon, a distance of [illegible] the direct view is interfered with by many [illegible]. The results obtained were perfectly clear, even in a thick fog. The signals could be read by their sound [illegible] but no results were obtained [illegible] in the reverse direction from the Panthéon to the Eiffel Tower, owing to the mass of metal in the latter.

TELEPHONE STATISTICS FOR GERMANY.—"Zeit. fuer Elek.," Nov. 27.—Brief extracts from recent official statistics.

MINE SIGNALS. Wilson. "Eng. and Min. Jour.," Dec. 10.—A brief description of the electric bell system which has been in use for the past ten months in a certain mine, and which is said to be the first of its kind in operation. The signaling is done by means of certain calls at each station and from one on the cage.

AMERICAN TELEPHONE PRACTICE. Miller. "Amer. Elec.," Dec.—Methods are given for neutralizing the electro-magnetic and electrostatic induction on telephone lines.

Miscellaneous.

MOHEGAN DISASTER.—Lond. "Elec.," Dec. 2.—The note stating that the official inquiry into the loss of this steamer has shown that it was not due to the compass. The ship was wired on the two-wire system, and the dynamos were 100 feet from the compass; therefore there could be no local deviation of sufficient strength to produce so serious an error in the course. All the lights of the ship were controlled directly from the dynamo, and this is claimed to have been a serious error. It is suggested that as oil lamps are an insufficient reserve, it would be an improvement to supply the masthead light and a few other lamps of equal importance by means of a secondary battery, so that they would burn whatever happened to the machinery. In a disaster of this kind the dynamo would stop running, and it is thought that the loss of life would have been less had it not been for the extinction of the lights. A brief extract from the report is published in the Lond. "Elec. Eng.," Dec. 2.

INCANDESCENT LAMPS IN FIRE-DAMP. Couriot and Meunier. "L'Ind. Elec.," Nov. 25.—An abstract of an Academy paper describing their experiments. This seems to be the same one already noticed; they describe experiments in which the explosive gas was admitted into the bulb, and in no case in which the filament was not first broken could an explosion be produced.

INSTITUTION OF ELECTRICAL ENGINEERS.—Lond. "Elec.," Dec. 2.—A reprint of the revised articles of association of this national society of Great Britain. The subject is also discussed in the leading editorial.

CARBOLITE.—"Eng and Min. Jour.," Dec. 10.—A short editorial commenting on the invention of Hartenstein, of which numerous accounts have been published in the technical papers. The material which he produces and calls carbolite is a biproduct in iron smelting, and is claimed to be a cheap substitute for calcium carbide, being of the same nature as the latter; it is claimed that the profit in producing it from blast-furnace slag promises to be so great that the pig iron may then be regarded as a biproduct. It is a calcium-aluminum-silicon-carbide. The slag is taken directly from the furnace blast in converters like those used in steel-making, impregnated with pulverized coke by means of a gas-blast, and the mixture brought into contact with carbon bars through which a current of electricity is passed, which generates the intense heat required to produce the carbide. It is then shown editorially where these claims are misleading. Such slags contain at most only 50 per cent. of lime, and the carbide thus produced would be very poor substitute for the calcium carbide; the silicon in the slag would form carborundum, which gives off no gas on the addition of water; the aluminum would form aluminum carbide, which, with water, evolves the methane, which is only faintly luminous, it being like natural gas; the iron oxide would form iron carbide, and would add another impurity. The mixture would therefore contain so many non-gas-making impurities that it would only produce a small amount of illuminating gas as compared with the calcium carbide. Moreover, the production of these useless impurities costs electrical energy, and it is doubtful whether the saving in heat due to using the already heated product would offset the waste of electric power. It is, moreover, doubtful if this material could be made without infringing on one or more existing patents.

AN ELECTRICAL PARADOX.—"Amer. Elec.," Dec.—Eleven letters, offering explanations of a so-called electrical paradox, noticed in the "Digest" Nov. 19, and which may be stated as follows: If between two given points of a conductor carrying a current the drop is 1 volt and a 1½-volt primary cell is connected between these two points, negative to positive, and positive to negative, why should not this reverse the main current, since it is presumably impossible to have two currents flowing in opposite directions in the same wire? Most of the letters correctly point out the fallacy implied, which arises from neglect to consider the entire circuit instead of a fractional part thereof. The actual result would depend upon the size and internal resistance of the battery, in any case the line current continuing and flowing in part or entirely through the battery.

ELECTRICAL CATECHISM.—"Amer. Elec.," Dec.—Hysteresis and measuring instruments are the subjects of the current installment of this series.

A Continuous Globe Enclosed Arc Lamp.

A lamp of new design, and possessing several novel features, has just been brought out by the Jandus Electric Company, Cleveland, Ohio. It is a continuous globe lamp and, briefly stated, the features consist of a continuous globe surface below the arc, ready accessibility to the mechanism, rigidity of the globe in the lowered position, and quickness of trim. The lamp, as shown in Fig. 1, is neat in appearance and compact. As there is no lower external globe support no shadows are cast, and the fact that the globe is continuous affords opportunity for variety of design. To trim the lamp the globe is lowered in a very simple and easy manner. Fig. 2 showing the trimming position. The outer globe is securely fastened to a ring or collar which is maintained in a horizontal plane in any position and holds the globe in rigid relation to the lamp structure. The inner globe and lower carbon can be quickly and easily removed for the purpose of cleaning and retrimming, and the outer globe can be returned to its normal position as easily as it is lowered.

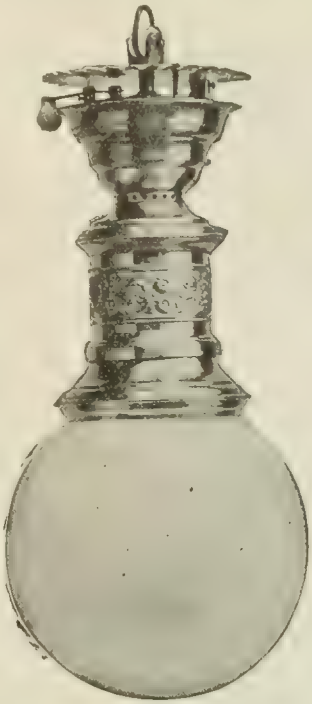


Fig. 1.—Continuous Globe Lamp.

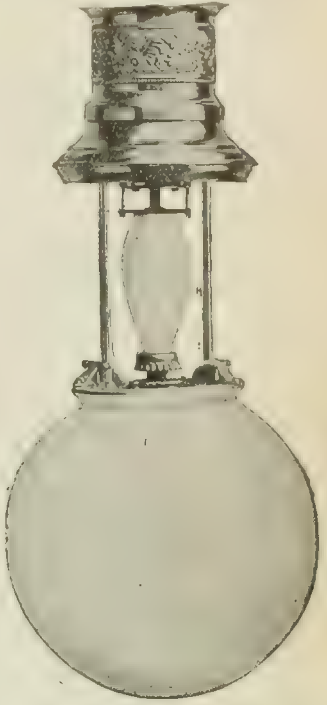
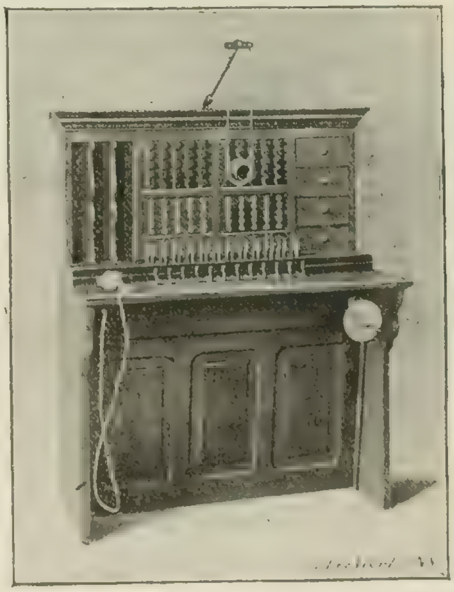


Fig. 2.—Trimming Position.

It is claimed that this lamp embodies the most rapid trimming device ever offered in connection with enclosed arc lamps. The case can be readily removed to afford access to the working parts of the lamp, which are of the regular Jandus 25-inch type.

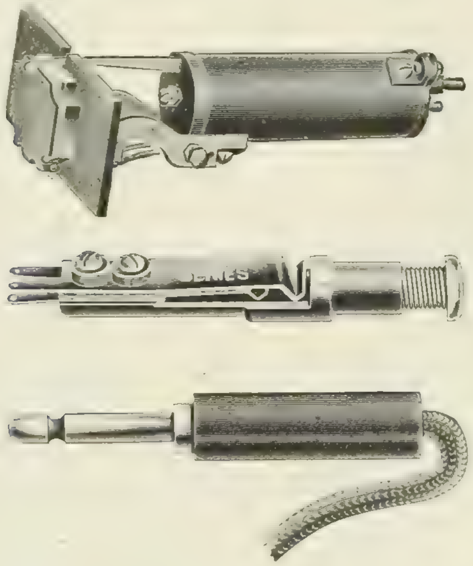
A New Toll-Line Switchboard.

The accompanying illustration is of a new toll-line switchboard recently manufactured by the American Electric Telephone Company, of Chicago. In this board the drop used represents the American Company's latest improvements in the tubular high-impedance drop, an illustration of which is also presented. This drop is said to be the most sensitive of its kind ever introduced to the telephone business. The close adjustment of the armature to the core, which adjustment is not interrupted in removing the coil, adds much to the efficiency of the drop. The drop is of a desirable form for use in connection with the Bell type of switchboard, that is, in boards where the drops and jacks constitute separate features.



Toll-Line Switchboard.

The jack of the American toll-line board is also illustrated. In its construction it is said to be extremely simple, and is one of the most durable in use at the present time. All the springs are made of heavy German silver, and the jack is fastened to the switchboard in a very simple and positive manner. The plug is stated to be something entirely new in this line. The tip screws into the handle in such a way that connections are made from cord to tip through the plug handle without the necessity of soldering the cord circuits. This is a matter of considerable importance, since, as is well known, there is no end of trouble in exchanges in the breaking of cord circuits at the point of connection with the plugs.



Drop, Jack and Plug.

The cam is also said to be something entirely new. Only one lever is used in listening and talking, and ringing either way. The mechanism, the company states, is novel, practical and substantial, and it is claimed that this cam is the most rapid in its operation of any on the market.

The head-band receiver is made with an aluminum back, so that it rests very lightly upon the head, and is fitted with a spring attachment that is easily adjusted to the ear, thus overcoming many of the objections to the ordinary style of head-band receivers.

Interior Telephone System.

One of the greatest fields of usefulness of the telephone is for interior communication by means of which persons in different departments of an establishment may converse with one another without leaving their rooms and even without leaving their desks. Notwithstanding this fact it is surprising to find so few installations in buildings where such a system would save much time and labor. The reason for this is not difficult to find. As the very best [illegible]

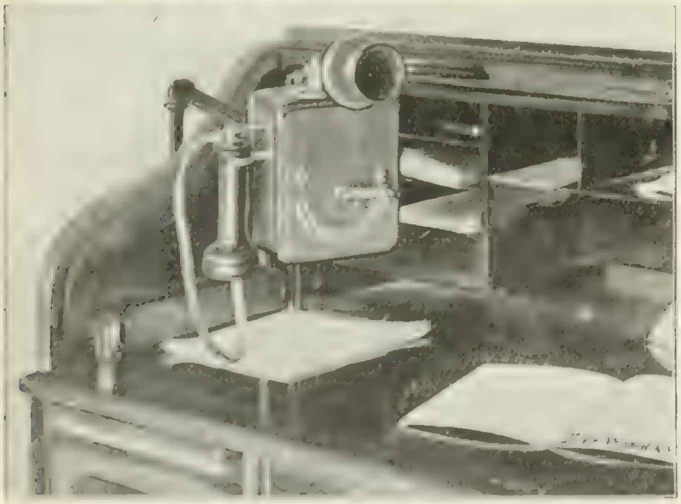


Fig. 1.—Desk Telephone with Automatic Switch.

[illegible]

[illegible]

effected by simply placing the receiver on its hook. This causes the switch lever to automatically fly back, thus disconnecting the instrument and placing it in proper relation with the system to receive a call. No expense has been spared to make the "Ness" automatic switch as nearly mechanically perfect as possible. All the working parts liable to wear are of Stubb's steel case hardened.

To meet different local conditions and individual tastes this switch is gotten up in a number of different forms. It is made up in both battery and magneto call forms, for 10, 16 and 20 stations, and is wired for either central or local calling batteries, and for use with or without induction coils.

The accompanying illustration, Fig. 1, represents a desk set and shows very clearly the automatic switch. In this instrument the switching devices are mounted in very compact form, and the apparatus as a whole is substantial and tastefully constructed. The desk set, as shown in the illustration, is supported by an arm, which arrangement saves the space on the top of the desk that would be taken up by a standard.

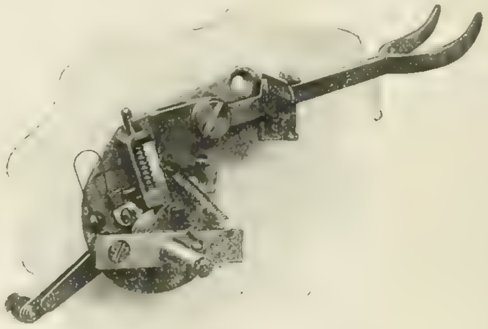
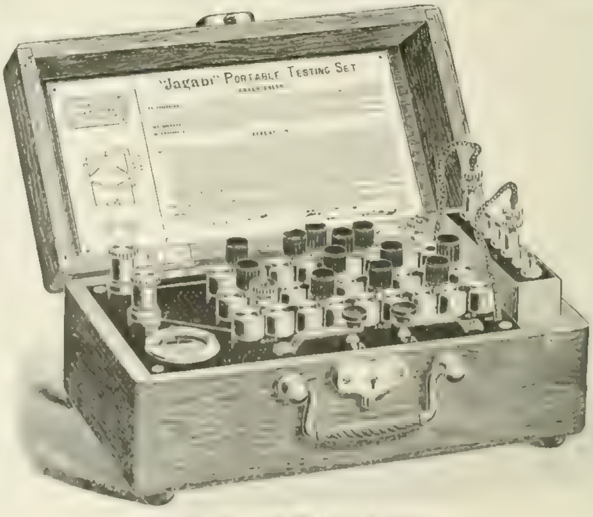


Fig. 2.—Switch Mechanism.

Fig. 2 shows a rear view of the automatic switch mechanism, which causes the switching lever to return automatically to its normal position when the receiver is hung on the hook after a conversation.

Jagabi Portable Testing Set.

The illustration herewith shows the Jagabi portable testing set for resistance measurements. This instrument has now been on the market for several months, and is said to be giving great satisfaction to those who use it. The manufacturers (Messrs. Willyoung & Co., of Philadelphia) claim that the Jagabi set is more compact and convenient to operate than other instruments of its class. The theoretical range of measurement possible with the Jagabi portable testing set is from .001 ohm to more thann 11 megohms. The outfit comprises a D'Arsonval galvanometer of latest design; set of resistance coils with total capacity of 11,110 ohms; reversible arm; Wheatstone bridge, with ratio of 1 to 1000; keys for galvanometer and battery, and six chloride of silver dry cells. All these parts are mounted in a handsomely finished mahogany case, with lock and handle. The total weight is 7 pounds, so that the instrument can be carried from place to place very readily. Mr. James G. Biddle, [illegible] Drexel Building, Philadelphia, is sole selling agent for the Jagabi portable testing set.



Portable Testing Set.

European Telephone Service as Seen by an American.

Mr. [illegible] P. Smith, president of the [illegible] Telephone Company, of New York, has just returned from a trip to Europe, where he visited a number of exchanges in Norway, Sweden, Denmark, Germany, Holland, France and Great Britain, thereby increasing his stock of knowledge on telephony, [illegible] company.

Mr. Smith says that in some of these countries, France and Germany, for example, [illegible] and as a consequence the telephone [illegible]. In the northern part of the Continent, however, he found the service very good and the rental cheap. He was also pleased with [illegible] England.

Among some of the best exchanges that Mr. Smith visited was that in Stockholm, Sweden, [illegible] in one building, [illegible] equipped exchange he has ever seen

The building was expressly erected for the purpose of a telephone exchange, and is so arranged that fresh air is constantly circulating throughout its interior, the circulation being maintained by machinery. The temperature of the air inside is kept uniform. The light and power necessary for the operation of the exchange is furnished by special apparatus. A very noticeable feature of the exchange is the balcony built around the operating room for the accommodation of visitors, the public being allowed to enter at certain hours each day and watch the operation of the exchange.

Another notable exchange is that at Copenhagen, Denmark, with between 10,000 and 12,000 subscribers. There are also some very large exchanges in England. Mr. Smith says that in the majority of the countries named the A. B. L. M. Ericsson Company, of Stockholm, is supplying the instruments and switchboards.

The Germans, he says, still stick to the old-style transmitters and receivers. The receiver is made in the shape of a large spoon and weighs about one and one-half pounds. On a number of occasions in Germany Mr. Smith requested the favor of the use of a 'phone in different houses, and without exception was advised to take a cab and deliver his message in person, which would be decidedly more satisfactory. From what he learned of the service he came to the conclusion that this suggestion was no joke. In France he found practically the same condition of things, the Frenchmen still using their wooden diaphragm transmitters and watchcase receivers, Yankee ingenuity not having yet made any impression on the powers that be. The Frenchmen, however, believe that they have the best instruments that can be made.

Telephone Apparatus from the South.

It may be said with good reason that the growth of the electrical industries in the South is a sure indication of the growing commercial importance of that section of the country, and it must be gratifying to the Telephone Manufacturing Company, of Sumter, S. C., which claims the distinction of being one of the earliest telephone manufacturing companies to take root on Southern soil, to know that its enterprise is encouraged and supported.

The Telephone Manufacturing Company was organized in June, 1897, succeeding the Mason Electrical Works in the same city. That the enterprise has been encouraged is evident from the fact that the company's plant has been extended since its organization no less than five different times, and at the present time it has a factory equipped with the most modern manufacturing tools and apparatus. The capacity of the factory is now about 300 telephones and 200 switchboard drops per week.

This company is a manufacturer in the strictest sense of the word, making, from the raw material, everything that enters into the construction of its apparatus. Among the new departures of this company is the manufacture of a generator which will be of the latest improved design. In its construction every mechanical detail has been carefully considered, and the instrument is said to have a high electrical efficiency.

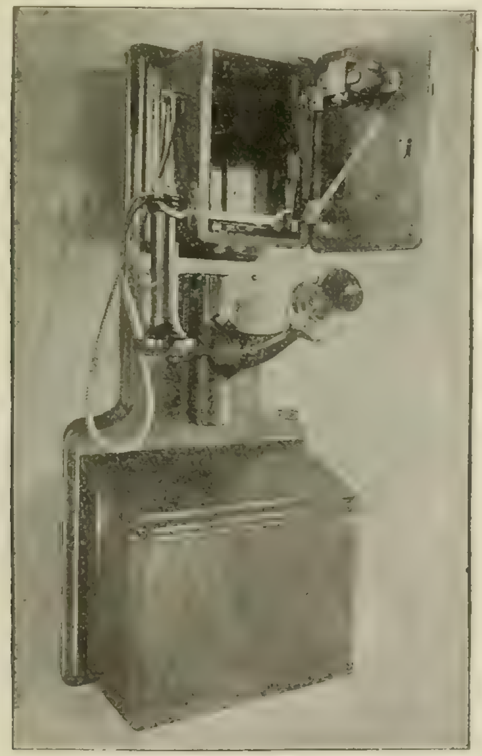


FIG. 1.—IMPERIAL WALL SET.

The telephone manufactured by this company bears the distinctive name of "Imperial." One of the features of its construction is that it is so wired that none of its circuits crosses any other at any part of the instrument. A very reliable and satisfactory gravity switch hook is used by the company on its apparatus. A superior make of spring is employed, and it is stated that the switch is always in order and may be relied upon to perform its functions.

Another valuable feature of this company's instrument is that any of the parts may be removed and restored without taking the telephone from the wall. This saves, as it will be readily understood, a great deal of labor. All of the wires are concealed.

In the No. 6 long-distance type of telephone, the primary circuit is independent of the iron transmitter arm and base. A double-conductor silk-covered cord is used for this circuit, the cord connecting with binding posts at the back of the board. The connections are soldered so as to insure a firm and reliable joint. Every part of the instrument is carefully made, and this applies especially to the winding of the wires on the induction coils, etc. The same care is bestowed in finishing the apparatus. Each instrument is provided with a mica carbon disc lightning arrester, which has proved to be a very efficient type of arrester. The ringer is so constructed that the coil or any other part may be adjusted or removed and re-assembled without taking the base of the ringer from the magneto-door box.

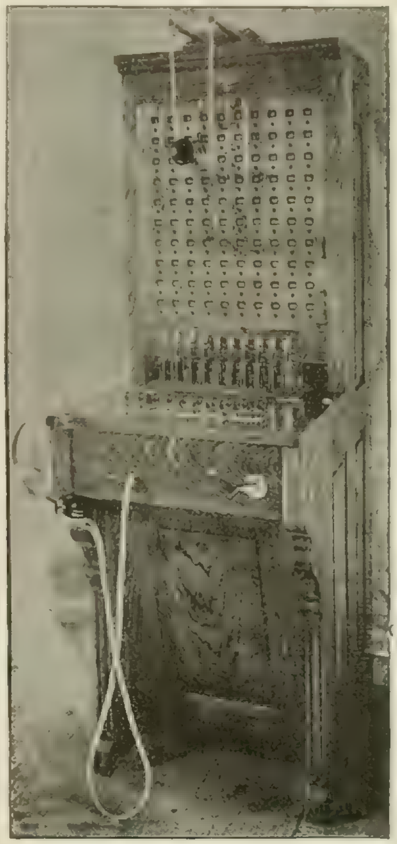


FIG. 2.—100-DROP SWITCHBOARD.

The "Imperial" transmitter is stated to be an excellent talking instrument; strong in volume, perfect and clear in tone. The company states that there are about 10,000 of these transmitters in successful use at the present time.

The company has recently brought out a switchboard which, it is stated, is a very perfect device, and is giving the best of satisfaction. The drop and jack is a self-contained device, and the shutter is automatically restored by the insertion of the plug in the jack. The self-restoring feature, it is stated, is very reliable, and is free from many of the troubles that are met with in many instruments of this class. The drop is constructed so as to eliminate any possible chance of inductive disturbances, and the clearing-out drops are designed so as to prevent any cross talk between the drop coils. The shutters are automatically restored by the plug when it returns to its socket in the operator's table.

In the accompanying illustration, Fig. 1 represents the No. 6 Imperial telephone set. A 100-drop switchboard is shown in Fig. 2.

This company is managed by gentlemen who are thoroughly familiar with the requirements of the telephone business, and who have had a practical experience in telephone manufacture. Mr. Charles T. Mason, general manager of the company, was among the earliest manufacturers in the United States of independent telephone apparatus, and many patents have been granted to him on essential features in telephone apparatus. By careful observation of the progress of the art, combined with constant effort to improve its own apparatus, the Telephone Manufacturing Company has been enabled to produce an instrument, which, besides being serviceable, embodies many new and unique ideas.

Victor Telephone Apparatus.

The Victor Telephone Manufacturing Company, 166-174 South Clinton Street, Chicago, is closing the year with a very gratifying showing of results in exchange and general telephone work. The company's switchboards and telephone apparatus are reported to be receiving particular consideration on account of the scientific methods of construction employed and their mechanical finish. The features of the Victor Company's apparatus are well illustrated and described in a catalogue of recent issue. The Victor combination cross-connecting and fuse board has been recently put upon the market for use in independent exchanges. These boards are made in sections of 12, 20 and 50 point metallic circuit capacity, consisting of terminal points of half hard brass, tinned and slotted so as to be conveniently and rapidly connected. An advantage obtained by the use of this board is that any style of circuit may be converted to straight metallic when using a straight metallic board. The board is also very convenient in testing, since by the removal of a fuse link, a line may be tested either way without removing a screw or opening any soldered connection whatever. It is compact and connections are easily and rapidly made. On account of these advantages the board has received the indorsement of many telephone engineers in the independent field. The Victor combination non-disconnecting carbon lightning arrester and induction absorber is especially adapted for long-distance metallic, common return and ground circuits where protection is necessary in isolated places inconveniently situated for re-fusing. It conducts all high-potential currents to the ground by means of a grounded carbon placed in close proximity to and between the plates in circuit. The slight space between the plates is said to have a modifying effect upon inductive currents, and in many instances where grounded lines were almost useless, owing to strong induction, this device, it is said, has had the effect of overcoming this trouble.

The Victor Company manufactures a very complete line of telephone apparatus, including portable desk instruments, magnetos, long-distance transmitters of various types, bipolar receivers, switchboards, etc. The Victor metallic switchboard is equally adapted to common-return, ground-circuit and toll-line work, and a description and illustration of this apparatus was given in The Electrical World of October 22, 1898. This type of board is made to any required size by using the Victor transfer or trunking system between every two 200-section switchboards. The company's products, it is stated, are constructed on scientific principles and with mechanical correctness, the best of material being used for the purpose.

A Notable Independent Telephone System.

The telephone plant recently installed by the Calhoun County Telephone Company, at Battle Creek, Mich., is an excellent example of the great advances made in independent telephone apparatus. When completed the system will comprise the exchanges at Battle Creek, Albion, Marshall, Bedford and a net work of toll lines throughout the county, connecting all the small towns and many of the representative farmers.

It has connection with more than 300 towns and cities in the State, enabling any subscriber in the entire plant to communicate with any of these stations, extending from Michigan City, South Haven, St. Joseph and Benton Harbor on the West, to Detroit on the East, and from South Bend, Ind., on the South, to Cadillac, Mich., on the North.

The exchange at Battle Creek, the centre of the county system, was the first to be installed, and was opened for operation about three months ago, when the first twenty-five instruments had been connected. The company now has 500 subscribers. The equipment used throughout the entire plant was manufactured by the Stromberg-Carlson Telephone Manufacturing Company, of Chicago.

Fig. 1 shows the exchange switchboard. The board is made up in sections of 100 lines each and has trunking capacity for a 1000-subscriber exchange. Additional sections may be added as required without altering the original equipment. The trunking jacks are placed immediately underneath the subscriber's jacks. The board is well protected from lightning and other heavy electrical currents, by S. C. fuse and carbon lightning arresters. The cables enter the office and terminate in pot-heads which thoroughly protect the paper-wrapped cables. From the pot-heads a rubber-covered wire is used to the lightning arresters.

In Fig. 2 are shown portable desk instruments, the state line testing board, wall style, and the toll line switchboard, in the manager's office. The toll board is equipped for ten toll lines and has three trunking jacks to each section [illegible]

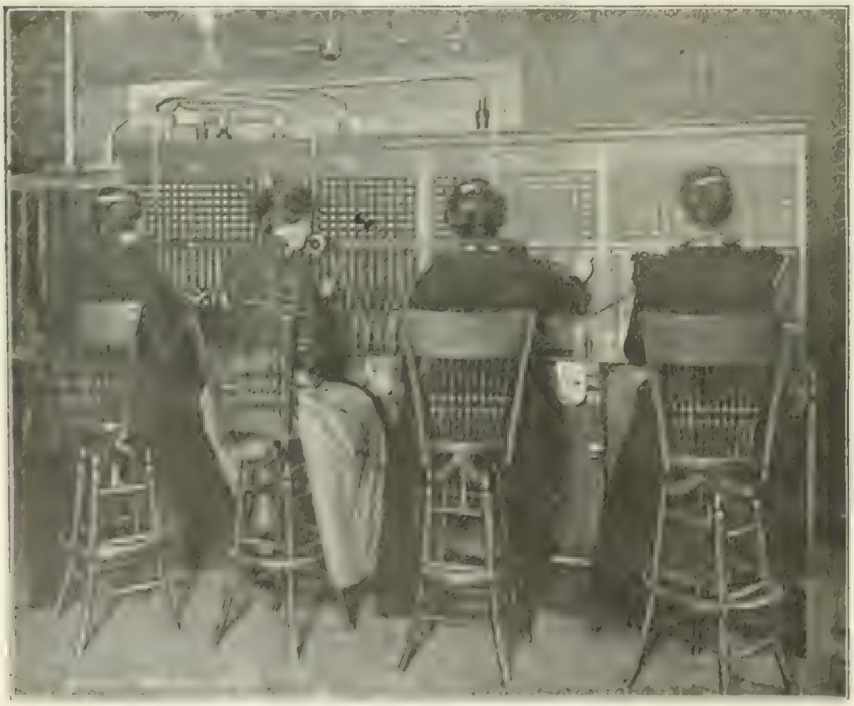


Fig. 1.—Exchange Switchboard.

two jacks either wire of the line can be connected to the ground or the lines opened or short-circuited. This enables an operator to test the line either way for any trouble on the lines or to readily ascertain if the trouble is in the office instrument.

Fig. 3 shows the main talking and ringing energy plant. The power generator furnishes the current to the line when a subscriber pushes the button to signal central. It is driven by an electric motor on a 110-volt electric-light circuit. The storage battery plant supplies the entire talking energy for the 500 subscribers' instruments, as well as the operators' telephones. It consists of two batteries, each of fifteen cells, which are charged from a power plant. One set is charged while the other is in use.

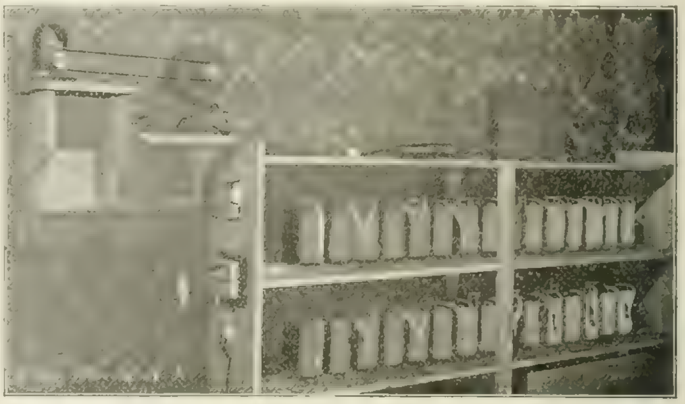


Fig. 3.—Talking and Ringing Energy Plant.

By means of the switch at the side of the battery shelves either set may be thrown on to the system and at the same time the other set is connected to the charging circuit. A second switch is used for throwing off the charging circuit entirely. Either one of these sets can also be used for a subscriber's ringing-in battery. The plant is also provided with an emergency battery of twenty Gordon cells, which can be used for furnishing power for ringing, in case of accident to the power generator, or for talking energy, should the storage batteries at any time fail.

In the police service the police boxes are equipped with S. C. double-pole receivers and long-distance transmitters. These instruments are especially adapted for such uses and can be applied to any police system. The receiver, having all parts firmly clamped in the brass adjustable head, which is securely locked when in proper adjustment, makes it practically impossible to become out of adjustment or affected by the greatest variation of temperature. The cord, running directly into the shell, leaves no binding posts to break and cords to become loose and disconnected. The transmitter, being sealed and the heavy metal diaphragms protected with an auxiliary diaphragm of weather-proof material, prevents it from getting out of order on account of dampness.

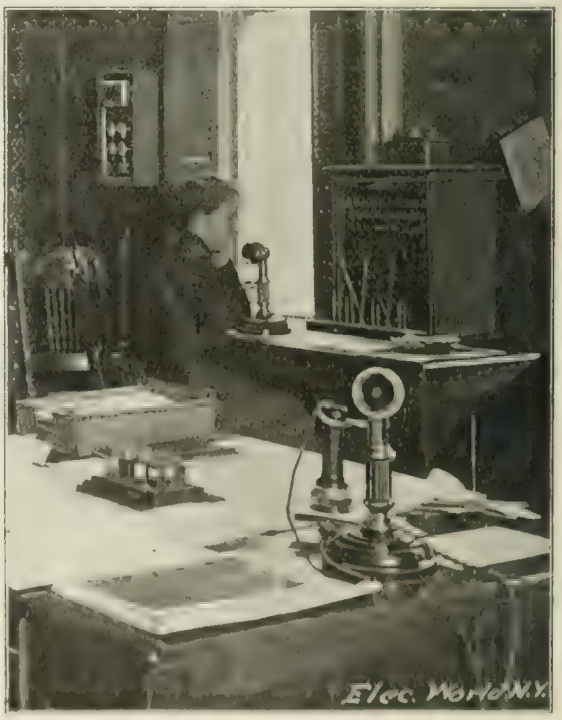


Fig. 2.—Apparatus in Manager's Office.

The telephones in this system are supplied with current from the central at police headquarters.

A new system has but recently been introduced for public exchange purposes. It is said to have proved to be thoroughly practical, having been in use for nearly two years in some large private plants. It is said to be entirely free from all patent claims not owned or controlled by the S. C. Company, and can be used for any size exchange and any length of toll line.

An Improved Telephone Transmitter.

In Fig. 1 of the accompanying illustrations are shown separately the component parts of the telephone transmitter manufactured by the Hipwell Manufacturing Company, Allegheny, Pa. The carbon electrodes of this transmitter are hermetically sealed, thus preventing any ill effects of atmospheric changes on the carbon parts. The diaphragm is of aluminum, the use of which metal, it is claimed by the manufacturer, obviates the harsh, grating effects arising from the use of diaphragms of other metals. All the parts of this transmitter are manufactured on the interchangeable system, so that like parts are an exact duplicate of one another. The transmitter is of the cartridge form, fitting neatly in the shell and held in place by rigid contact springs. A faulty transmitter can be quickly repaired by putting in a new loaded cartridge. It is claimed that this transmitter in its electrical design and mechanical construction is unsurpassed.

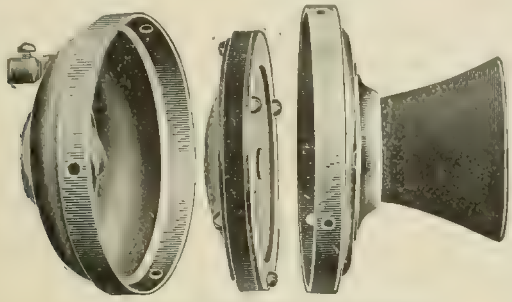


FIG. 1.—PARTS OF TRANSMITTER.

Fig. 2 represents the transmitter on an extension arm in connection with the induction coil in the case at the back.

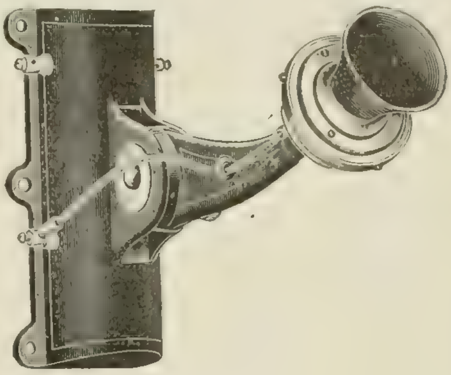


FIG. 2.—EXTENSION ARM TRANSMITTER.

Some Viaduct Telephone Specialties.

The accompanying illustration shows a line of telephone specialties manufactured by the Viaduct Manufacturing Company, Baltimore, Md. The various instruments are numbered, and these numbers will be referred to in the text.

Instruments No. 1, 6 and 7 show wall and desk sets for the Viaduct Company's interior intercommunicating system. This system is furnished for both magneto and battery-call, and is so wired that call signals are received irrespective of the position in which the strap switch is left after the conversation. In manual switches of this kind it is usually necessary that the strap be placed in its normal position after a conversation in order that a subsequent call can be received, and this necessity is frequently overlooked by the user, thus rendering the line inoperative. In the Viaduct system, however, the line is always in working condition, this result being obtained by the company's special system of wiring. The old plain strap switch is used, thus avoiding the necessity of employing automatic mechanism.

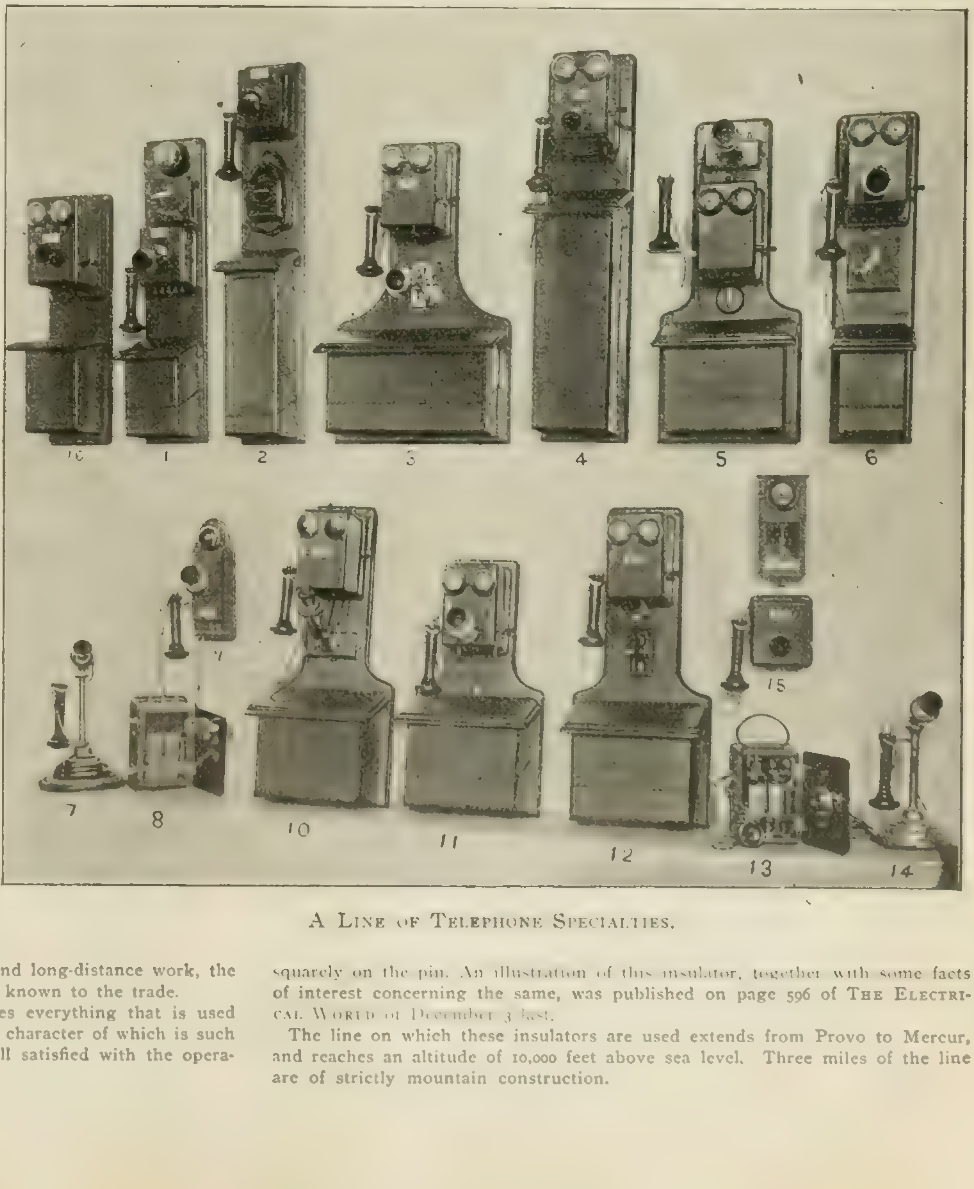
No. 2 represents the district telegraph messenger call instrument. This instrument is connected upon the regular district loops, without interfering with the operation of the regular call-box system. The telephone enables the subscriber to communicate with the central office and make known his wishes, without the necessity of employing the services of a messenger. Several of the district telegraph messenger companies have been equipped with this system, and, it is stated, are perfectly satisfied with its operation.

Instrument No. 13 shows a new style of portable telephone gotten up in a very compact form, and said to work very efficiently. It measures 8½ by 5½ by 5½ inches, and weighs 9 pounds. This instrument is highly recommended for the use of linemen in testing, to carry on street cars to enable the conductor to communicate with headquarters, and in situations where a portable telephone is needed.

The Viaduct Company's B-1 telephone apparatus is represented in Instrument No. 16. With this system no generator is required at the subscriber's office, and no drops on the switchboard at the central office. Several other features of the old system are dispensed with in this instrument, thus reducing the cost of the outfit and at the same time making it efficient and reliable. The Viaduct Company has installed several of these instruments in the South, which, it is said, are giving the best of satisfaction. The system is said to be rapidly growing in favor.

The other illustrations represent the company's line of regular telephone instruments for exchange and long-distance work, the efficiency and durability of which apparatus are well known to the trade.

The Viaduct Manufacturing Company manufactures everything that is used in its telephone apparatus from the raw material, the character of which is such that patrons have expressed themselves as being well satisfied with the operation of the finished instruments.



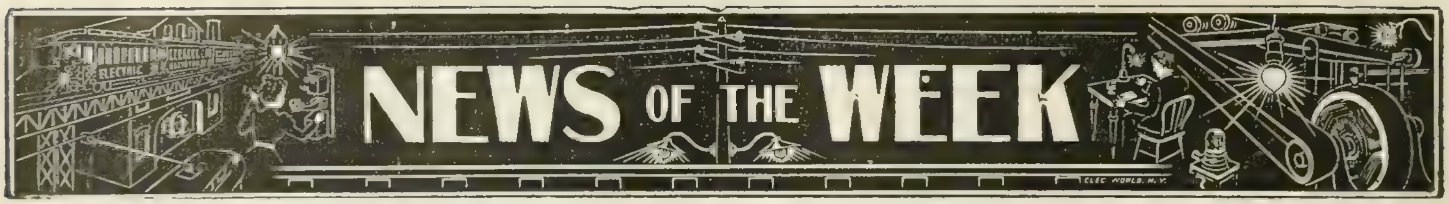
A LINE OF TELEPHONE SPECIALTIES.

The "Provo" Type Insulator.

The subject of insulators for high-potential transmission lines has received the very serious attention of electrical engineers, and as a result some very efficient types have been produced.

The "Provo" type high-potential insulator, manufactured by the Hemingray Glass Company, Covington, Ky., has won for itself a reputation by its successful use since February last on the 40,000-volt transmission line of the Telluride Power Transmission Company in Utah. The design of this insulator was arrived at by a careful study of the action on insulators of high-potential currents as employed in actual practice. The insulator is made of glass, and is said to be homogeneous and impervious to liquids. It has an extra long surface distance between the line and pin, namely, 16 inches. The point of support of the wire is high above the cross arm and the petticoats near the line wire protect surface of small area of high resistance and prevent the accumulation of moisture, thus checking leakage near its source. The insulator withstands an extra high test between the line and pin, 125,000 volts having, it is stated, been applied in a number of tests without puncturing. The edge of the outer petticoat is finished off in some points for the purpose of facilitating the shedding of water. The thread of the insulator is 2½ inches long. It is stated that this insulator has a strong resistance to mechanical breakage and is not affected by changes of temperature. The strain of the wire is brought squarely on the pin. An illustration of this insulator, together with some facts of interest concerning the same, was published on page 596 of THE ELECTRICAL WORLD of December 3 last.

The line on which these insulators are used extends from Provo to Mercur, and reaches an altitude of 10,000 feet above sea level. Three miles of the line are of strictly mountain construction.


ELEC. WORLD. N.Y.

NEWS OF THE WEEK

Financial Intelligence.

THE INTERNATIONAL BELL TELEPHONE COMPANY has declared a dividend of 6 per cent., payable on January 4 next.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY has declared a regular quarterly dividend of 1¾ per cent. on its preferred stock, payable January 3, 1899.

WESTERN UNION DIVIDEND.—The directors of the Western Union Telegraph Company have declared a quarterly dividend of 1¼ per cent., payable January 16, 1899. The company reports for the quarter ending December 31 net revenue (estimated), $1,450,000, a decrease of $103,514 from the actual revenues during the same period last year. The interest on bonds decreased $974, the balance showing a decrease of $104,488.

Special Correspondence.

NEW YORK NOTES.

THE NEW YORK GAS, ELECTRIC LIGHT, HEAT & POWER COMPANY, it is stated, has purchased half a block of land near the Metropolitan Street Railway Company's new power house at Ninety-sixth Street and East River. The newly acquired property has a frontage of 100 feet on First Avenue and extends down Ninety-seventh Street to the water front, a distance of 295 feet. It is stated that the company paid $100,000 for the land. Just what the company's plans are with reference to the utilization of this property has not yet been divulged.

CALCIUM CARBIDE REGULATIONS.—Steps have been taken in this city to control the trade in calcium carbide, and regulations have been issued governing the transportation, storage and sale of the product, which firemen declare to be the source of danger in a burning building. The regulations require that hereafter, in transit or in storage, calcium carbide must be enclosed in hermetically sealed iron receptacles marked "Dangerous, if not kept dry." No package may contain more than 100 pounds. The carbide must be stored in isolated buildings that are fireproof and waterproof, and no artificial light or heat will be permitted in the building where it is stored. The manufacture, transportation, storage, sale and use of liquefied acetylene is absolutely prohibited within the limits of the city. The regulations were framed by the Bureau of Combustibles, and the Fire Department has ordered their enforcement.

MEETING OF THE NEW YORK ELECTRICAL SOCIETY.—The New York Electrical Society is keeping up its record of valuable and interesting meetings, the last being that held at the College of the City of New York on Wednesday, December 14, the papers of the evening being on the subject of the work done by electrical engineers in the recent war. The first paper, or rather address, was given by Eugene Griffin, colonel of the First Regiment of Volunteer Engineers and first vice-president of the General Electric Company. His topic was "Ideas Underlying the Organization of the Volunteer Engineer Corps; the Work Accomplished by It in Porto Rico, and the Opportunities for Further Usefulness." In reviewing the history of the organization of the corps, the speaker gave credit for the idea to Mr. J. R. Haskin, and spoke of the reluctant attitude of the War Department toward the question of organ- [illegible] men, a number which [illegible] the Secretary of War was remarkably small in comparison with the number of engineers in service during the [illegible] of the regulars, the conditions of ordinary military service being in this case exactly reversed, [illegible] In one of these the [illegible] point for searchlight work on one of the fortifications in Boston Harbor, the orders be- [illegible] to get [illegible] down the harbor, floating on its own enclosed air. The men in charge of the engine and [illegible] in order that the knowledge thus obtained might be available for future emergencies.

Following Colonel Griffin's address, Mr. F. W. Roller, late chief engineer of the "Nashville," and well known to the electrical fraternity through the firm of Machado & Roller, addressed the meeting, giving some valuable data on the experience obtained with electrical apparatus on shipboard. Mr. Roller pointed out the same fact that is mentioned in Mr. Weaver's paper, an abstract of which appears in another column, namely, that electric apparatus of the signaling variety—that is, that using small powers—was, as a rule, a failure at the time when it is most wanted, namely, during an engagement. The heavy concussions, the severe service and the lack of opportunity for keeping it in repair are the causes of this. Engine-room telegraphs and other signaling devices are much too delicate as at present designed. The electric range-finder also proved itself a complete failure, owing not so much to the delicacy of the apparatus as to inherent defect in attempting to find the height of a very long triangle with a very short base. Range-finding was done on the "Nashville" by a method to which the term "hit-or-miss" is more than usually applicable, a rapid-fire gun with an elevated range being tried on the target until after a few shots the proper range was found. Electrical apparatus of the type using large powers, namely, dynamos, motors, incandescent lamps and the searchlight, proved itself a great success during the war, the searchlight being one of the most useful pieces of apparatus in the navy. It was the searchlight that, shining up the narrow entrance to Santiago Harbor, prevented Cervera from coming out by night and necessitated his attempt to escape by daylight. Without this detective agency one or more of his ships would undoubtedly have escaped. The same light prevented the Spanish torpedo boats from coming out of the harbor and attacking the American fleet. The incandescent light proved itself most valuable through the means it gave of cutting off all exposed lights at night. The circuits of the cruisers and battleships have all lights which may be run without the risk of exposure on what is known as the battle circuit. By cutting off all other circuits the commander of any ship could be absolutely sure that he could not be found at night, while the auxiliaries without this provision were almost sure, in spite of every precaution, to be picked up by their comrades through some inadvertence, and had the enemy been there could have been picked up by them. The Ardois signaling set, with the incandescent light, proved, as might be expected, a thousand times more satisfactory than oil lamps bent to a halyard and run up in the rigging for every signal. Electric firing mechanism proved itself superior to percussion. The former consists of the ordinary detonation cap heated by a platinum wire, which greatly simplifies the breech block. Speaking of the auxiliary apparatus on naval ships, Mr. Roller gave some figures as to the excessive steam consumption of machines on which he had made tests. One duplex pump showed a steam consumption of 327 pounds of water per horse-power hour, another running even up to 343. One dynamo engine made the poor showing of 132 pounds. Mr. Roller advised that all new electrical apparatus, especially motor-driven steering gear and auxiliaries, be tested first in the merchant marine before any attempt is made to apply it in naval work.

Mr. Weaver could not attend the meeting, but his paper, an abstract of which may be found in another column, was read by Mr. Roller. Following this, Captain Zalinski, the designer of the pneumatic dynamite gun, spoke briefly on the work of the "Vesuvius" at Santiago.

NEW ENGLAND NOTES.

THE G. & P. ENGRAVING COMPANY, Boston, an old and reliable establishment, manufactures high grade name plates for all purposes, and is sending out to its patrons a neat little souvenir in the form of a paper weight. The company reports an increasing demand for its manufactures in the electrical field, where its motto is still, as always, "Not cheapest, but best."

THE MASSACHUSETTS TELEPHONE AND TELEGRAPH COMPANY has been successful in securing the franchise from the Board of Aldermen to do business in the city of Boston. The privileges accorded the new company are most comprehensive. It may lay conduits in every street, lane or highway in the city. The new company cannot charge a higher rate than $6 a month for unlimited service, nor can it dispose of its franchise, and it is required to have an exchange in operation in Boston within a reasonable time.

TELEPHONE FIRM REORGANIZED.—The telephone firm of Taber & Mayer, Boston, has recently been reorganized, and will be known hereafter as the Taber & Mayer Company. Its factory and works are now located at Yarmouth, Me., where it has secured a plant with manufacturing facilities more than double that of its former factory. The company will hereafter engage [illegible] in the manufacture of telephones and telephone supplies. It retains its Boston office at [illegible] Atlantic Avenue, with President V. A. Mayer in charge. Mr. [illegible] S. Taber, treasurer of the company, is in attendance at the factory. We bespeak for the company a successful future, as both of its officers are well known in telephone and electrical circles.

WASHINGTON NOTES.

TO INSPECT AMERICAN STREET RAILWAYS.—The Durban, Natal, [illegible] is about to appoint a commission of two engineers to investigate and report upon the electric street railway systems of America and Europe, in order that it may [illegible] decide upon the best system to be installed in Durban.

TELEGRAPH MONEY ORDERS IN EUROPE.—It is stated that it will soon be possible to telegraph money orders from Great Britain and Ireland to Germany and other Continental countries. For many years past it has been necessary to go to France to telegraph money to Egypt through the post office. Negotiations are now, according to a consular report, almost completed for telegraphing money orders to Germany, and it is intended to propose a similar arrangement to other foreign countries and British colonies.

WATER POWER IN SERVIA.—A German firm recently obtained a concession from the Servian Government to exploit the water power of the Danube at the Iron Gate by establishing different industrial concerns to be worked by electric power. Work had hardly been started, however, when the Hungarian Government stopped it, declaring that Servia had no exclusive claim on the water power, and that an international commission must decide to what degree each of the countries might use it. This information comes from a consular report to the State Department.

THE WAR TAX ON TELEGRAMS.—Chairman Dingley, of the Ways and Means Committee, has received a letter from the Commissioner of Internal Revenue, N. B. Scott, recommending a number of amendments to the act of June 13, 1898, known as the "war revenue act." Among the proposed amendments is one to amend the paragraph imposing 1 cent on telegraphic dispatches, so as to make it definite and certain as to who is to affix and pay for the stamp, the telegraph company or the person who sends the dispatch.

REBATE ON IMPORTS AT THE CAPE OF GOOD HOPE.—The State Department has been notified by Consul-General Stowe that the Government of the Cape of Good Hope has reduced the duty on imported goods passing through the colony to the inland states from 5 per cent. to 3 per cent. This reduction applies to the South African Republic, Orange Free State and Rhodesia, and means a saving of between $250,000 and $300,000 per annum to the importers of Johannesburg alone. Among the articles mentioned in the schedule affected by this reduction are electric cable or wire and posts for the same; electric fittings, not including fancy or ornamental lamps; switches and fittings for indoor lighting; tramway equipments; machinery designed to be driven by all kinds of power, including electric; apparatus and appliances used in connection with the generating and storing of electricity, and materials for use in the construction of telegraph lines.

THE METROPOLITAN RAILROAD COMPANY, of this city, is putting in some improvements in its station, which, when completed, will make it one of the most powerfully equipped plants in the district. They include the installation of one 1200-hp McIntosh & Seymour tandem-compound condensing engine directly connected to a General Electric railway generator of 850-kw capacity. The cylinders are 26 and 56 inches in diameter, respectively, with 48 inches stroke, and the engine will run at 90 revolutions per minute. The flywheel weighs 80,000 pounds. The shaft is 22 inches in diameter and weighs about 34,000 pounds. In addition to this there will be two 750-hp tandem-compound condensing engines directly connected to two General Electric railway generators of 500 kilowatts each. These engines and generators are of the latest type and the current output from the machines will be at a pressure of 600 volts. There are also being installed a specially constructed engine and generator to light the station and car shed, and an air compressor for the purpose of cleaning cars and performing other work by the use of compressed air.

IT IS STATED upon direct authority that the General Electrical Company, of Berlin, entered upon the present year with orders on its books amounting to 95,000,000 marks ($22,610,000), against 65,000,000 marks ($15,470,000) on the first day of 1897; and that the Schuckert Company, of Nuremberg, had in June, 1897, orders on hand aggregating 96,000,000 marks ($22,848,000)—more than double those of the same date in 1896. American experts whose testimony is entitled to credence, have repeatedly stated, after careful examination of the subject, that the prices for electrical machinery of all kinds in Germany are nearly or quite double those which prevail in the United States; and it is both natural and gratifying that the opportunity thus offered has been seized, at least to some extent, by American manufacturers. Among the American equipments may be cited the electrical street-railway plant at Bamberg, in Bavaria, which has been supplied during the past year by an electrical company at Cleveland, and there appears to be an increasing import of American dynamos, motors and electrical appliances for special purposes.—Extract from a consular report.

THE TELEPHONE SITUATION IN WASHINGTON.—At a recent meeting of the directors of the Telephone Subscribers' Association held in this city, Mr. A. A. Birney, attorney for the association, made a statement as to the status of the contest against the Bell Telephone Company, having for its object the enforcement of the law fixing the rates for telephone service in the District. Mr. Birney stated that sixty suits for injunction had been filed against the telephone company since the passage by Congress of the act making the maximum rate for telephone service $50 per year. Each of these suits and one for a writ of mandamus have been instituted through the association. The case of the complainants, the Subscribers' Association, will be to show that telephone companies in other cities give their subscribers a better service than is furnished in Washington at the rate of $50 per year or less and under the same conditions. In support of this contention, experts will be examined from Detroit, Toronto, Richmond, Norfolk, Baltimore and other places and a mass of testimony will be adduced. It was decided to invite members of the old Subscribers' Association to join the more recently-formed permanent organization, and to urge the necessity of all subscribers to telephones in Washington becoming members of the association and joining in the fight for low rates. The telephone company, on the other hand, is sparing no expense in the effort to prove that it cannot afford to furnish telephone service at the rate of $50 a year. The complainants will have thirty days in which to produce their testimony, unless an extension of time is granted, and this the defense will strenuously oppose.

BUFFALO AND NIAGARA FALLS NOTES.

THE HAIRCLOTH COMPANY, which has a factory on the gorge side of Niagara Falls and obtains electric power from the Schoellkopf power house in the gorge, has erected a new factory, and will soon increase its output, taking additional power from the same source.

INCREASING THEIR LIGHTING PLANT.—The Wagner car shops, of Buffalo, are increasing their lighting capacity, and have bought from the General Electric Company a new generator of sufficient capacity to run 1,600 additional incandescent lights. The Wagner shops will run day and night hereafter, for it is reported that the company has orders for cars sufficient to keep the shops running full force about a year and a half.

THE NIAGARA CENTRAL RAILWAY, which runs from Niagara Falls to St. Catharines, Canada, is about to be equipped with electric power. Its condition became so deteriorated last season that the Government inspectors ordered it to stop business, and it was then sold to a Mr. Nelson, of St. Catharines, for $50,000. A syndicate of New York and Albany capitalists has now about completed the purchase of the road, and next season it will be started up as a trolley line.

THE PARTIAL STOPPAGE of the Niagara power current to Buffalo during the late heavy fall of snow is explained. There were two reasons for it; one was the leakage caused by the accumulation on the insulators of dust from the carbide works, near which the line passes, and the other and more serious reason was the short circuit caused by the guard wires falling on the line wires from the weight of the snow. It appears that these guard wires have always been a source of trouble, and some of the company's electrical engineers objected to them on general principles. They were intended primarily as a protection to the lines against lightning, and have met this requirement very well; but it has now been proven that they are such a menace to the lines that it has been decided to take them down entirely.

CHICAGO NOTE.

THE STREET RAILWAY FRANCHISE FIGHT—.Mr. Charles T. Yerkes at a meeting of the Sunset Club on the night of December 15 discussed the subject of the street railway franchises. He intimated that if the Allen law was repealed the street railways might go to Springfield and get something better. He stated frankly that the railway companies wanted a fifty-year franchise because it would do them good. So far as monopoly is concerned he admitted that the companies wanted a monopoly of the streets of the city. He did not want a consolidation of the street railways of Chicago, neither did the street railways of Chicago want the "eternal sandbagger" after them all the time. He stated that the companies were not being fairly treated in the fight and suggested that if there is any bribery in the City Council the best way to stop it would be to grant their fifty-year franchise.

WISCONSIN NOTES.

COLUMBUS, WIS., WANTS AN ELECTRIC LIGHT PLANT.—The Council of Columbus, Wis., is contemplating putting in an electric light plant to cost about $9,000.

ALLEGED ILLEGAL ISSUE OF BONDS.—A suit has been started by Mr. C. H. Holmes, of Green Bay, against the Fox River Electric Railway Company and the Farmers' Loan and Trust Company, of New York, to set aside $117,000 of bonds of the company, which the plaintiff alleges were illegally issued.

THE CITIZENS' TRACTION COMPANY, of Oshkosh, has secured the right of way along the Ridge road between that city and Neenah. The company has sixty days in which to accept the franchise, and, if accepted, it will be required to pay a forfeiture of $4,000 if the road is not completed by August 1 next. The plan is independent of the Tilotson Interurban road along the lake shore.

ST. LOUIS NOTES.

SALE OF EDISON PLANT.—A rumor is current that the Edison electric plant has been sold. It is said that William C. Whitney, of New York, and a syndicate are the persons who are said to have secured it. The report is denied, however.

SALE OF THE HAMILTON LINES CLOSED.—President C. H. Spencer, of the Southern Electric Railway, has returned to St. Louis from Chicago. The purchase of the Hamilton Syndicate lines by himself and Charles F. Orthwein has been consummated. The $3,000,000 agreed upon as the purchase price has been paid, and all details have been attended to.

BURYING THE CITY WIRES.—The contract for putting city wires underground has been approved, and bids for the laterals to connect the cables with the engine house and boxes have been advertised for. Five bids on the work were received. The lowest was made by the Abbot & Gamble Construction Company. The contract price will be about $5,700.

WIRES ALL UNDERGROUND.—When the time limit of the Keyes ordinance, which provides for placing all downtown electric lights, telephone and telegraph wires underground, shall expire, January 1, all wires except those of the city will have been buried. The city will be delayed in complying with the law because its ducts cannot be used until the conduit system is in full operation. Excavations for the conduits began two years ago, and have been continued with remarkable speed and success.

CANADIAN NOTES.

THE CITY COUNCIL of Vancouver, B. C., is desirous of purchasing the electric railway, but a proposal to float the whole electric railway system of the syndicate are the persons who have secured it. The report is denied, however.

MR. LETHEULE, an electrical engineer of Paris, France, was in Quebec recently. He was subventioned by the French Government to visit Canada and examine and report for French capitalists on the application of electricity for industrial purposes.

DR. C. J. EDGAR, manager of the Eastern Townships Light & Power Company, has concluded the purchase of the water power at Nengle's Dam, near

Rock Forest, Quebec. The company intends to transmit electrical energy for power and lighting purposes to the city of Sherbrooke, Que.

THE NIAGARA POWER FRANCHISE.—The Lieutenant-Governor-in-Council of the province of Ontario, on the advice of the Attorney-General, has referred to the High Court of Justice for the province certain questions to determine whether the non-completion by the Niagara Power Company of the water connections to the extent of 20,000 horse-power and 10,000 horse-power actually ready for use, supply and transmission by November 1, 1898, has not put an end to the agreement between the Park Commissioners and the company, giving the latter exclusive use of the water power at Niagara Falls.

AFTER HAVANA'S STREET RAILWAYS.—A syndicate of Toronto, Ont., capitalists is said to be now in Havana, Cuba, endeavoring to secure the franchise of the street railway system in that city. The gentlemen named are William MacKenzie, Frederick Nicholls, S. F. Madden and Z. Lash. The franchise includes an electric railway system for Havana and a steam railway to Matanzas. The latter railway is in existence, but for the city there is nothing at present save a line of buses drawn by mules. Sir William Van Horne, president of the C. P. R., is also said to be interested.

BELL TELEPHONE ASSESSMENTS.—The three county judges who have been hearing the appeal of the Bell Telephone Company from the assessment as fixed by the city of Toronto, Ont., have given judgment, knocking off over half a million dollars. The assessment on land and buildings was not touched, but that of $377,992 on poles, wires and conduits was reduced to $32,750; the one of $177,174 on one switchboard was cut to $12,000, and on two others $50,733 to $3,900. This reduction is made because the company claims, and the judges decide, that the material should be assessed, not as of a system in operation, but as separate parts, for what they would bring if they were taken away and sold.

General News.

NEW INCORPORATIONS.

THE AUTOMATIC TELEPHONE COMPANY has been incorporated at New Bedford, Mass., with a capital stock of $100,000. The incorporators are J. W. Macomber and Frederick Tabor.

THE FLEMINGSBURG & MYERS STATION TELEPHONE COMPANY, of Fleming County, Kentucky, has filed articles of incorporation with the Secretary of State. The capital stock is $600, and the principal stockholder is J. B. Sherwood.

THE HAMILTON & EATON ELECTRIC STREET RAILWAY COMPANY, Hamilton, N. Y., has been formed with a capital stock of $10,000. Among the incorporators are J. H. Shallenbarger, J. A. Walker, A. T. Elliott, and J. C. Unzicker.

THE FARMERS' & MERCHANTS' TELEPHONE COMPANY has been incorporated at Pittsburg, Pa., with a capital stock of $5,000. The incorporators are J. P. Darling, S. C. Kissner, John Fischer, W. D. Kissner, T. L. Darling, J. F. Rees, and L. G. Rees.

THE SWEDESBORO LIGHT, HEAT & POWER COMPANY, Swedesboro, Pa., has been incorporated with a capital stock of $25,000. Those interested are Charles D. Lippincott, Henry M. Mitchell, Thomas B. Turner, John C. Rulon, Benjamin F. Lawrence and James J. Davidson, all of Swedesboro.

THE MANHATTAN LIGHTING COMPANY, of New York, has been incorporated with a capital of $250,000 to manufacture and supply gas and electricity for lighting, heating and power purposes in New York and Westchester counties. The directors are Henry D. Brenner, New York; H. E. Bowen, Brooklyn, and Henry P. Keith, Hempstead, L. I.

THE BOSTON & NEW YORK TELEPHONE & TELEGRAPH COMPANY has been incorporated in New Jersey, with a capital stock of $1,000,000, the incorporators being Zephaniah S. Holbrook, of Cambridge, Mass.; Oakes Ames, of Milton, Mass.; Frederick A. Spear and Charles E. Adams, of Lowell, Mass., and J. Stewart Rusk, of Boston.

THE SOUTH AFRICA GENERAL ELECTRIC COMPANY, of Schenectady, N. Y., has been incorporated with a capital stock of $50,000 to deal in electrical apparatus, machines, engines and mechanical devices, and to construct works and plants involving their use in the United States, South Africa and other foreign countries. The directors are S. D. Greene, Henry W. Darling, D. [illegible], J. F. Lovejoy and M. F. Westover, of Schenectady.

THE TELEGRAPH AND TELEPHONE.

BURLINGTON, N. J.—An ordinance for the Burlington County Telephone Company was [illegible] by the Common Council of Burlington.

[illegible], MASS.—During the month of November the Erie Telegraph & Telephone Company added [illegible] subscribers to its system. The net gain in the number of subscribers so far during the present year is 6[illegible].

DULUTH, MINN.—The Duluth Telephone Company has just completed the necessary equipment for [illegible] long-distance instruments, and [illegible] at $[illegible] per annum each for two 'phones on one line.

[illegible], OHIO.—The People's Telephone system, consisting of fifty-[illegible] Ashland, [illegible], Medina and Holmes [illegible]. A stock [illegible] Ashland.

[illegible], MASS.—The Erie Telephone Company will expend $[illegible] in [illegible] the six States [illegible] the number of sub[illegible] per cent.

DULUTH, MINN.—[illegible] for bids for a tele[illegible] of the Duluth [illegible]

will be demanded, also a lower rate than heretofore given, together with a certain number of free instruments and a differential rate in favor of residence telephones. The Bell company has just reduced its residence rates from $50 to $36 per year.

PITTSBURG, PA.—The telephone war in Homestead between the Bell Telephone Company and the Home company still continues. The Bell company has made another cut in prices, offering to put in a long-distance, 500-call 'phone for $12 per year, while the Home company is asking $24 for a local service. The Home company has been granted a charter. Dr. George Gladden, the president of the company, says the system will be in working order by February 1, and by that time they will have 400 subscribers. The business men of the town claim the Bell company is making the big cut in prices simply to freeze the local company out, and will restore the old prices as soon as the new company is gotten out of the road, and refuse to subscribe for a long-distance telephone unless given five-year contracts. This the company refuses to do, and not a single additional subscriber has been obtained by it since the war began.

KANSAS CITY, MO.—Conversation by telephone is admissible as evidence in court. This was decided by the Court of Appeals in the case of James A. Guest against the Hannibal & St. Joseph Railway. A piano belonging to Mr. Guest was in this road's freight depot at Chillicothe, Mo. Mr. Guest called the agent by 'phone and directed him to ship the piano that afternoon. That night the depot burned, and as the piano had not been shipped, it was burned also. Mr. Guest brought suit in the Livingston County Circuit Court, lost, and appealed. At the trial the railroad agent testified that he did not receive the message, and the court ruled that a telephone message was not admissible. The Court of Appeals holds, however, in reversing the case, that if the man at the other end of the line answers to the name of the man called for and receives the message, it is as competent as though a letter had been mailed to him.

BOSTON, MASS.—The New England Telephone Company on December 16 inaugurated a new telephone service by which it is prepared to establish at residences or places of business located within the Boston or suburban exchange districts and accessible to the company's wires, long distance telephones, measured service basis, as follows: Residences, six on a circuit, $30 per annum; business, three or more on a circuit, $48. An extra charge is made for stations located more than one mile from the company's exchange office. The $30 suburban service allows 500 calls in the town wherein the instrument is installed, a charge of 10 cents extra being made for a call in Boston or other out-of-town places. The $48 service, three stations being on the line, permits of 500 calls, including Boston and other out-of-town points. The party line service heretofore in operation cost the subscriber $60, two stations. This is now reduced to $48 with the addition of a third instrument to the line. The previous charge of $36 for local service with three or more stations is now reduced to $30 with six instruments on the line. The new system, therefore, is a reduction in telephone rentals with the addition of one or more stations to the line.

ELECTRIC LIGHT AND POWER.

VANCEBURG, KY.—A movement is on foot to organize an electric light company, the stock to be taken by public subscription. The amount of capital stock for the proposed company is placed at $3,000.

WASHINGTON, D. C.—On the night of December 8 a peculiar accident occurred at the station of the United States Electric Light Company in this city. One of the steam pipes burst, and a large section of the pipe fell across the corner of a switchboard in such a way as to result in the temporary extinguishment of all the lights operated from the station.

YORK, PA.—At the annual meeting of the stockholders of the Edison Electric Company the following were elected directors: G. P. Yost, C. A. Elsenhart, A. F. Geesey, H. S. Wiest, Edward T. Moul, B. S. Gilbert and W. F. Bay Stewart. The board organized by electing G. P. Yost, president; C. A. Elsenhart, vice-president; A. F. Geesey, secretary, and C. C. Frick, treasurer.

PORTSMOUTH, N. H.—The Boston & Maine Railroad Company is erecting here an electric power station. The building is 118 feet wide and 64 feet long, divided into two rooms—one for the boilers and the other for the engines and generators. The side walls are of brick, the roof construction fireproof. The contract for the steelwork was given to the Berlin Iron Bridge Company, of East Berlin, Conn.

DES MOINES, IA.—It is reported that upon the completion of improvements to its steam plant by which the General Electric Company will have an added capacity of nearly 30,000 incandescent lights, a material reduction will be made in the price of incandescent lights. This will be done with a view of making the use of electric lights for the illumination of residences more popular and to discourage the putting in of private plants.

PITTSBURG, PA.—It is stated that the directors of the Allegheny County Light & Heating Company have approved the offer of an option to Brown Brothers, of New York, of all the stock at $180 a share, the total amount being $600,000. It is stated that Messrs. Brown Brothers aim to combine all the electric light, illuminating and fuel gas companies in this territory. The promoters have already acquired the illuminating gas companies here, paying therefor $7,000,000.

SOMETHING FOR SALE IN ST. LOUIS.—An advertisement in a St. Louis daily paper of recent issue offers for sale at a bargain the following-named articles: "A [illegible]-horse multipolar motor or 25-horse multipolar dynamo; 400 lamps, belt driving or direct connection or American ball, simple centre crank, horizontal or tandem, compound 60-horse engine." The person offering these things for sale could perhaps dispose of them in time if he were to offer a prize to the first person who succeeded in guessing what he had to sell.

WILMINGTON, DEL.—A deal is in progress, if not actually consummated, for the purchase of the controlling interest of the Wilmington City Electric Company. The Pennsylvania Heat, Light & Power Company is suggested as the probable purchaser. The Wilmington City Electric Company has a capital stock of $[illegible], of which $[illegible] was added about the time of the purchase of the charter of the Wilmington Heat, Light & Power Company, which promised to become a competitor of the old organization.

BALTIMORE, MD.—It is stated that the Westinghouse Air Brake Company has secured control of the Brush Electric Light Company in this city. The Brush Company defaulted on its special mortgage bonds last November, and in making an offer Mr. Westinghouse agreed to take these at half their face value at cash or exchange them for Westinghouse Air Brake stock. The cash proposition was accepted. The special mortgage, which was the third obtained by the company, is now merged into stock, and the dividend passed in November is guaranteed.

WASHINGTON, D. C.—It is understood that experiments will be made in the use of electric lights for lighthouses at various points on the lakes. The first experiments will be conducted at Marquette, Mich. At this point there is a breakwater extending into the lake about 3,000 feet, and during stormy weather the trip to the outer end, in order to light the oil lamp, is extremely dangerous. The plan is to lay a submarine cable along the top of the breakwater masonry, and to use a 50-cp stereopticon incandescent lamp, which will be controlled from the shore.

ATLANTA, GA.—An isolated plant has been installed in the custom house in this city. Heretofore the lights have been furnished by the Georgia Electric Light Company, and it was found to be very expensive, costing from $400 to $600 a month. It was decided to put in an isolated plant, and three gas engines were purchased and put into place, and are now furnishing the lights for the building. The engines cost about $15,000, and the cost of running them is about $10 a day, so that in the course of time the Government will save something on the investment.

NEWARK, N. J.—The People's Electric Light & Power Company is about to issue a circular to its out-of-town patrons and prospective customers making a reduction in its present rates for current of from 7½ to 13½ per cent. The reduction will apply to Jersey City, Bayonne, Irvington, Clinton, Vailsburg, the Oranges, Bloomfield, Montclair, Caldwell, Verona, Harrison and Kearny, and will be from a schedule of prices as now charged in the different towns, to a uniform rate of 13 cents per kilowatt, not including lamp renewals. The company is installing a new engine in the River Street plant, and expects to have it in operation by the beginning of the year. Then the recovery from the disastrous fire a year or two ago will be complete.

HELENA, MONT.—Helena is now stated to be the most thoroughgoing electrical city in the United States by reason of the inauguration on December 15 of the second largest and most complete electrical plant in the country. The amount of power developed by damming the Missouri River is about 30,000 horse-power, which power is utilized for a variety of purposes. Chief among them may be mentioned the East Helena smelters and concentrators, all of the mining power; street railways, electric lighting and newspaper plants in the city. The mining industry will receive the greatest benefit, and it was for this purpose principally that the work was undertaken. It is intended to transmit power to Butte in the spring.

THE ELECTRIC RAILWAY.

CHICAGO, ILL.—The Yerkes franchise ordinances have been side-tracked indefinitely. The vote was 38 to 25.

MAYSVILLE, KY.—An attempt is being made to build an electric railway from this city to Flemingsburg, a distance of 17 miles.

PROVIDENCE, R. I.—The Providence & Taunton Street Railway Company has declared a first dividend of 2½ per cent., payable January 2, 1899.

PHILADELPHIA, PA.—The Hestonville Passenger Railway Company has declared a dividend of $1.50 on its preferred stock and a dividend of $1 on its common stock, payable December 31.

DAYTON, OHIO.—Stockholders of the Dayton, Springfield & Urbana Electric Railway Company, at Springfield, Ohio, have increased the capital stock of the company from $10,000 to $750,000.

CHATTANOOGA, TENN.—Work on the power house of the Chattanooga Rapid Transit Company is rapidly nearing completion, and everything will be in readiness for the operation of the electric cars in a very short time.

ERIE, PA.—The ordinance giving a franchise to the Erie Rapid Transit Company (the North East Line) has been passed by the City Council. A franchise was also given to the Erie Transit Company (the Edinboro Line).

DALLAS, TEX.—The strike on the Dallas Consolidated Street Railway was amicably settled and officially declared off. The men are to be taken back to work and their union fully recognized. The strike began November 10 and lasted until December 6.

BINGHAMTON, N. Y.—The Binghamton Street Railroad Company will have a skating rink this winter, having arranged to lease Brigham's pond, furnish lights and music each evening, together with a place where the patrons can keep warm and refreshments can be served.

RICHMOND, IND.—Benjamin Binford and other well-known capitalists of Greenfield, this State, are at the head of a project to build an electric railroad from Indianapolis to this city by way of Greenfield and Knightstown, and with side lines to Newcastle and other towns of similar importance.

AKRON, OHIO.—It has been given out by officials of the company that the Akron, Bedford & Cleveland Electric Road is to be double-tracked at once between Cuyahoga Falls and Newburg. When this is done there will not remain more than two miles of single track on this road, and this strip will be doubled next summer.

DETROIT, MICH.—A proposition for new franchises submitted to the Common Council on December 13 by the street railroad companies was rejected by a vote of 30 to 3. It provided for certain improvements and extensions, a thirty-years' extension of all existing franchises, universal transfers, and several lesser features.

SHAMOKIN, PA.—The Williams Valley and Lykens Street Railway is now in operation. This road connects Lykens with Reiner City, a distance of about 12 miles. Electricity is the motive power. The power plant is located at Williamstown, which is quite central. This road will be a close competitor for passengers of the Williams Valley Railroad, a steam railway.

PITTSBURG, PA.—A great 15-foot fly-wheel in the Pittsburg and Birmingham Traction Company's power house, at Carson and South Thirtieth Streets, burst a few nights ago. It wrecked a 300-hp engine, wrought ruin in the building and did considerable damage to neighboring houses. No one was injured. The whole neighborhood was thrown into darkness as a result of the accident.

NEW HAVEN, CONN.—The Meriden, Southington & Compounce Trolley Company has given notice of a petition to the next General Assembly for permission to increase its capital stock to $500,000, and to extend its line to Waterbury, to Cheshire, to Mount Carmel, to the top of West Peak, to Berlin, and through certain Meriden streets, the whole involving extensions of about 40 miles.

ANSONIA, CONN.—A corporation has been formed here to be known as the Seymour Electric Railway Company, which will petition the next session of the Legislature for the privilege of building and operating an electric railway between this city and Beacon Falls, 10 miles to the north, running through the town of Seymour. The incorporators include the most prominent business men of this city.

CHATTANOOGA, TENN.—The Chattanooga Electric Street Railway Company contemplates some very extensive improvements. New cars for the summer will be at once purchased and fitted up. Negotiations are now pending for the purchase of this rolling stock, including motor equipment. It is intended to put the road in first-class condition. The tracks are to be repaired as well as the overhead work.

CHESTER, PA.—The Wilmington extension of the consolidated trolley line is now completed, with the exception of 1000 feet at Grubb's Landing, Del., at which point a bridge is being built. The approximated cost of the extension, which leaves this city via Ninth Street, is $180,000. The ultimate intention is to have a direct line between Wilmington and Philadelphia. The Wilmington extension will be in operation by January 1, 1899.

NEW YORK, N. Y.—The Brooklyn Heights Railroad Company has, by the purchase of a piece of land on West Eighth Street, Coney Island, secured the long-desired outlet whereby the connection between the Sea Beach branch of the system and its newly acquired line, formerly owned by the Sea View Railroad Company, can be made, thus giving the company a direct line between Park Row, Manhattan, and Brighton Beach.

BALTIMORE, MD.—It is officially announced that all of the street railways in and about Baltimore will be consolidated, and that the different lines will hereafter be controlled by one management. The companies involved in the deal are the Consolidated, City Passenger, Baltimore & Northern, and Baltimore, Middle River & Sparrow's Point Railways. It is stated that the sum involved in the transaction is about $28,000,000.

ELMIRA, N. Y.—It is announced that the Elmira & Seneca Lake Electric Railway, which has been talked of for several years, is to be built this winter, and that work is to be commenced at once, the contract for constructing it having been let to the American Engineering Company, of Bound Brook, N. J. The road will run from Watkins through Montour Falls to Horseheads, where it will meet with the Horseheads & Elmira Electric Railway.

BOSTON, MASS.—Electric railways in this vicinity have declared dividends as follows: The Wellesley & Boston Street Railway Company, a quarterly dividend of 2 per cent., payable to stock of record December 24; the Newtonville & Watertown Street Railway Company, a quarterly dividend of 1 per cent., payable to stock of record December 24, and the Newton & Boston Street Railway Company, a quarterly dividend of 1¼ per cent., payable to stock of record December 24.

CLEVELAND, OHIO.—It is reported that an English syndicate is negotiating for the purchase of both the Big and Little Consolidated Street Railways, the two companies which control and operate all the street railway lines in the city, both cable and electric, as well as all the suburban lines in and about Cleveland. The combined capitalization of the two companies is $24,300,000. It is estimated that the entire street railway system can be purchased for about $35,000,000.

CINCINNATI, OHIO.—A deal is now pending involving a number of Ohio electric railways. It is the consolidation of a number of interurban electric railways, including those now in operation between Piqua and Troy and Dayton and Troy, and lines that are now under course of construction between Cincinnati and Dayton. It is now possible to travel over different interurban railways between Cincinnati and Dayton, Ohio, in less than twice the time it takes the quickest railway train, and for just one-half fare.

WASHINGTON, D. C.—Before many months the old cable system of the Columbia Railway Company will be a thing of the past. Theodore J. King, superintendent of the company, has made application to the District Commissioners for a permit to change the existing system to a modern underground electric system similar to that in use upon the Metropolitan and Capital Traction Companies' lines in this city. The commissioners approved the request. The work of changing the conduits will not be begun until some time in January. The Columbia Railway is the only remaining local street railway line depending upon the cable as a motive power.

NEW HAVEN, CONN.—Ex-Governor Thomas M. Waller, Lieutenant-Governor James D. Dewell, Israel I. Kelsey, vice-president of the Winchester Avenue Railroad Company; S. Harrison Wagner, a director in the New Haven Street Railway Company, and W. B. Ferguson, president of the Winchester Avenue Company, have petitioned the General Assembly for an act of incorporation empowering them to form a new street railroad company and to lay tracks through several streets in New Haven and through surrounding towns. It is likely that the petition will be opposed by the New York, New Haven & Hartford Railroad, inasmuch as the new road will parallel its Derby division and will connect Allingtown, Orange, Milford, Ansonia and Derby with New Haven.

PITTSBURG, PA.—The Monongahela Street Car Company is running cars over its new line from the city through to Homestead. The company has completed its line between the down-town portion of the city, running through the Squirrel Hill district, to Homestead and Braddock. By virtue of a contract with the Consolidated Traction Company the tracks of that company are used between Woodlawn Avenue and Forbes Street into the heart of the city. The company also contemplates the operation of cars from the city to Duquesne and McKeesport as soon as its line, which is now under construction, is completed, which will be within the next thirty days. The system, when completed, will have 17 miles of double track. The running time from Pittsburg to Homestead will be thirty-five minutes; from Pittsburg to Braddock, forty-five minutes.

RICHMOND, VA.—Richmond is soon to have another large industrial enterprise, which will be a big addition to the manufacturing interests of the city. It will consist of a plant for the development of James River water power for the purpose of furnishing electric light and power. Mr. F. C. Todd, of Baltimore, applied to the City Council some months ago for a franchise to use the water of the James River for the purpose of generating electric power for industrial uses, and although there was some opposition to the granting of the franchise, it has been shown to the satisfaction of the Council that the scheme was backed by well-known business men, and finally the franchise was granted. Engineers have been surveying the ground and making estimates, and find that 8000 horse-power can be obtained. It has not yet been decided where the plant shall be located, but it is expected that the work will be commenced within the next month and hurried to completion as rapidly as possible.

NEW HAVEN, CONN.—Five electric railway companies are to petition the Legislature, which convenes in January, and should all meet success a continuous passage by trolley from South Norwalk to Waterbury, a distance of more than 50 miles, will be possible by August 1. The Waterbury Traction Company petitions to extend its road to Beacon Falls, connecting with that of the Seymour road, which in turn will connect with the lines of the Derby Street Railway Company. The Shelton Street Railway Company, which is a continuation of the Derby Street, purposes to continue its tracks to Bridgeport, 13 miles south, having obtained a right-of-way over the lines of the Bridgeport Traction Company, which connects with the Westport & Saugatuck Road and the Norwalk Traction Company. The lines will parallel the Consolidated the entire distance, and the latter road is preparing to make strong opposition to the granting of the petitions.

MOUNT VERNON, N. Y.—A committee of the Board of Trade is investigating the granting of a franchise for an electric railroad through 7 miles of the streets of the city to the New York, Westchester and Connecticut Traction Company for fifty years. Joseph S. Wood, acting for the Board of Trade, says that in October the aldermen had two applications for franchises over 7 miles of the principal streets of the city. One was by the Westchester Electric Company, and the other was by the New York, Westchester & Connecticut Traction Company. By a vote of 8 to 2 the aldermen, at that time, gave the franchise to the Union company, and by a like vote rejected the application of its opponent. The aldermen made it a condition with the Union company that it must apply within thirty days for franchises. The time for presentation of this application expired at midnight on December 5. According to Mr. Wood's statement, on that day, at 3:10 P. M., the Union Railroad Company, through a special messenger, delivered to City Clerk Hoyt the application which it was required to make, and the city clerk gave a written receipt therefor. On the following evening there was a meeting of the aldermen, and it is charged by the Board of Trade that the application was suppressed, and the New York, Westchester & Connecticut Traction Company was granted the franchise it had asked for. This was done by a tie vote, the resolution being adopted through [illegible]

HAVANA, CUBA.—It is stated that the American West Indies Syndicate, which owns the Ceballos concession for a belt street railway line around Ha-[illegible] from the Chief Justice declaring void the recent action of the Secretary of Public Works in the Colonial Cabinet, who had vested the Ferro-carril with rights claimed by the syndicate. The syndicate has now applied to the Mayor of Havana for a recognition of the Ceballos concession. Toronto capitalists are seeking a fran-[illegible] for the present city street railway system. The same syndicate already operates railways in Montreal, Toronto, London, Ont.; Winnipeg, Kingston, Jamaica and Birmingham, England. Another report affecting the street railway interests of this city is to the effect that a syndicate backed by New York and Canadian capital has acquired the entire street railway system and street railway conces-[illegible]

Personal Notes.

[illegible]

[illegible]

Obituary Note.

MR. JAMES BROWN, superintendent of the Direct Cable Company, died at his home in New York City on December 17 at the age of fifty-one years. Mr. Brown was born in Aberdeen, Scotland, and came to this country when twenty-seven years of age.

Educational Notes.

TEACHING TELEPHONY BY CORRESPONDENCE.—The United Correspondence Schools, 154-158 Fifth Avenue, New York, has a course in telephony, in addition to its courses on various other electrical subjects. The telephone course is claimed to be very thorough and practical. Beginning with arithmetic, it carries the student through mathematics and the use of formulas, then the principles and measurements of electricity are taken up. The subject of telephones is divided under various heads, such as acoustic principles, simple telephone circuits, induction coils, magneto generators, call-bells, batteries, multiple-circuit connections, bridging-bell system, auto-telephone systems, switchboards and their construction; drops; transposition of overhead wires; cables; lightning arresters, etc.

THE ELECTRICAL NUMBER OF THE "PURDUE EXPONENT," published at the Purdue University, Lafayette, Ind., contains matter of extraordinary interest. The attempt has been made in this number (which is the first of the proposed numbers on departments of the university) to give an idea to those outside of the institution of what is being done there in the electrical engineering course. The articles are written by alumni, and cover a wide range of subjects. Among the contributions are the following: "The Uses of the Storage Battery in Railway Work," by A. F. Chamberlain; "Electrical Transportation," by Cloyd Marshall; "The Commercial Aspects of Electrical Engineering"; "The Training of an Electrical Engineer"; "Wireless Telegraphy," by Dr. S. N. Taylor; "Long-Distance Transmission of Power," by C. Rice Dooley, and "Lightning Arresters," by Nathan Kohn.

Directory of Scientific Societies, Associations, Etc., and Meetings of the Same.

THE NEW YORK ELECTRICAL SOCIETY.—President, Gano S. Dunn; secretary, George H. Guy, 120 Liberty Street, New York.

HENRY ELECTRICAL SOCIETY meets every other Friday evening between October and May. Headquarters, 115 West Twenty-eighth Street, New York City.

NATIONAL ELECTRIC LIGHT ASSOCIATION.—President, A. M. Young, Waterbury, Conn.; secretary, George F. Porter, 203 Broadway, New York. Next meeting, New York, May, 1899.

THE KANSAS GAS, WATER & ELECTRIC LIGHT ASSOCIATION.—Organized at Topeka, September 26, 1898. President, L. F. Palmer, Leavenworth; secretary and treasurer, J. H. Foley, Leavenworth.

CHICAGO ELECTRICAL ASSOCIATION.—Meetings, first and third Friday of each month, from October 1 to June 1; J. R. Cravath, secretary, Monadnock Block, Chicago, Ill. Future meetings and papers for the season of 1898-99: "Wireless Telegraphy," by Arthur V. Abbott; January 6, 1899, "Telephone Engineering—Some Problems Solved and Unsolved," by S. G. McMeen; January 20, "Observations on Ventilating Fans," Gerard Swope.

THE ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA held its regular monthly meeting on the night of December 20 at its house, 410 Penn Avenue, Pittsburg. Mr. G. F. Greenwood, chief engineer and general manager of the Consolidated Traction Company, read a paper on the "Design and Construction of the Twentieth-Street Power Station of the Consolidated Traction Company." Mr. Reginald A. Fessenden is the secretary of the society.

FRANKLIN INSTITUTE (Electrical Section), Philadelphia, Pa.—Secretary, Wm. H. Wahl. Programme of lectures for the season 1898-99: January 24, 1899, "The Practical Application of the Electric Motor to Printing Press Machinery," by W. H. Tapley; February 14, "The Electric Inspection of Street Car Equipments," by Mr. A. B. Herrick; February 28, "Some of the Larger Transportation Problems in Cities," by E. E. Higgins; March 28, "Water Power Electric Plants in the United States," by Mr. B. C. Washington, Jr.; April 25, "Design of Electromagnetic Mechanism, with Especial Reference to High Frequency Telegraphic Receivers," by Prof. Reginald A. Fessenden; May 23, "Electrical Clocks, Historically Considered; with a description of the Most Successful Applications of Electricity to Clocks and the Uniform Distribution of Time," by Mr. James Hamblett. On February 10 Mr. T. Commerford Martin will deliver a lecture under the joint patronage of the institute and the Central Branch of the Y. M. C. A. on the subject of "Electric Power Transmission."

Trade and Industrial Notes.

[illegible] ZIMDARS & HUNT, [illegible] Fifth Avenue, New York, report that [illegible] with an increased force, in order [illegible]

[illegible] TELEPHONE COMPANY, Chicago, Ill., reports that it has received quite a number of orders for its new toll-line switch-[illegible] Other [illegible] have also been received.

[illegible] COMPANY, [illegible] and 12 North Ninth Street, St. Louis, Mo., has secured the general selling agency of the Warren Electric Manufacturing Company, manufacturer of the Warren alter-[illegible] Maloney trans-[illegible]

MR. CHARLES WIRT, 1028 Filbert Street, Philadelphia, is making a specialty of field rheostats and also building a number of heavy and special designs. A searchlight rheostat recently shipped by Mr. Wirt is believed to be the largest constructed for this work, and has a capacity of 14 kilowatts for continuous duty.

THE PITTSBURG REDUCTION COMPANY has received an order for 25 miles of aluminum wire to be used in the construction of a telegraph and telephone line between Manilla and Cavite, in the Philippine Islands. The company has also received an order for 150 miles of wire for an electric company in San Francisco, Cal.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, of Chicago, it is said, has worked out a complete multiple switchboard with an efficient busy test, which it will put on the market during the coming season. It is said to be entirely clear of all patent claims not owned or controlled by the company.

THE RAW-SILK WIPERS manufactured by the American Silk Manufacturing Company, 311 Walnut Street, Philadelphia, are recommended and endorsed by the Boards of Fire Underwriters of St. Louis and Philadelphia. These silk wipers are used in many electric light stations, and are found to give better satisfaction than cotton waste.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is calling particular attention to the Jenkins switch, which is the latest arrival in the field of snap switches. The company claims that it is in a position to sell these switches at a very much lower figure than has ever been offered before on a first-class article. It solicits an opportunity to quote prices to all users of snap switches.

THE WASHINGTON ELECTRIC LIGHT & POWER COMPANY, Washington, Pa., has recently increased the capacity of its station by the addition of a 175-hp engine, built by the Ball Engine Company, of Erie, Pa. The Ball Company is installing an engine in the plant of the Sheffield Electric Light Company, Sheffield, Ill., and has sold to the California Powder Works, San Francisco, a 100-hp tandem compound engine for electrical purposes.

THE STERLING VARNISH COMPANY, Pittsburg, Pa., which is supplying a rapidly increasing quantity of its varnish to manufacturers of electrical machinery, is anxious to widen the demand for its product, and invites correspondence from electrical supply houses in a position to represent the Sterling varnish in their respective localities. The trade need have no hesitation in recommending the varnish, a large sale for which can easily be worked up.

THE JAGABI PORTABLE TESTING SET, for which Mr. James G. Biddle, 910 Drexel Building, Philadelphia, is sole selling agent, is fully described in that gentleman's new catalogue B, "Electrical Measuring Instruments." This catalogue contains 108 pages of valuable data concerning testing instruments, and should be in the hands of every one interested in the subject. Mr. Biddle states that he will mail a copy to any address upon receipt of 10 cents in stamps.

"GRAPHITE" is the title of a four-page sheet just issued by the Joseph Dixon Crucible Company, Jersey City, N. J. The sheet is issued monthly in the interest of the Dixon graphite productions and for the purpose of establishing a better understanding in regard to the different forms of graphite and their respective uses. The leading article in the December number discusses the nature of graphite and gives some interesting and valuable information regarding its uses.

THE "NEW STANDARD" DRY CELL manufactured by Mr. William Roche, 259 Greenwich Street, New York, is, that gentleman reports, meeting with an extraordinary demand. This cell, Mr. Roche states, was adopted last spring by the United States Navy for machine-gun firing, torpedo nozzles, mines, etc., and many of the best telephone companies are using them, and supply houses find an increasing demand for them. They are made in all sizes to order, from the size of a finger to the dimensions of a barrel.

THE WARDEN OIL FILTER and purifier, manufactured by the Burt Manufacturing Company, Akron, Ohio, is a device to filter and purify lubricating oil after it has passed through bearings and has become charged with dirt and grit. To cleanse such lubricant and render it fit for re-use is not always an easy task, but the Warden oil filter and purifier is recommended by the manufacturer as providing a complete and satisfactory solution of the problem. The unclean oil is first filtered, then washed by rising through a body of water. It is a common-sense device, and is spoken well of by those who have had experience with it.

UNIVERSAL PARIS EXPOSITION OF 1900.—Manufacturers intending to place an exhibit at Paris in 1900, and who have not yet made application for space, should do so without delay, as the space will be soon allotted. The Trans-American Company, 163 Washington Street, Chicago, takes charge of exhibits from start to finish, including all the expenses. By giving it an idea of size, value and approximate weight this company, which is endorsed by the National Association of Manufacturers of Chicago, will send a moderate estimate which would be advantageous to know before making any other arrangements.

A UNIQUE AND HANDY SKETCH-BOOK has been produced by Mr. M. H. Avery, Woonsocket, R. I. The book is made up of fifty sheets, and the feature consists of inch-scales printed on the four edges of each sheet. It is made up in two styles, one having angle readings in addition to the edge scales, and the other book without the angle readings. These books will no doubt serve a very useful purpose to draughtsmen in aiding them to produce small drawings rapidly and accurately. They are designed for schools, colleges and practical draughtsmen, and are 5½ by 8½ inches in dimensions. Further information concerning these useful books may be obtained by addressing Mr. Avery.

THE GENERAL ELECTRIC COMPANY, it is stated, has obtained the contract to supply eight electric locomotives and other electrical equipment for the Orleans Railway in Paris. This contract was secured in the face of strong competition from British and other European companies after negotiations extending over a period of two years. Last spring a party of French engineers made a thorough examination of the General Electric Company's experimental railway at Schenectady. The three-phase transmission system will be used on the French line and rotary converters will change the alternating to direct current at 500 volts. The proposed installation on this line was described and illustrated in THE ELECTRICAL WORLD of June 4, 1898.

ELEVATING AND CONVEYING MACHINERY has become such an important factor in the economical operation of electric light stations, railway power plants and manufacturing establishments generally that new developments in this class of apparatus possess extraordinary interest to those concerned. The Jeffrey Manufacturing Company, Columbus, Ohio, one of the leading manufacturers of machinery of this class, has just issued a 224-page catalogue, which contains a list of several new lines added to the company's already large line of specialties. The new apparatus includes spiral conveyors, elevator buckets, the Jeffrey-Columbian separator, blotter and screen and the Jeffrey Century belt conveyor system. The catalogue is profusely illustrated, many of the cuts representing the articles in full size. Many of the illustrations show plants with this company's labor-saving devices in actual use, and one of the most impressive facts in this connection is the great variety of applications of this class of machinery. This, of course, indicates the important place it occupies in the electrical and manufacturing industries. The Jeffrey Company manufactures chain belting, steel cable conveyors, elevators, conveyors, carriers, labor-saving appliances, power-transmission machinery, mill, factory and mine supplies, coal-washing and mining machinery.

Business Notice.

GOOD WINTER READING for farmers in the Eastern States is now being distributed by the Chicago, Milwaukee & St. Paul Railway, free of charge to those who will send their address to H. F. Hunter, Immigration Agent for South Dakota, Room, 565, Old Colony Building, Chicago, Ill., the finely illustrated pamphlet "The Sunshine State" and other publications of interest to all seeking new homes in the most fertile section of the West will serve to entertain and instruct every farmer during the long evenings of the winter months. Remember, there is no charge—address as above.

UNITED STATES PATENTS ISSUED DECEMBER 13, 1898.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

615,669. THERMOSTAT; I. F. Beers and F. C. Beers, of Rochester, N. Y. App. filed April 5, 1897. In a thermostat the body provided with a suitable binding post, binding posts mounted thereon, and insulated from the body and provided with contact points, one of which contact points is made adjustable; combined with a pintle upon the lower end of the body, a thermostatic bar mounted upon the pintle, an extension of the thermostatic bar extending up between the two contact points, a spring secured to a lug upon the body, and which spring has its lower end arranged to exert a pull upon the pintle, and a regulating screw which has its lower end to bear against the pintle upon the opposite side from the spring.

615,673. METHOD OF AND APPARATUS FOR ELECTRICALLY TRANSMITTING POWER; C. S. Bradley, of Avon, N. Y. App. filed July 14, 1897. The method of altering the rate of an alternating current consisting in leading said current through a motor generator, feeding an armature from the secondary of said generator, and varying the strength of the field magnetism co-operating with the armature to adjust the capacity of the circuit to the required rate.

615,686. ELECTRIC LAMP; W. S. Doe, of Jersey City, N. J. App. filed August 12, 1897. A battery for electric lamps having a cylinder adapted to receive the anode, a contact wire therefor extending down inside said tube, said wire near its lower end passing out through the wall of the tube and then back and across the same, forming a stop to support the anode, substantially as described.

615,691. METHOD OF MANUFACTURING ELECTRIC CABLES; S. Ziani de Ferranti, of Hollinwood, England. App. filed Dec. 28, 1897. The method of manufacturing electric cables for electric light and power distribution which consists in first forming a circular stranded conductor passing the same between rolls to compress it to the shape of part of a circle in cross-section, insulating said conductor, and lastly laying a number of such conductors together to form an approximately cylindrical cable.

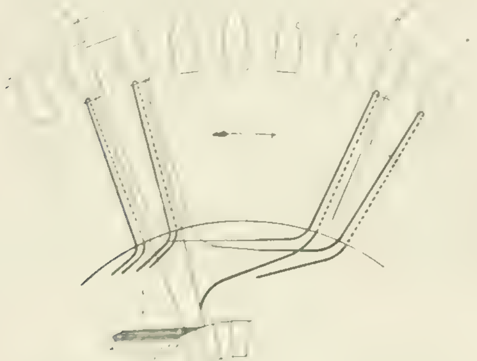
615,695. HYSTERESIS METER; J. L. W. Gill, of Montreal, Canada. App. filed March 25, 1898. A meter or instrument for measuring hysteresis in iron comprising a vertically movable solenoid, with means for operating same electrically and mechanically; a carrier for the sample of iron being tested, extending through the solenoid; yielding supports for such carrier, and integrator mechanism carried in part by said carrier and in part by the mechanically operating means of the solenoid for indicating the work done, substantially described.

615,723. FIRE-ALARM INDICATOR; L. Le Baron, of Pensacola, Fla. App. filed Sept. 29, 1897. In an electrical alarm apparatus a main indicator having a mainspring and mechanism actuated thereby, an electromagnet and armature controlling the operation of said mechanism; an auxiliary indicator in a circuit that is closed by a vibratory member actuated by the expansion of said spring, said vibratory member being electrically connected with the armature of said electromagnet, and a branch line from said auxiliary indicator having its terminal situated in the path of the said armature, substantially as described.

615,731. DYNAMO-ELECTRIC MACHINE; W. M. Mordey, of Loughborough, England. App. filed Feb. 15, 1897. In a dynamo-electric machine, an armature having each element of its winding arranged as a pair of coils or separate portions so disposed and connected that during the greater part of the revolution the e. m. fs. in the two coils or the separate portions are additive, while at the time of commutation they are in opposition.

615,732. DYNAMO-ELECTRIC MACHINE; W. M. Mordey, of Loughborough, England. App. filed Feb. 15, 1897. In a dynamo-electric machine the combination of a toothed or slotted or channeled drum and a chord-winding, the angle of chord of said winding being such that at the moment of commutation one portion of the element is under the influence of one pole, while the other portion, or another portion, of the said element is under the influence of an auxiliary pole.

615,762. RAILWAY-CROSSING SIGNAL; J. D. Taylor, of Chillicothe, Ohio. App. filed Jan. 12, 1898. In a railway-crossing signal the combination with an electric circuit comprising the railway tracks, of a motor circuit, a motor in the motor circuit, a cam operated by the motor, a bell-sounding hammer operated by said cam, and another cam operated by the first-named cam for cutting the motor out of the circuit.



No. 615,731.—Dynamo-Electric Machine.

615,814. ELECTRIC FIRING DEVICE FOR ORDNANCE; A. T. Dawson and G. T. Buckham, of London, England. App. filed May 16, 1898. Electrical firing apparatus for ordnance consisting of a wire connecting a [illegible] to a spring plunger, a trigger lever having an arm adapted to form an conducting bridge to a piece of metal, a wire connecting the piece of metal to a switch on the gun cradle, this switch being provided with a spring and lever arm having a pin in the path of the breech-ring of the gun, and a wire connecting the switch to the firing-fuse, arranged and operating substantially as described.

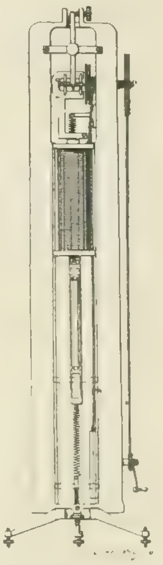
615,[illegible] VACUUM INSULATOR FOR ELECTRIC CONDUCTORS; J. A. [illegible], of New Orleans, La. App. filed Oct. 6, [illegible] An insulator for electric conductors consisting of a sleeve adapted to inclose the conductor, [illegible] and secured thereon air tight, and [illegible] be exhausted from said chamber [illegible] and form an internal resistance in the [illegible], substantially as described.

[illegible] ELECTRIC LIGHTING APPARATUS FOR RAILWAY CARS; [illegible] App. filed Feb. 7, [illegible] The combination [illegible] mounted on the car, a [illegible] a tightener pulley bearing [illegible] the tightener pulley [illegible] the tension of the [illegible]

[illegible]

[illegible] Bradley, of Avon, N. Y. [illegible]

615,953. CONTROLLING ALTERNATING-CURRENT MOTORS; C. S. Bradley, of Avon, N. Y. App. filed July 14, 1897. An alternating-current system comprising a source of alternating currents, a free-running motor generator supplied thereby, a work circuit supplied with alternating currents by the motor generator, a plurality of motors having their armatures supplied by the work circuit and their field magnets excited by a direct current, and means for varying the strength of the direct current.

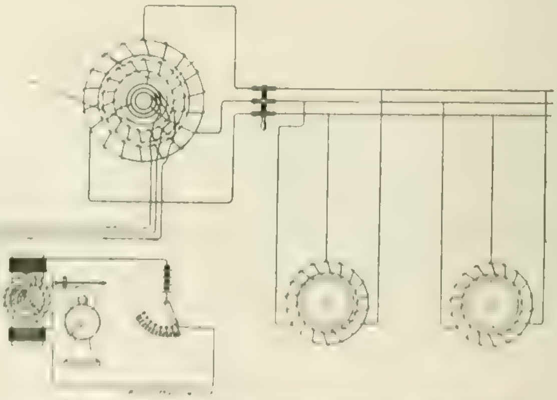


No. 615,695.—Hysteresis Meter.

615,954. HANGING PERIOD AND PHASE OF ALTERNATING CURRENTS; C. S. Bradley, of Avon, N. Y. App. filed June 22, 1896. A motor generator provided with a rotary field winding, and an armature having an adjustable condenser in its circuit.

615,966. TROLLEY REPLACER FOR ELECTRIC RAILWAYS; L. A. Cowles, of Randolph, Mass. App. filed Feb. 7, 1898. In a trolley-wheel restoring device the combination with the pole or wheel, of the forked lever having the ends and the swinging guides properly connected with the trolley pole, and adapted to be moved by the forked lever, substantially as described.

616,035. ELECTRIC MOTOR; J. L. Thoma, of Kansas City, Mo. App. filed June 20, 1898. An electric motor comprising a circular series of magnets, a commutator arranged concentrically thereof and composed of a corresponding series of insulated strips, wires connecting said series of magnets and strips, a shaft suitably journaled, an armature mounted thereon and embodying a plurality of coils, a frame also mounted upon said shaft, brushes carried by but insulated from said frame and engaging said commutator, and electrically connected to an opposite pair of the armature coils, electric conductors between said coils and the other armature coils, conductors between the latter and the armature frame, conductors connected to the frame, and conductors connected to said magnets, substantially as described.



No. 615,952.—Alternating-Current Generator.

[illegible] TELEPHONE SWITCHBOARD; T. F. Ahearn, of Detroit, Mich. App. filed May [illegible] In a divisional switchboard having an answering and a connecting division, the combination of lines ending in and permanently connected to line jacks, one in each division; local jacks corresponding to the line jacks, one in each division, said pair of local jacks being permanently electrically connected, local drop annunciators in the connecting division, one for each line, and means for energizing the [illegible] substantially as described.

[illegible] TROLLEY-WHEEL REPLACER; G. F. Mittinger, Jr., of Cleveland, Ohio. App. filed [illegible] A replacing section consisting of sheet metal [illegible] and provided with a spiral groove [illegible] the sheet metal, substantially as described.

The Electrical World.

.Vol. XXXII. NEW YORK, DECEMBER 31, 1898. No. 27.

PUBLISHED EVERY SATURDAY BY

THE W. J. JOHNSTON COMPANY,

9 Murray Street, New York.

Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York.

New England Office, 620 Atlantic Ave., Boston.
Western Office, 936 Monadnock Block, Chicago.
Philadelphia Office, 929 Chestnut Street.

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In the United States, Canada or Mexico; other foreign countries, $6.00.

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THE ELECTRICAL WORLD,

9 Murray Street, New York.

Vol. XXXII. NEW YORK, DECEMBER 31, 1898. No. 27.

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SWITCHING AND CONTROLLING APPARATUS FOR BOOSTERS.

The ordinary means of cutting out an electrical generator in case of emergency are not sufficient for the dynamo using a booster, owing to the peculiar nature of its winding and load. Especially is this the case in series-wound, motor-driven boosters, such as those described in the article on the power plant of the Capital Traction Company on other pages of this issue. Here the boosters are used to raise the voltage of the current supplied to the longest feeders, the generating end being series-wound and direct-coupled to a 600-volt motor supplied with power from the main circuit. The contingency which calls for a special protective apparatus is the opening of the motor circuit. In this case the torque generated between the armature and field of the booster generator tends to reverse the direction of rotation of the machine, and—as it is series-wound—it tends to run away as a series motor. This accident is provided against by connecting the "tell-tale" of the motor circuit breaker through a battery circuit with an electromagnetic relay, which in turn closes the circuit of an auxiliary magnet on the booster circuit breaker, tripping it and opening the booster circuit. This rather indirect method of control might be improved by using a double-pole circuit breaker instead of the single-pole breaker in the motor circuit, the added pole being connected up in the booster generator circuit. Both circuits would then be opened simultaneously.

Either method, however, involves the opening of the feeders supplied by the booster whenever the latter is thrown out of service, and if this is not immediately noticed by an attendant these feeders and corresponding line sections may be without current for some time. A better method would seem to be the provision of some arrangement for throwing the "boosted" feeders over from the booster to the main bus, so that whenever it became necessary to put the machine out of service either automatically or manually, the feeders will be immediately given a source of current which even at a lower voltage would be better than throwing them on open circuit. A simple means of accomplishing this and also of cutting the booster in and out without even an instantaneous interruption of the current supply could be obtained by short-circuiting the series field of the booster-motor instead of opening the same circuit. This would allow the current to pass idly through the booster armature without any danger of runaway, and after the machine had come to a standstill the armature could be short-circuited and the machine cut out without opening the feeder circuit at any instant. The switching over of a railway feeder without opening it is, of course, advisable wherever possible, owing to the destructive nature of the arcs at the switch blades under heavy load, and the consequent necessity of opening by means of circuit breakers instead of switches, which requires an elaborate sequence of operations difficult for the switchboard attendant to remember in times of emergency. It might be objected that the booster would give trouble with its field short-circuited, owing to the lack of a commutating field, but boosters in storage-battery service are now regularly run with differential windings, which often neutralize each other's exciting tendency, giving zero field magnetization, with no troublesome sparking, in spite of heavy currents flowing.

With engine-driven boosters there is no need of special appliances for shutting down the generator when the supply of power to the driving machine ceases. The steam can hardly be cut off from the engine except intentionally, and the reversal of the direction of rotation would instantly be noticed and remedied by a man at the throttle-valve. Engine-driven boosters are, it may be remarked here, rarely used for feeder work, owing to the peculiarly violent fluctuations of the load, which varies as the square of the current output, since the voltage generated by the machine is proportional to the current, and the watts, therefore, are proportional to the square of the current. It is hard enough to make a steam-engine governor regulate well on a load as fluctuating as that of a single section of a street railway, but when the changes of this load are squared the condition is peculiarly difficult to meet.

The other common use of boosters is for controlling storage-battery currents, and to render a storage battery suitable for over-compounded systems they are absolutely necessary, as, without them, the storage-battery load would increase with increased external load and aggravate the variations in engine and dynamo load. Boosters so used are generally differentially wound, one field winding of comparatively fine wire being connected across the mains and giving an excitation which, by means of a reversing rheostat, may be made to give a booster voltage, helping constantly either to charge or to discharge the batteries at the will of the manipulator. The other winding is of comparatively large wire and carries a current proportional to the external load of the system, being for this purpose generally introduced between the equalizer and the main bus in parallel with the series field windings of the generators. This winding is so connected up as to increase the voltage, helping to discharge the battery with increased station load, and vice versa, and may be so proportioned as to give an excitation dependent upon the load sufficient to make the battery take up all fluctuations, rendering the load on the engines and main dynamo practically constant, a condition highly conducive to steam economy. Such boosters are best motor-driven, as both field magnetization and armature current are reversed often not simultaneously, the booster proper often running as a motor instead of as a dynamo, a condition rather hard for the steam engine governor to meet.

ENGLISH VIEWS OF ELECTRICAL TRACTION.

The installation of electric street railways, or, as the English call them, electric tramways, in the cities of Great Britain is handled with a strange mingling of engineering conservatism and economic [illegible]. For a long time England held out against the overhead trolley on the score of its unsightliness, but now that a superior [illegible] has been developed in Germany and this country, the English technical press opposes it bitterly. The London "Electrical Review," in a recent discussion of the matter, claims rightly that the conduit costs at least from two to three times [illegible] [illegible] thoroughfares as Broadway, in New York, and similar lines. The [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] hibitive cost of the latter, the cable road, which is more costly in [illegible] [illegible] rarely adopted.

[illegible]

difficult for students of economics in this country to understand. This is largely due to the attitude originally assumed by English cities toward their street railways. Starting as horse-car lines, the authorities took the position that the road bed was a part of the street, and should therefore be constructed by the city, as was the rest of the street, and leased to the highest bidder. This plan proved very satisfactory with the small capital investment in equipment of tramways operated by horse-power, but when mechanical traction began to come into vogue it became apparent that the operators of the system should also own the whole of it. The English being more considerate of public as against private rights, and perceiving the dangers of abuse in long-term franchises, have in many places decided to have their tramways operated directly by the municipal authorities, although some still lease the lines to operating companies. Glasgow was the first such city, the municipal service starting in 1894, and owing to the policy of keeping down profits the fares have been reduced, the service increased and the hours of employees reduced and the wages raised. Other towns are rapidly following in the same line, among them Liverpool, Leeds, and Sheffield. Manchester will start an electrical system in full sway next spring. This policy of collectivism, or, as some would call it, socialism, appears to give good satisfaction in England, although on account of the civil service abuses in this country it is doubtful if it can be safely introduced here before many years.

ENGINE-ROOM FLOORS.

There is in this country quite a varied practice in the construction of engine-room floors. Most power-station designers prefer a concrete floor with a cement surface, supported on brick, tile or concrete arches, sprung between steel beams, as in ordinary fireproof office-building construction. Some prefer cast-iron plates and gratings, giving light and ventilation to the basement below.[1] Others use a concrete floor framed integrally with concrete beams, the whole set at one time over wooden false-work with twisted or knotted iron rods in the lower sides of the beams to take the tensile strains.[2]

In the description, on other pages, of the power plant of the Capital Traction Company it will be noticed that the engine-room floor is finished in wood. While this may appear at first sight to be a return to dangerous principles, it possesses many elements of value which engineering visitors to the station will instantly recognize. The chief reason for its use in this case was the added comfort of the attendants who are required to walk and stand upon the floor for many hours each day. The discomfort of standing on as rigid a flooring as cement is a feature not sufficiently considered in engine-room design.

A further advantage presented by the wooden floor is the improved appearance of the room, a great indirect advantage in the pride which it induces in the men in charge and the care they take with the whole of the installation. Oil and grease soak into cement flooring and leave unsightly stains that are totally absent from the polish of a nicely finished wooden floor. The danger of fire is not as great as might appear. There is in this particular example [illegible] should be in all cases, no air space below the flooring, the sleepers to which the flooring is nailed being bedded flush in concrete so that the flooring proper rests directly upon it. Fire, unless it be a very hot one, will not run on an upper exposed horizontal surface, so that, other woodwork being suppressed, this will [illegible] great danger.

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[1] [illegible]

[2] [illegible] page 7[illegible]

The Open-Conduit Electric System of the Capital Traction Company.

THE city of Washington is, on account of the great width of its streets as well as their beauty, peculiarly ill-adapted to the overhead-trolley system, and on account of the almost universal use of asphalt paving and the favorable climatic conditions peculiarly well adapted to the operation of open conduits. The lines of the Metropolitan Railroad Company have been operated in this manner for several years, and the Capital Traction Company has had in service a short line fitted with the Love conduit system. When, therefore, the great power house of the Capital Traction Company was completely destroyed by fire on the night of September 29, 1897,[1] there arose the alternative of rebuilding the cable equipment or replacing it with an electrical system. Four days after the fire the directors decided definitely to adopt the underground electric system for the Pennsylvania Avenue and Fourteenth Street lines, and a building committee was appointed to lay out the enormous amount of special work which the occasion called for, and called for in a hurry, in order to get the line in operation again as soon as possible.

THE RECONSTRUCTION OF THE TRACKS.

The track system adopted was the same as that in use by the Metropolitan Railroad Company in Washington and by the Metropolitan Street Railway Company in New York City,[2] with such changes as were necessary to adapt it to the existing cable tracks. Twenty-two miles of track (see Fig. 1) have been changed over, including the Seventh Street line, which was kept in operation by cable while the change was being made; the Love conduit system on U Street will later be rendered uniform with the rest. This renders the company's whole system electrical.

A 24-duct conduit for the electrical cables was laid midway between the two tracks, except where deflected by existing pipes and ducts, the material used being vitrified clay pipes, and wrought-iron cement-lined pipes are laid in concrete in the ordinary way. Temporary tracks were laid down for the horse cars on Pennsylvania avenue and Fourteenth Street, so that the track work could be carried on without interruption. The cable conduit—18 inches wide by 38 inches deep—was fortunately made of concrete, plaster-lined, and without any inside metal sheathing. Entrance to it was obtained by means of manholes at intervals of 31½ feet, running from the slot rail to the outer track rail, as shown at the right hand side of Fig. 3.

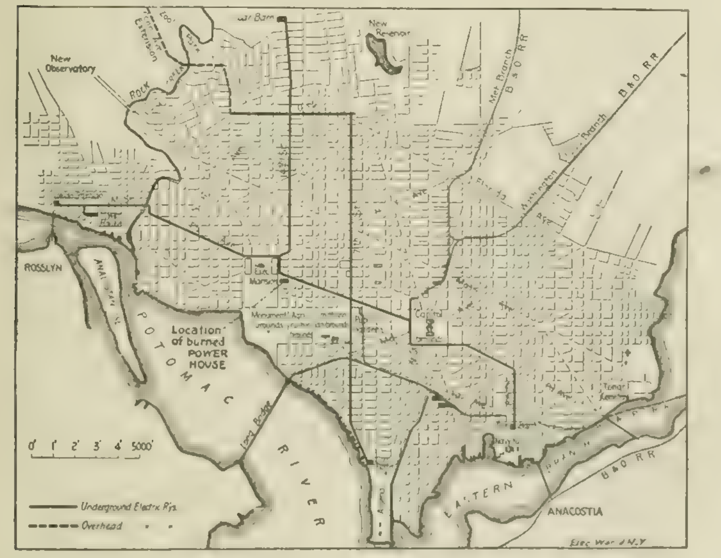

FIG. 1.—MAP OF THE CAPITAL TRACTION COMPANY'S SYSTEM.

The conductor rails for the new electrical work are of steel, T-shaped, 4 by 2 inches, weighing 23 pounds to the yard, and having the conductivity of 300,000 circular mils of copper. They were cut into 31 foot 6 inch sections to span the distance between these manholes in which the insulating supports for the outer rail were placed. To hold the other conductor rail a small handhole was put in immediately across the slot from the manhole, as shown at the left-hand side of Fig. 3. and to give an intermediate support at the middle of the rail length a pair of similar handholes was put in midway between manholes. The conductor rails were inserted through slot hatches which were placed at intervals of about 800 feet, one of which shows clearly in the foreground of Fig. 8.

The porcelain insulators are supported, as Fig. 3 shows, by cast-iron caps with ears, which are bolted to the foot flanges of the slot rails. The holes for these bolts were made by punching machines as soon as the excavations for the handholes had been made. The two holes in the web of the slot rail for the attachment of each cast-iron handhole frame were made by a specially designed drill let into the excavation and backed up against the track rail. Knock-down frames were then placed in the excavations, making an inside form for the concrete shells of the handholes, which are 5 inches in thickness, internally plastered with cement mortar.

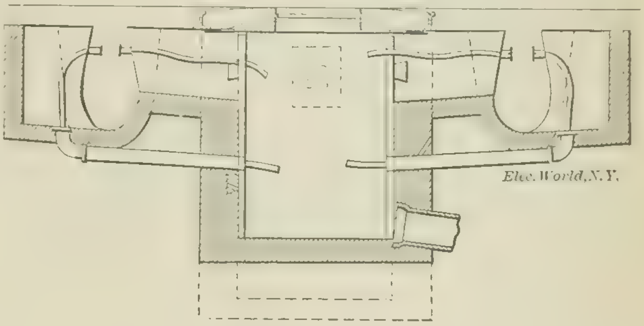

FIG. 2.—THE DRAW-IN MANHOLE, SHOWING TAPS TO CONDUCTOR RAILS AND METHOD OF DRAINING.

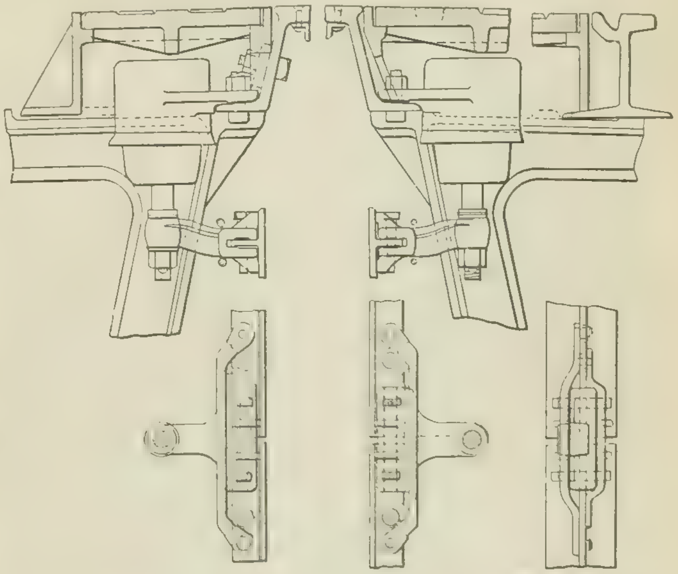

FIG. 3.—THE INSULATING SUPPORT AND BOND OF THE CONDUCTOR RAIL.

To prevent the water entering the slot from trickling down the sides and dripping over the conductor rails, which are 6 inches apart, the upper flange of the slot rails in such a road must be fitted with a downwardly projecting lip, from which all water will drip off and fall between the conductor rails to the bottom of the conduit. There was, of course, no such lip on the old cable rails, and rather than replace them, bedded as they were in good asphalt paving, it was decided to rivet steel 1 by 1 inch angle sections to them in the manner clearly shown in Fig. 3. The angles were let down through the slot and held up against the lower face of the slot-rail head by a specially designed tool, and rivet holes were drilled through both at intervals of about 4 feet. A gang of laborers at this work is shown in Fig. 9. The holes are countersunk from the top and the rivet heads finished flush with the surface.

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[1] See THE ELECTRICAL WORLD, October 9, 1897, page 417.

[2] See THE ELECTRICAL WORLD, August 28, 1897, page 239; September 18, 1897, page 328; September 10, 1898, page 258.

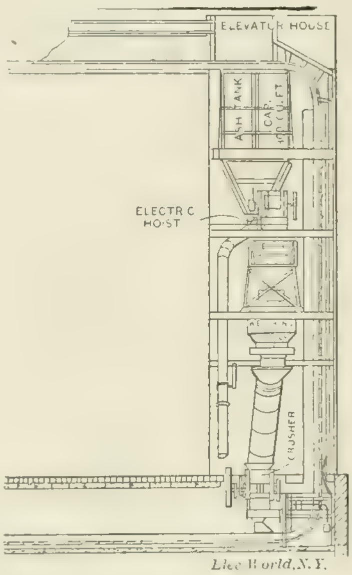


Fig. 4.—Vertical Section of the Conveyor Tower.

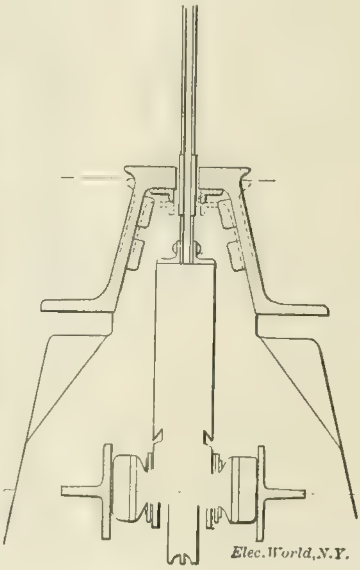


Fig. 5.—Slot Rails, Conductor Rails and Plow.

The old track-rail ends were pretty badly dropped, and it was decided to bring them up by the well-known cast-welding process. The fishplates were removed, the rail ends cleaned by hand, no power being available, for a distance of about 10 inches back from the joint, and the splice-bar bolt holes in the rails were plugged, the iron plugs projecting about an inch on each side of the web so as to become bedded firmly in the casting. Strips of iron of the rail section were driven between the abutting ends, making the joints tight. The flattened rail of each joint was shimmed up a trifle higher than the other, and the usual cast-iron mould was clamped about the hole and filled with molten iron poured from a portable furnace, as shown in Fig. 8. The heating of the steel was found to bend the ends upward to just about a true bearing, a smooth joint being assured by finishing the surface by hand filling. The joints now ride very smoothly, but few of them being perceptible.

The conversion of the Seventh Street line, which was kept in operation by cable as usual except during a few hours of each night, was still more difficult. The placing of the ducts and the cutting of [illegible], and [illegible] were done in the day time. At night the [illegible] entered the conduits and secured the [illegible] to the [illegible] of the [illegible] supports. The cast welding of the rail joints on this line was done several years ago. Drip angles were only put on the slot rails in the valleys.

After the electric roads had been in operation about six months the company decided to put down heavier and higher rails at the curves. Excavations were made between the yokes at all the curves in which cast-iron chairs, weighing about 100 pounds each, were set with concrete packed around them. This work was done in the daytime, and at night after traffic was suspended the old rails were taken up, the rail seats on the yokes broken off, and the new rails put down and secured to the rail chairs. Courses of scoria block are laid on each side of the rails at the curves, the crevices between the bricks being filled with asphaltum.

As a ground return is not used, both the positive and negative feeders are insulated. There are thus twenty lead-covered cables for the ten feeders, each with a cross-section of copper of 1,000,000 circular mils, insulated by saturated paper three-sixteenths of an inch in thickness, and protected by a one-eighth inch lead sheath. They are drawn in through manholes running across the two tracks, spaced at intervals of about 400 feet, one of which is shown in Fig. 2. The knock-down frame for the construction of the concrete walls of one of these manholes is shown in Fig. 11. At points determined by traffic conditions the feeders are tapped in the manholes with two branches from the one splice, as shown in Fig. 14, to the conductor rails, to which they are attached by clamps, one of which is shown in Fig. 16. Those going to the outboard rails pass down through a duct from the handholes to the manhole, as is clearly shown in Fig. 2. One pair of cables is held in reserve as an emergency feeder, being provided with blind taps ready to be cut in at any point from Georgetown to Seventh Street at any time it may be needed. In all there are about 66 miles of cable in place.

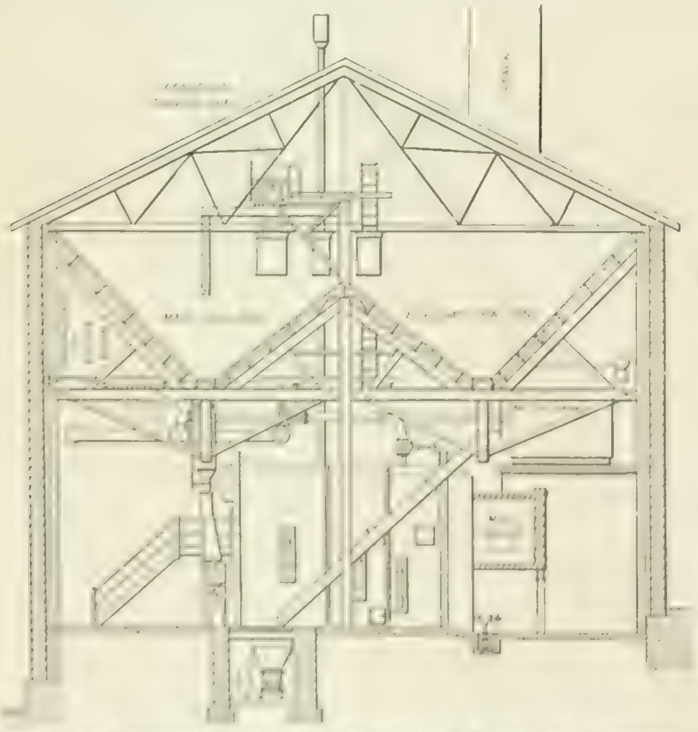


Fig. 6.—A Vertical Section of the Boiler Room and Overhead Coal Bunkers.

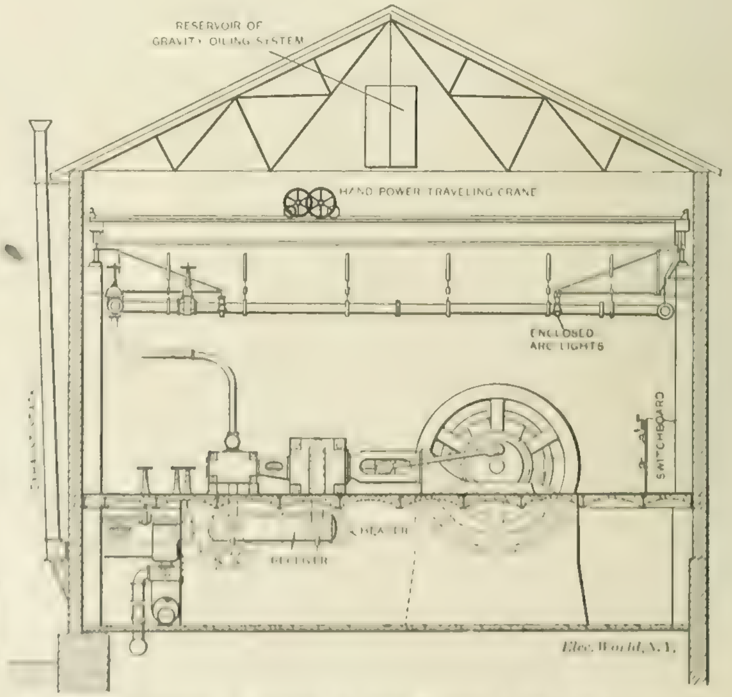

RESERVOIR OF GRAVITY OILING SYSTEM
HAND POWER TRAVELING CRANE
ENCLOSED ARC LIGHTS
SWITCHBOARD
HEATER
Elec.World,N.Y.

Fig. 7.—A Vertical Section of the Engine Room and Condenser Basement.

THE POWER HOUSE.

The work on the new power house was necessarily very much rushed. There was no year or two for the engineers in charge to look into the relative merits of alternative plans, and they were further hampered by the necessity of using a building which formerly did duty as a feed mill and storage warehouse in the old horse-car times. The work had to be carried on almost while the drawings were being made; nevertheless the plant evidences a surprising amount of ingenious design to overcome the difficulties involved, as will be seen by a study of the description given below. The work was begun about December 1, 1897, and power was on early in April, 1898. The old material was used to a certain extent, the good bricks of the partition walls which had to be taken down, being used in the engine foundations, the new crane runways being made of the I-beams of the old floors, etc.

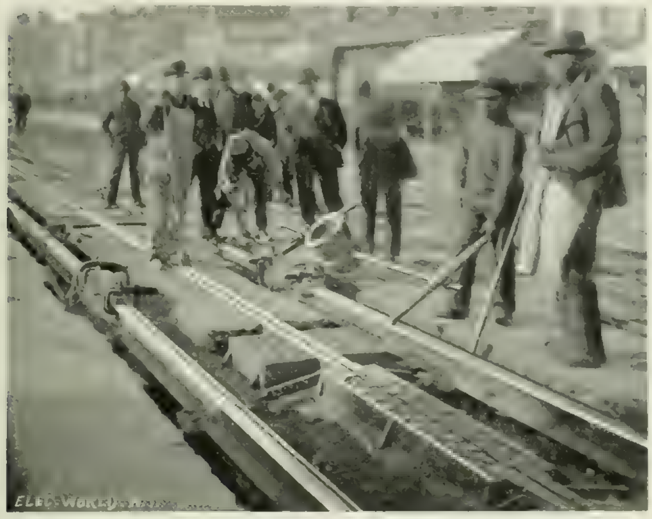


Fig. 8.—Cast Welding the Old Rail Joints.

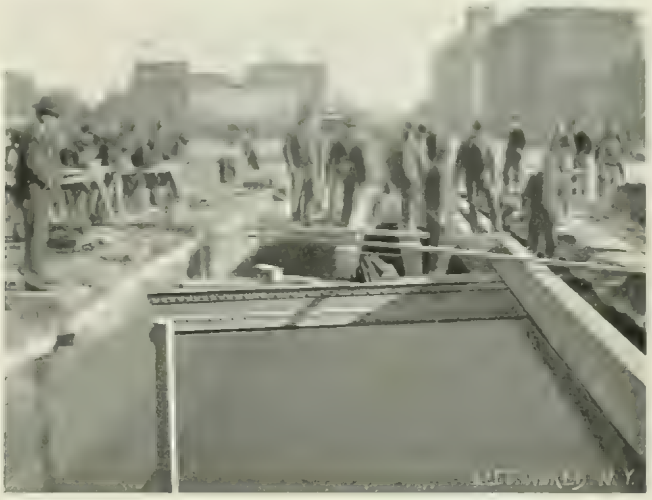


Fig. 10. Bridging an Old Cable Vault.

The building, a view of which appears in Fig. 12, is located on the edge of the Chesapeake & Ohio Canal, in Georgetown, with Grace Street on the opposite side, between Thirty-second and Thirty-third Streets. It is a long, narrow structure, which did not admit of the standard practice of placing the boilers in a row along one side of a division wall and the engines nearly in a parallel row along the other side. This building required a division midway of its long dimension, one half being the boiler and the other half the engine room. Fortunately, solid rock was but 2 or 3 feet below the basement floor, so that all foundations, even to those of the auxiliary pumps, are carried clear to rock. The old walls, 18 inches in thickness, are reinforced by pilasters, bonded in and tied to them with anchor rods, the pilasters in the engine room carrying the crane runways. The old wooden roof, covered with slate and supported on combination trusses, has been retained.

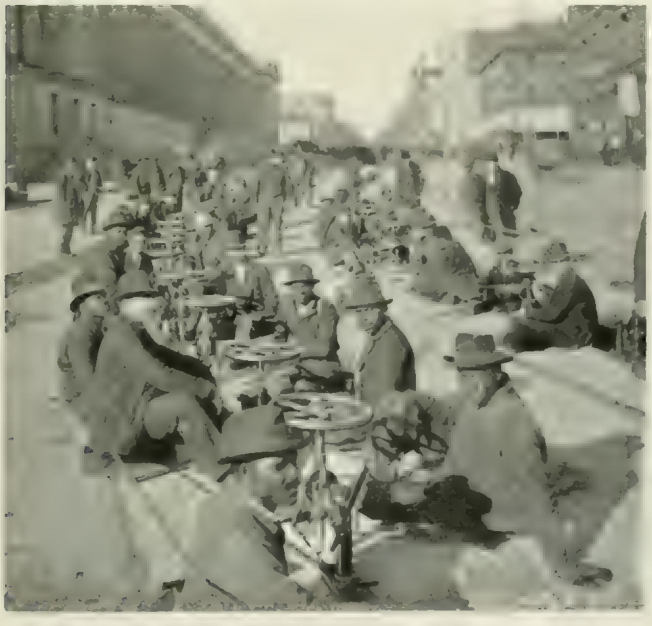


Fig. 9.—Drilling the Steel Rail for the Deep Angle Lips

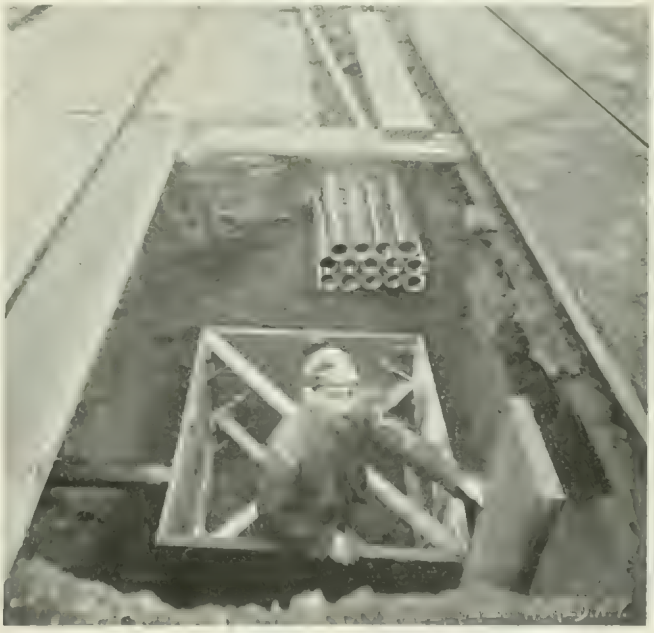


Fig. 11.—The Knock-Down Frame of a Draw-in Manhole

THE COAL-CONVEYING APPARATUS.

One of the most interesting parts of the equipment is the coal-conveying apparatus. "Run-of-mine" bituminous coal is brought directly to the plant on canal boats, holding about 120 tons each. Standing apart from the main building, toward the west, is the coal-unloading tower of steel-frame construction, covered with corrugated-iron sheathing. (See Fig. 4.) This tower, which shows clearly in Fig. 12, has a boom projecting over the canal, by which tubs holding 1,000 pounds each take the coal up from the canal boats and dump it into a receiving hopper, which, in turn, dumps it into the weighing hopper, Fig. 17, from which it passes down into the crushing equipment shown in Fig. 18. The bucket hoist and crusher are both driven by one 30-horse-power 500-volt motor.

From the crusher the coal is dropped into the buckets of a pan and bucket conveyor. Owing to the novelty and ingenuity of this machine, an extended description may be of interest. The conveyor consists essentially of two ⅝-inch steel cables, to which are clamped, at intervals of a foot, attachments carrying axles, the wheels of which are lubricated with graphite and run on 20-pound steel rails with a 2-foot gauge, each axle carrying a pan and pivoted to it a bucket. An idea of the general arrangement can be obtained by the view shown in Fig. 13, which shows the driving mechanism.

This is on the upper horizontal run, the cables in this case being on top of the conveyor, the interlapping pans below fitting closely into each other, the buckets hanging downwardly from them. On the under horizontal run, which is in the ash tunnel below the boilers, the cables (see Fig. 19) are underneath the conveyor, the pans forming over them a continuous trough into which material may be discharged from the hoppers regardless of the position of the buckets, and which protect the cables (the essential driving element) from the material handled. As the conveyor turns up in the vertical run the material is slipped out of the pans into the buckets, which in this position fall against the pans, and when the conveyor turns over from the vertical into the upper horizontal run, the pans swing free with their loads. The driving mechanism, as is shown in the illustration (Fig. 13), consists of a 15-horse-power motor geared down through triple reduction gears to the heavy sprocket wheel, under which run the cables, the clamps on which fit into pockets in the wheel rim, the teeth adjacent to these pockets insuring an absolute drive. The conveyor dumps the coal into W-shaped bins over the boiler room, clearly shown in Fig. 6.

The construction of these bins is most ingenious. They are supported on bar trusses worked in between the steam pipes, resting on columns at the side walls and a row of columns down the centre of the fire room. The bin walls consist of arches sprung between I-beams very much after the fashion of fire-proof floors. The arches are of concrete formed with a flat interior surface on corrugated iron arch plates with a minimum thickness of concrete at the crown of the arch of about 3 inches. This gives a simple construction with a very low depreciation and keeps any corrosive material in the coal from the ironwork. One-half of the W-shaped bins, known as the main bin, is immediately over the fire-room, and from it the coal descends into volume-measuring chutes of 1,000 pounds capacity, which in turn empty through spreaders into the hoppers of the Roney mechanical stokers, with which the boilers are fitted.

These spreaders are shown clearly in Fig. 20, where they are shown swung back from the hoppers. The other half of the W-shaped coal bins, which together hold 3,000 tons, is filled by overflow from the first half and is held as an auxiliary or reserve supply to tide the station over the period when the canal is frozen over. The coal does not chute directly from the auxiliary bin into the stokers, but can be delivered through chutes running down, as shown in Fig. 6, to the conveyor in the ash tunnel, which will raise it up again and deliver it into the forward or main bin. Each boiler is fitted with a 100-cubic foot ash hopper in the tunnel through which the conveyor returns, shown in Fig. 19, from which the ashes are elevated by the conveyor into an 800-cubic foot tank in the elevating tower, from which they may be delivered either to canal boats on one side or wagons on the other.

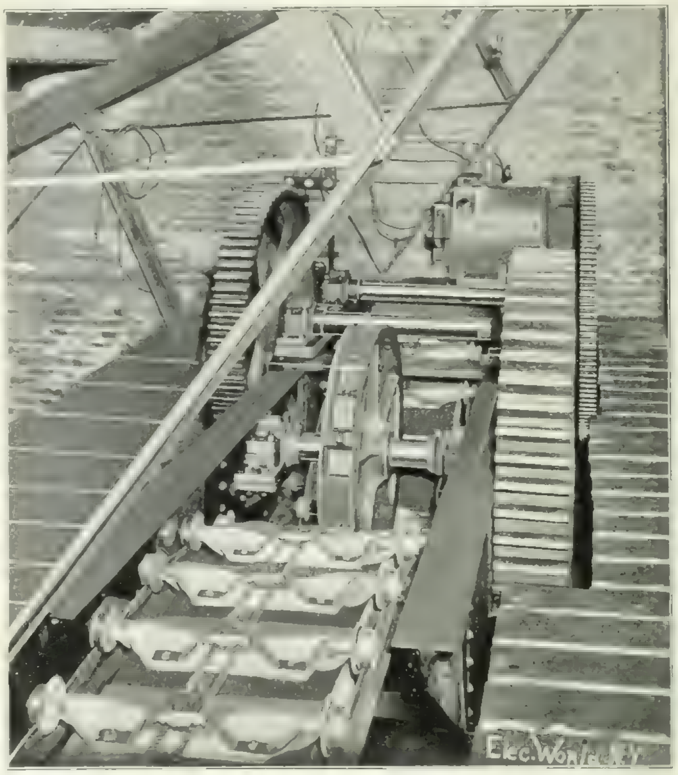


Fig. 13.—The Conveyor Driving Equipment.

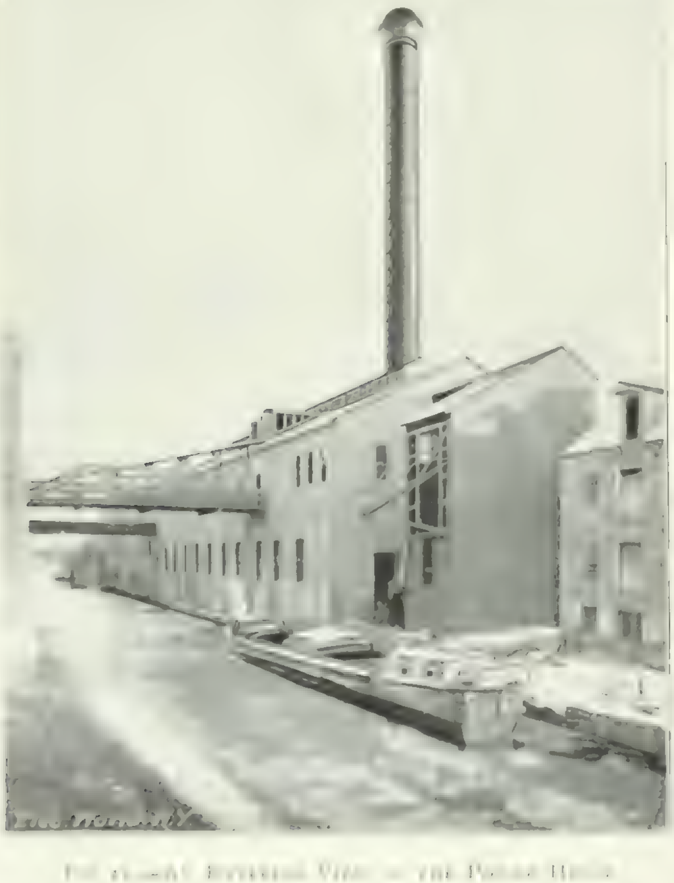


Fig. 12.—An Exterior View of the Power House.

THE BOILERS, FLUES AND STACK.

There are four batteries of boilers in place, laid out as shown on page 720, one battery on the west of the stack and three to the east of it. The space in front of the stack is occupied by filters and the space to the west of the boiler room is reserved for another battery in case increased boiler power is wanted. Each battery consists of two Cahall B. & W.-type boilers, each boiler being nominally of 350 horse-power on the centennial rating. The boilers are fitted with the latest type of Roney mechanical stokers, the detail construction of which is shown in Fig 21, driven by three small Westinghouse engines worm geared to the shafts running across the front of the batteries. In the bottom of the hopper of the conveyor there is located a sliding pusher, to which a reciprocating motion is given by a link driven by the main shaft, the stroke of this motion being limited by a feed wheel. An arm driven by the same link moves the connecting rod, which tilts the grate-bars alternately between a horizontal position and an inclined position, tending to shift the coal gradually down toward the dumping grate. The extent of this motion may be also controlled by a simple adjustment of the nuts on the connecting rod. The steam drums—the boilers being bricked in—are protected against radiation by 1½ inches of magnesia covering under the brickwork. Thorough ventilation of the boiler room is obtained through the center passage under the W-shaped bins, which discharges its heated air through a slatted monitor in the roof.

The construction of the back flues is rather interesting, the rear wall being of brick 12 inches in thickness, the top and bottom are of brick, laid between the upturned flanges of inverted T-shaped beams made of cast iron to withstand the considerable heat.

The flues enter the octagonal brickwork base of the stack, a baffle plate preventing their mutual interference, with a pair of twin dampers provided in each and controlled by Locke damper regulators. The stack foundation is carried down to rock, the stack itself being of steel plate 150 feet in height, with a uniform diameter of 9 feet inside the brick lining. This brick lining is 4½ inches thick

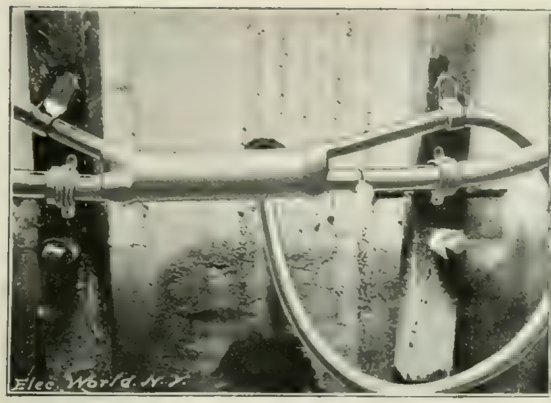


Fig. 14.—The Splice of the Branches to the Feed Cables.

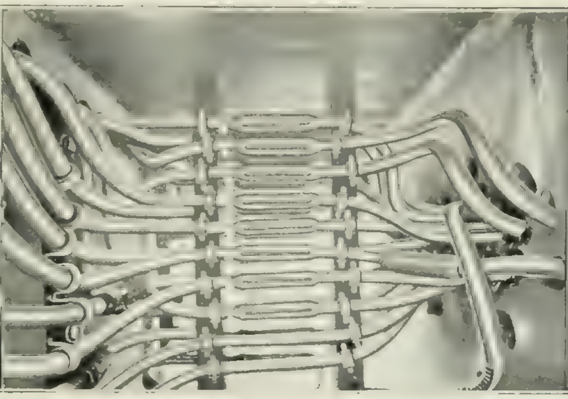


Fig. 15.—The Feeder Splices.

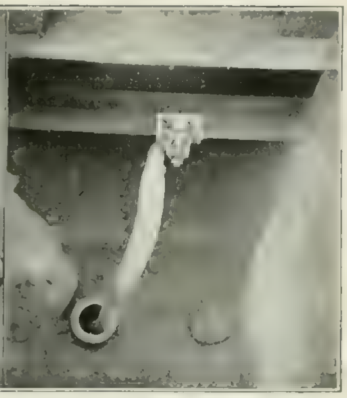


Fig. 16.—The Connection of the Feeder to the Conductor Rail.

at the top of the stack, and increases in thickness as the stack tapers outwardly toward its base. The height of stack over all from boiler room floor is about 175 feet.

STEAM AND WATER PIPING.

The piping system of this station has been the subject of unusual study, and is worked out in a very complete manner. Water for boiler feed and condensing purposes is taken from the canal through a 24-inch intake below the ice level, through two screens of half-inch mesh into a concrete settling tank or basin in the engine-room basement. From this five 8-inch pipes with foot valves and strainers rise and run to the five independent jet condensers of the five main units. In this way the condensers cannot interfere with or rob each other, and the choking of any one pipe does not shut down the whole plant. The exhaust of each engine passes first through a Hartford feed water heater and thence through its own jet condenser and its own independent 14-inch exhaust stack of spiral-riveted pipe. Three valve standards on the floor above at the head of each engine control respectively the valves of the steam supply, water supply and exhaust-steam supply of each condenser pump. An automatic atmospheric valve in the pipe running to each exhaust stack is fitted so that when it opens its valve stem projects upward above the floor of the engine room and stays there until forcibly pushed down by the engineer. The arrangement of these details will be more clearly understood by reference to the drawing on page 721.

The feed water is handled by three pumps in one end of the boiler room, one of which, the tank pump, is arranged to lift the water from the well above mentioned to a 4,000-gallon tank over the toilet room to the rear of the boilers. A Mason gravity pump governor controls this pump. The tank may also be supplied from the city mains through a meter at times when the canal is emptied for repairs, and an automatic float valve is installed for control under these circumstances. From the tank the water normally passes to two Loomis-Manning filters, and thence through one of two direct-acting duplex feed pumps, which in turn deliver it through any one or more of the primary heaters attached to the engines and then through the supplementary heater in the boiler room, thence to the feed line and to the boilers. The supplementary heater takes the exhaust of all the auxiliary engines. The whole feed water system is most thoroughly bypassed, as any one or all of the primary heaters or the supplementary heater or the tank or the filters may be cut out, the feed pumps may be used to supply the tank or the boilers direct from the well, the auxiliary exhausts may be bypassed around the supplementary heater, or the condenser pump exhausts may be turned into their own vacuum chambers. Finally, two injectors are installed connected with an entirely independent feed line running along the rear of the boiler steam drums.

The main steam pipe is run on the loop system and is all of extra heavy piping designed for 200 pounds steam pressure, although the pressure at present carried is 140 pounds. The main header is run along one side of the boiler room and continued along the same side of the engine room, and into it all the boilers feed and from it all the engines take steam. This header is 12 inches in diameter, its terminals being connected around to the opposite side of the building, as is clearly shown on pages 720 and 721, to a 10-inch auxiliary main. These two mains are cross-connected near the division wall by an 8-inch equalizing main, giving a sort of figure-8 arrangement. Over the boilers the main header is supported on gas-pipe stands with ball and socket bases to allow for expansion, and at other points it is hung by adjustable rods from brackets and stayed against vibration by sliding attachments to the pilasters. Both the main header and the auxiliary

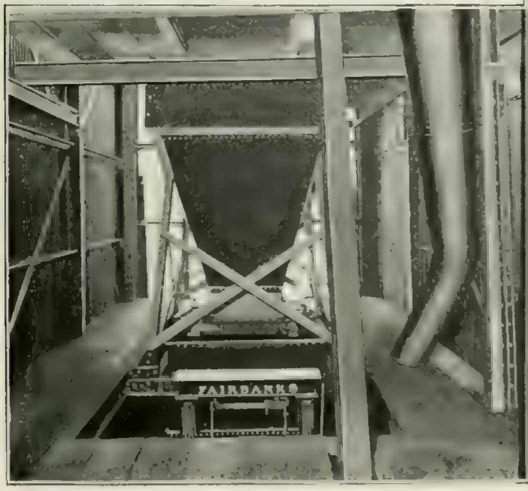


Fig. 17. The Coal Weighing Hopper.

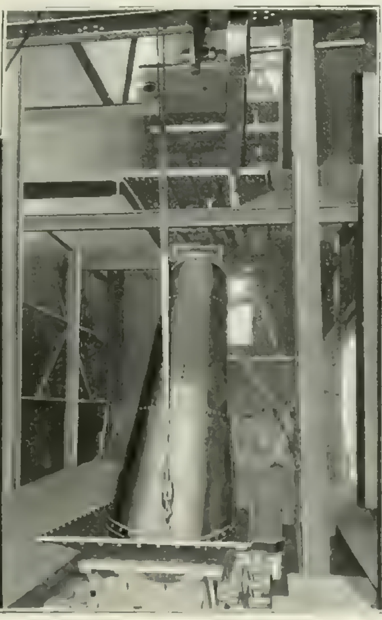


Fig. 18.—The Coal Crushing Equipment.

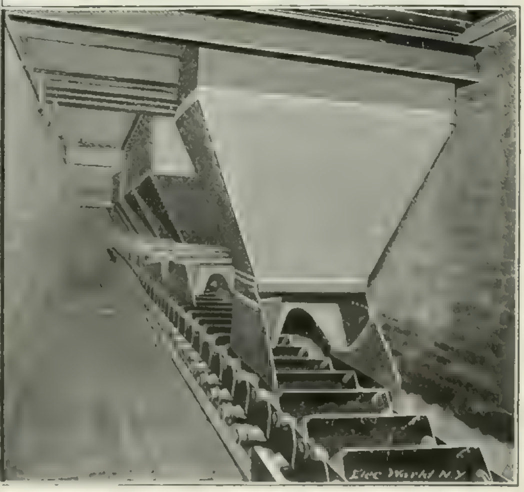


Fig. 19.—The Ash Hoppers in the Tunnel.

main are anchored where they pass through the wall between the engine and the boiler rooms, and the expansion—which amounts to a movement of about 3 inches at the extreme ends—is taken up without slip joints or copper bends. This is done by giving each boiler and engine branch a horizontal run with a vertical turn at each end, so joined that the flanges give the proper flexibility. There is a gate valve in the main header between each battery of boilers and between each engine, so that any part of the main can be cut out without shutting down more than one battery or one engine at a time. The cross or equalizing main allows the steam to be fed via any one of several routes, thus giving a surety of operation even with simultaneous accidents to more than one part of the system. Steam for all auxiliaries is taken off from the middle of the equalizing main, which it can reach by either the main header or the auxiliary main. The steam is dried by two separators, one in each of the two steam mains near the points where they pass through the boiler room wall, the entrainment from these separators being returned to the boilers by gravity through the blow-off connections. There are no separators near the engines, and the tees for the engine branches open downward, but there is absolutely no water knocking in the cylinders. The main header has no slope one way or the other, but the auxiliary main slopes from both ends toward the separators. This freedom from water is obtained by means of the two separators above mentioned and by [illegible] of the engine branches [illegible] [illegible] pressure [illegible]. All the [illegible] with [illegible] joints are kept [illegible] tight, there being not the slightest visible leak or audible hiss in the whole station.

The oiling system shows also the results of original study. The bearings and slides are oiled by the usual gravity system with a 12-barrel tank up in the roof trusses, shown in Fig. 22, with sight-feed oil cups; a set of auxiliary glass cups are also kept in reserve. The drips pass through two oil filters, in series and thence to a tank in the basement, from which the oil is lifted to the overhead tank from time to time by a steam pump. Oil from the guide drips is separately piped down through a separator, from which it is

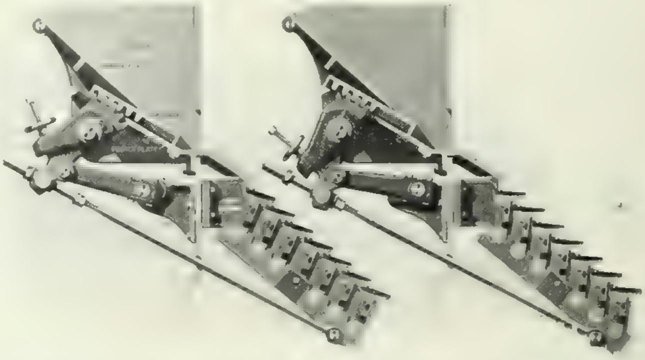


Fig. 21.—Details of Feed and Grate Movement of Mechanical Stoker, with Grate Bars in Inclined and Horizontal Position.

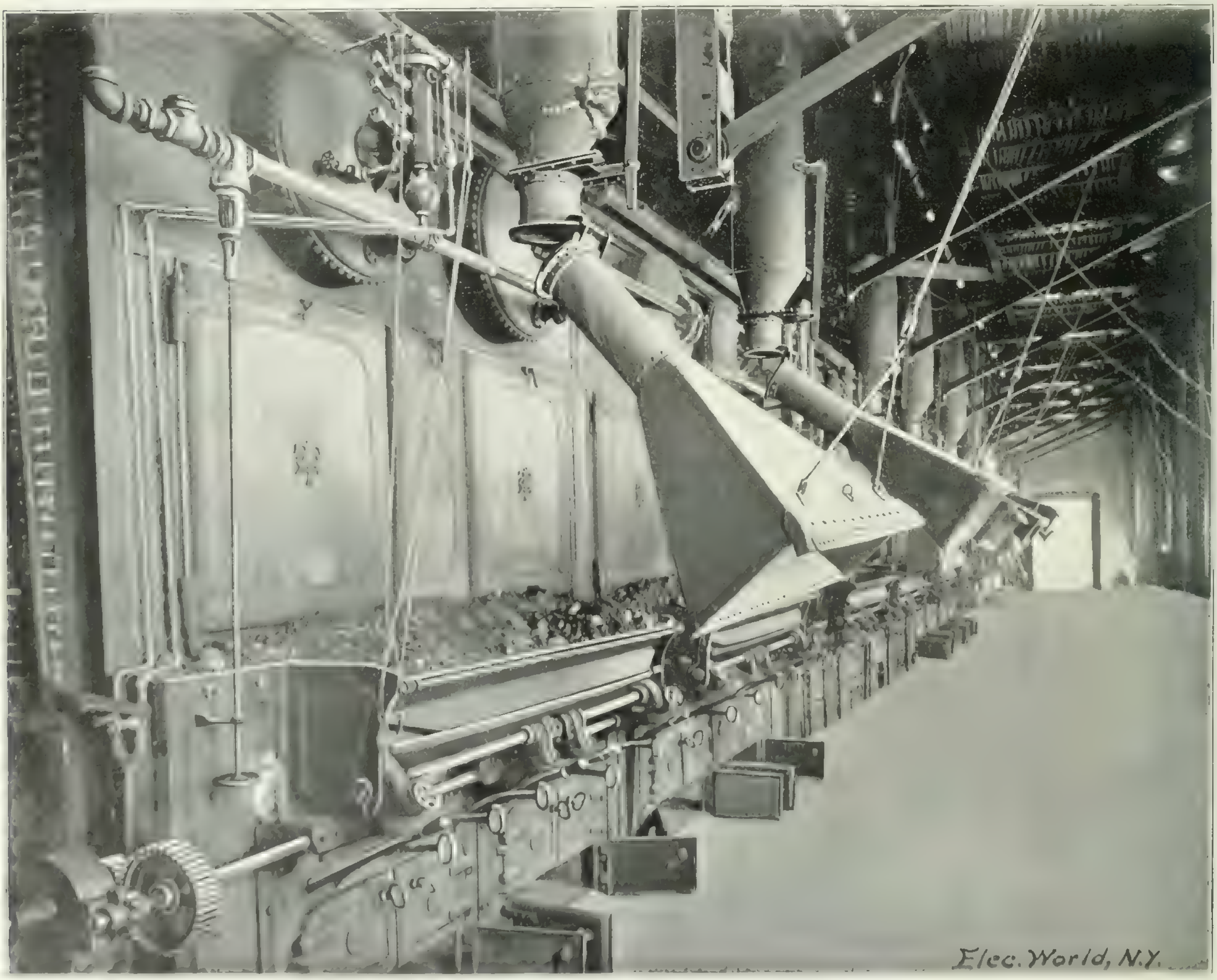


Fig. [illegible].—The Interior of the Boiler Room.

drawn to the filters. The cylinder oil is fed under steam pressure by a very ingenious system. A tank holding about one barrel of oil is placed in the basement and piped to the steam header above, the pipe naturally filling with water, which flows into the bottom of the tank and forces the oil floating upon it upward. This is piped to sight-feeders on the engine steam pipes. Two such cylinder-oiling systems, one supplying high-grade oil to the main engines and the other an inferior grade to the cylinders of the auxiliaries, are in use, and a third one is in the boiler room to feed to the pumps and stoker engines. An air compressor of the regular locomotive type is also in service to give compressed air for cleaning the dynamos and switchboard. A constant pressure for this purpose of any desired value is assured by a reducing valve in the steam supply.

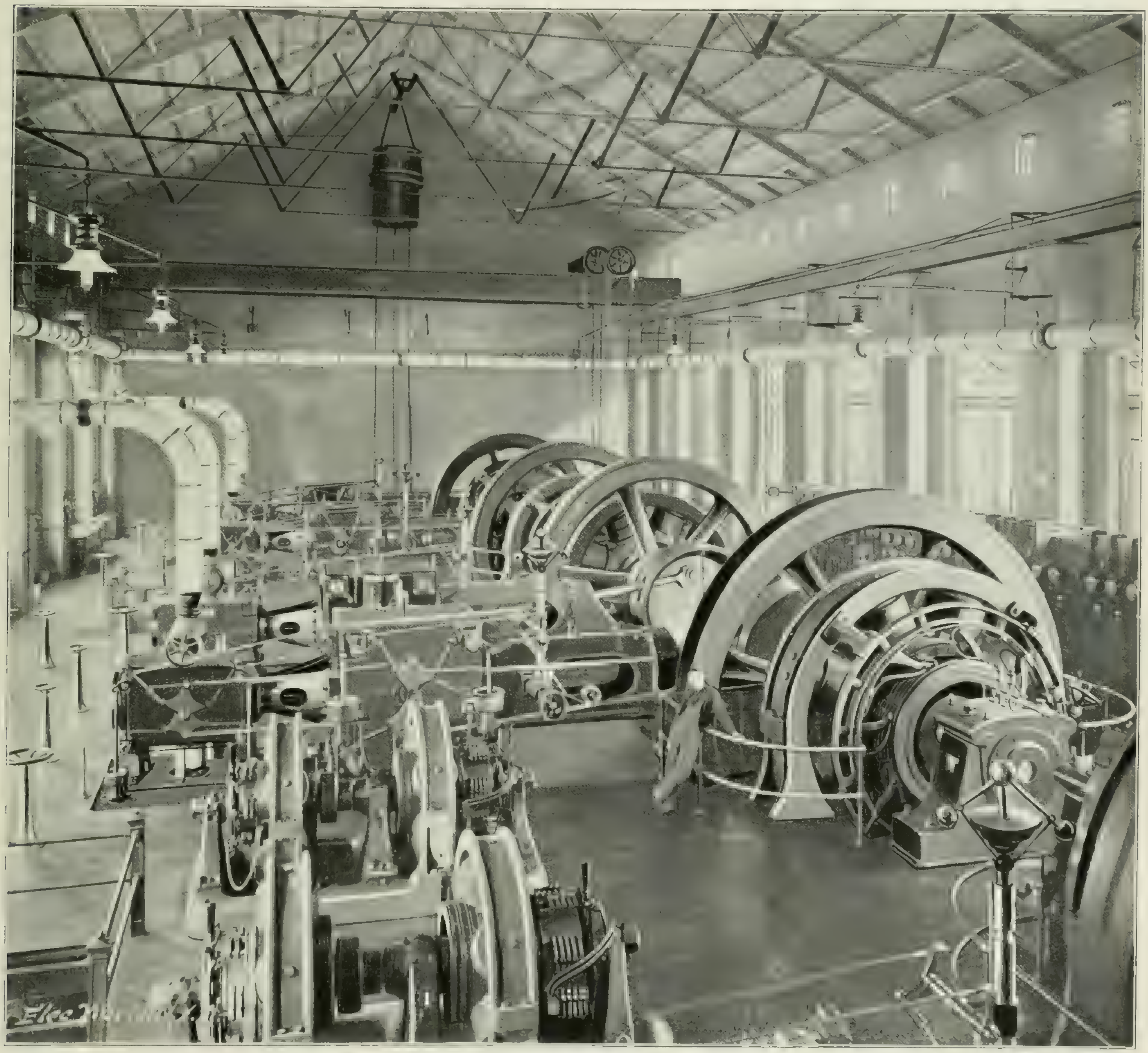


Fig. 22.—The Main Engine Room.

THE ENGINE ROOM.

The main engine room, shown in Fig. 22, is noticeable for the ample provision of light, owing to the fact that both the long sides are outside walls and well provided with windows. The floor is supported on steel I-beams with concrete arches built on corrugated-iron forms and covered with narrow edge-grain yellow-pine flooring fastened to sleepers bedded in the concrete. A 15-ton hand crane spans the room. The arrangements for lighting at night are unusually complete and ingenious. Ten enclosed arc lights are supported from the craneways on hinged gas-pipe brackets, so that they may be swung in to clear the crane grab or to trim the lamps. These arcs, beside a large number of incandescents and the lighting service of the adjacent shops and the Union Passenger Station nearby, are supplied by a direct-coupled 50-kw 125-volt set, so that light may be had when the railway plant is shut down at night without running one of the large generators. To provide for derangements of this lighting set the incandescent lights are divided, part of them being on series circuits fed from the railway bus-bars and part on the 125-volt lines. All the interior wiring of the lighting circuits is run through loricated steel tubing.

There are five main Allis-Corliss tandem-compound 800-horsepower engines, with the standard and well-known features of this design, the 1890 frame, two wrist plates on each cylinder, raised dash pots on the low-pressure valves, etc. Four of these are arranged in right and left hand pairs on two heavy brick foundations carried down to rock and capped with cast-iron oil pans. Each engine is coupled to a standard 600-volt generator and fitted with a 16-foot 25-ton cast-iron flywheel. Between these engines there are to be three motor-driven boosters, two of which are now installed, each with a capacity of 550 amperes and 180 volts, with a straight characteristic up to 100 volts when running at 600 r. p. m. These are 100-kw 6-pole three-bearing machines with a coupling fitted snugly under the overhanging barrel winding at the motor end. The dynamo ends are series wound.

The switchboard (see Fig. 23) is of standard General Electric construction with a few peculiarities. The five panels at the left-hand end are standard 1,000-ampere generator panels, with current indicators; the next panel contains two totalizing output instruments, one an 8,000-ammeter and the other a 5,000-ampere integrating wattmeter, and beyond these come the feeder panels, of which two are required for each feeder, one positive and one negative with throw-over switches, by which the polarity of the sections fed may be reversed when desired. This is to provide against a ground on the west rail of one section, for example, and the east rail of another, short-circuiting the buses. By reversing the polarity of either one of the two feeders, the two grounds can be brought on one side of the system and the same can be done with any number of grounds provided no two of them are on opposite sides of seen that any switch thrown up cuts the rheostat in to the corresponding motor and absolutely cuts it out from any of the others. Another interesting detail is the protective device designed to cut the series-wound booster generator out when for any reason the circuit breaker of the motor opens, under which circumstance the generator would tend to run away as a series motor. The circuit breaker of the booster motor is provided with the ordinary tell-tale connected into a battery circuit, which in turn energizes the magnet of a specially designed relay, shown in Fig. 26. This relay, when its magnet is energized, closes the circuit of a fine-wire winding on the booster-generator circuit breaker, which operates the trigger to open the breaker, and immediately thereafter opens the circuit of this same fine-wire winding and also opens the battery circuit to prevent waste of battery power. This does not connect the boosted feeders over onto the bus bars, but leaves them on open

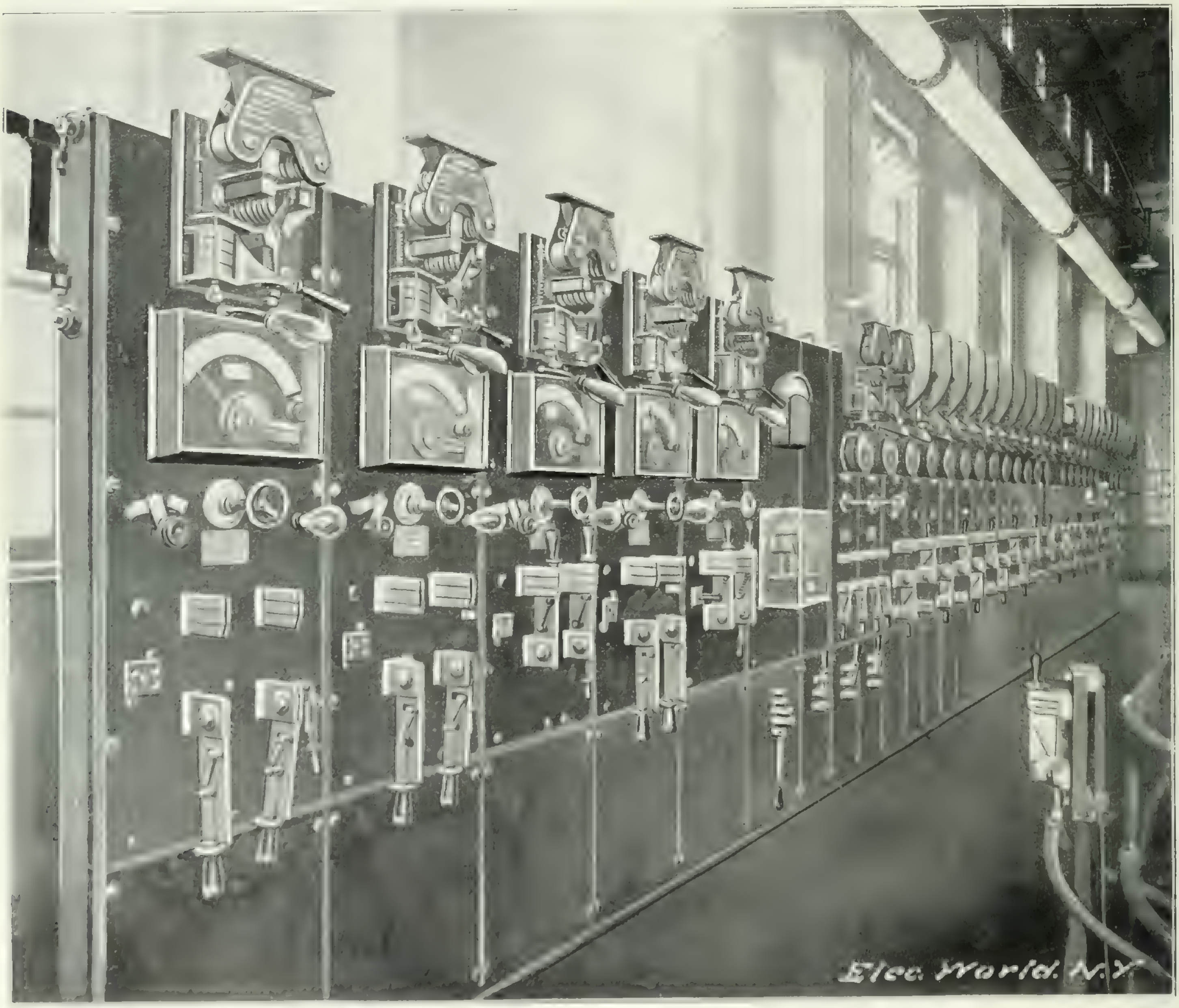


Fig. 23.—The Front of the Switchboard.

[illegible] [illegible] [illegible] the [illegible] difference between adjacent feeder panels, the circuit breakers at the tops are separated [illegible] barriers.

The controlling arrangements of the boosters are novel and very interesting. But one motor starting rheostat is used for all the machines, and this is of the single switch type illustrated in Fig. [illegible], the different [illegible] [illegible] [illegible] [illegible] [illegible] in different positions cutting out the different sections. This is connected in to the line feeding the various motors through a number of double-pole double throw switches, one for each motor, connected up as shown in the diagram, Fig. 24. Tracing out the lines, it will be

circuit. There are two long feeders for which the boosters are intended, the board being so arranged that each of the two feeders may be thrown in series with its own booster, the third booster being arranged to be thrown on either of the two feeders, or either feeder may be thrown directly to the 600-volt bus. At the right hand end of the board the next to the last panel is fitted with a water rheostat which may be connected between either bus and ground, its purpose being to burn out grounds on the line by a current which may be thrown on through and adjusted by means of the water rheostat. The last panel controls the auxiliary motors and 600-volt lighting lines.

THE ROLLING STOCK.

About sixty motor cars are run, and both trucks and bodies are new. Short cars with bodies only 18 feet long are used, and run with trailers. The plow, an idea of which can be obtained from Figs. 5 and 27, consists of the usual steel plate enclosing copper straps and running down through the ¾-inch slot with an enlarged wooden section carrying on outward-bearing springs the cast-iron shoes. The shoes are beveled at the ends to prevent their catching on the joints in conductor bars and on parts of the switch gear. The plow-hanger in the truck is ingeniously arranged so that in case of derailment or a misplaced switch the plow will fall off after traveling part way across to the side frames of the truck, and drop into the conduit sufficiently to clear the motors. This prevents, in case of such an accident, the plow from becoming wedged and twisted in the slot, which requires its cutting out by cold chisels and the shutting down of the line for some time.

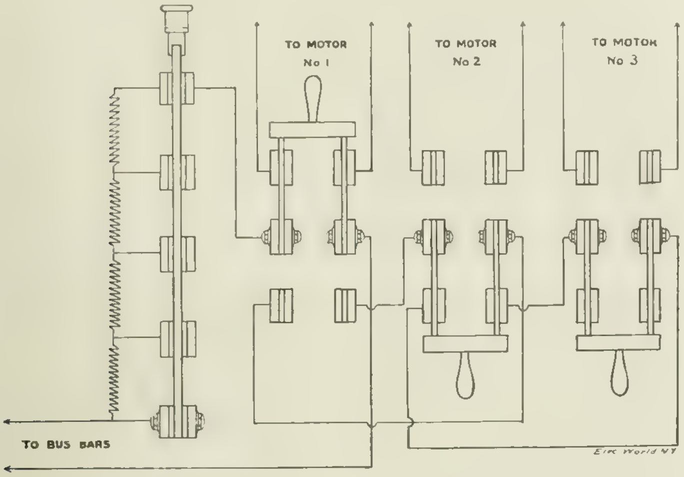


Fig. 24.—The Starting Rheostat Connections.

THE PERSONNEL.

Those in charge of the work and to whom credit is due for many of the ingenious improvements and modifications designed for the special problems involved are as follows: The work was in general charge of Mr. D. S. Carll, chief engineer and superintendent of the company, who was assisted by W. B. Upton, the principal assistant engineer; the special tools for track work were designed by Mr. H. P. Clarke, master mechanic, and M. E. Safton, the contractor. Mr. J. H. Hanna, assistant superintendent, has charge of the electrical work, and Mr. Carroll Hoshall is the chief engineer of the power station. The consulting electrical engineer was Dr. Louis Duncan.

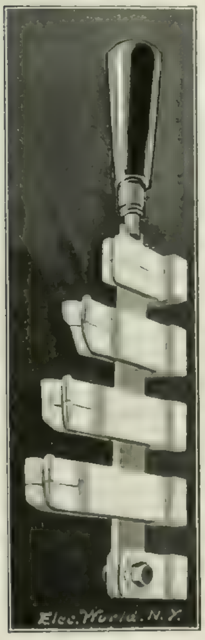


Fig. 25.—The Booster Starting Rheostat.

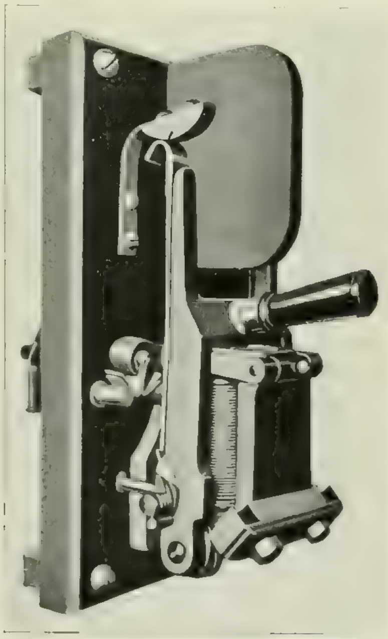


Fig. 26.—The Booster Cut-out Relay.

The Building Committee having in charge the reconstruction of the road consisted of Mr. George T. Dunlop, president of the Capital Traction Company; Mr. Henry Hart and Mr. Samuel F. Phillips.

The concerns supplying various parts of the equipment and contracting for stated portions of the work were as follows:

Street and track work, E. Saxton.

Iron work for power house, Structural Iron Company.

Boilers, The Aultman & Taylor Machinery Company.

Stack, The Campbell & Zell Company.

Water filters, The Loomis-Manning Filter Company.

Pumps and condensers, The Deane Steam Pump Company.

All valves, The Chapman Valve Manufacturing Company.

Steam piping, Thos. C. Basshor & Co.

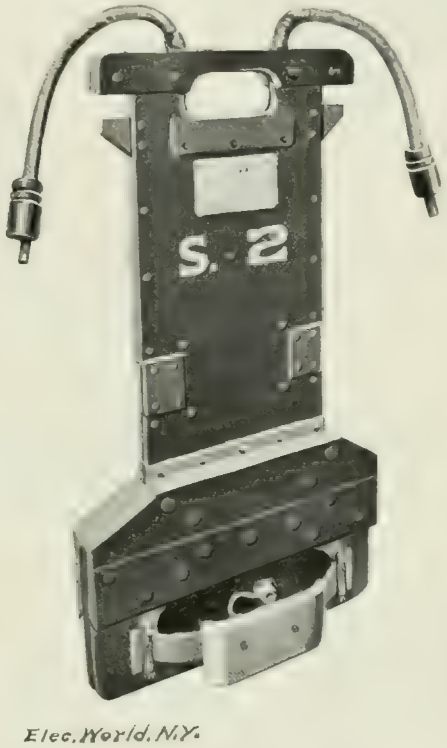


Fig. 27.—A View of the Plow.

Covering, The Keasbey and Matteson Company.

Stokers, Westinghouse, Church, Kerr & Co.

Coal conveyor, The Steel Cable Engineering Company.

Engines, The E. P. Allis Company.

Dynamos, switchboard, boosters, car motors and controllers, enclosed arcs, General Electric Company.

Auxiliary motors, The Westinghouse Electric & Manufacturing Company.

Trucks, The Baltimore Car Wheel Company.

Car bodies, The American Car Company.

Vitrified clay pipe, The H. P. Camp Company and the Potomac Terra Cotta Company.

Wrought-iron cement-lined pipe, The National Conduit & Cable Company.

Heaters, I. B. Davis & Son.

Underground feeder cables, The John A. Roebling's Sons Company.

Cast welding of the joints, The Falk Manufacturing Company

Another Electrical Conduit System in Washington.

Another cable road in Washington will be transformed into an open conduit system. The Columbia Railway of that city, notwithstanding the fact that it has a modern cable plant in perfect running order, will follow the example of the Capital Traction Company, described above, and install electrical conductors in its cable conduits.

Electric Street Railroads in Cairo, Egypt.

FORTY centuries, declared Bonaparte in 1798, looked down from the pyramids upon the victorious armies of the French Republic in Egypt. Forty centuries and one now look down from them upon an innovation in the very home of orientalism, of greater inportance to the Egyptian people than even the great French incursion—an innovation which transplants into that old-world country one of the civilizing influences of the very youngest nation—the American trolley car. The cars themselves, as well as certain other portions of the equipment, may not have been built here, but the system is American, and Sprague, Vandepoele and Edison have as much contributed to the wholesale toting of Arabs in Cairo, as to the transportation of the intellectual Bostonians in the "Hub."

In December, 1894, a Belgian syndicate secured from the Egyptian Government a concession for the equipment of the streets of Cairo with electric traction, and a company was formed for the purpose of constructing the road. None of the shares are held in Egypt. The road is entirely owned by foreigners, and the shares are already worth nearly, if not quite double their par value.

The lines so far completed are ten in number, having a total length of 23 kilometers, or somewhat over 14 miles, of which ten miles are laid in double track and four in single track with a gauge of one meter.

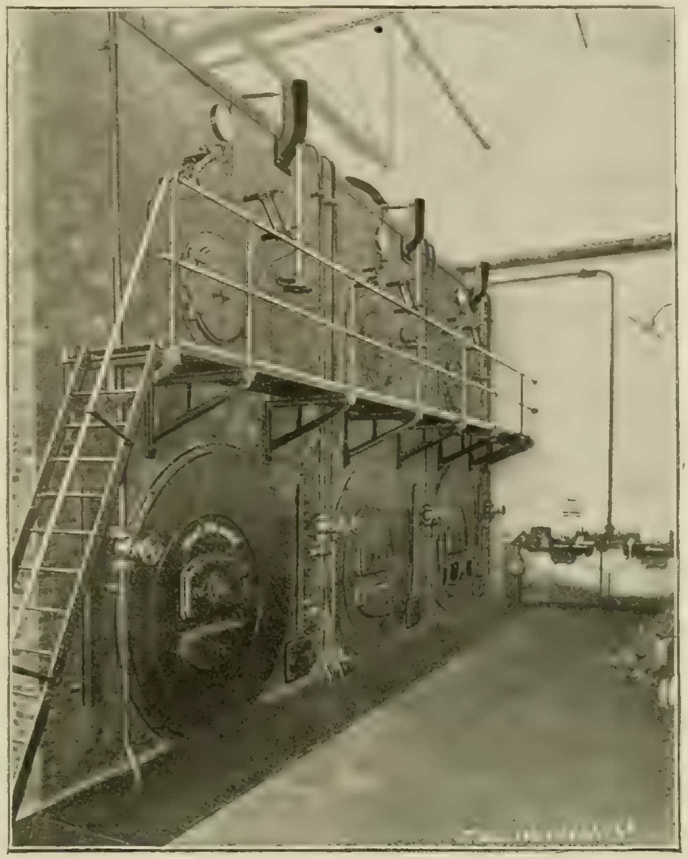
The power station, built upon substantial European lines, is located at the mouth of the Ismailia Canal, near the Nile. The equipment of the boiler-room consists of three Cornish boilers, each of 400-hp. capacity, provided with fuel economizers. Steam at 150 pounds pressure is supplied to three horizontal tandem-compound condensing Sulzer engines, running at 120 r.p.m. The high pressure cyclinders of these engines are nearest the crossheads, and the valves of all are driven by a shaft running parallel with the piston rod and actuated from the main shaft through mitre gears. The exhaust valves are below the cylinders and the steam valves of the lift type above. All the exhaust valves are actuated by eccentrics on this auxiliary shaft, the steam valves on the low-pressure cylinder are driven by cams, and those on the high-pressure cylinder by eccentrics with a detaching device with a drop and dashpot, the trip being controlled by a governor, as in Corliss engines. The cylinders are oiled by small force pumps driven by the valve shaft. The water for the boilers and condensers is pumped directly from the Nile by electrically driven centrifugal pumps. Room has been left in the engine room for five electrical steam units, the additional two to be added as traffic warrants. A travelling crane runs the length of the engine room.

The overhead line is suspended from span wires, which in the city streets are stretched between wrought iron poles or from ornamental wall plates fixed to the sides of the houses. Outside the city the span wires are suspended from impregnated wooden poles. At the Kasr-el-Nil bridge, which at certain fixed hours of the day is open to allow the Nile boats, with their tall single masts, to pass

Street Scenes in Cairo, Egypt.—Illustrating the Old and the New Methods of Transportation.

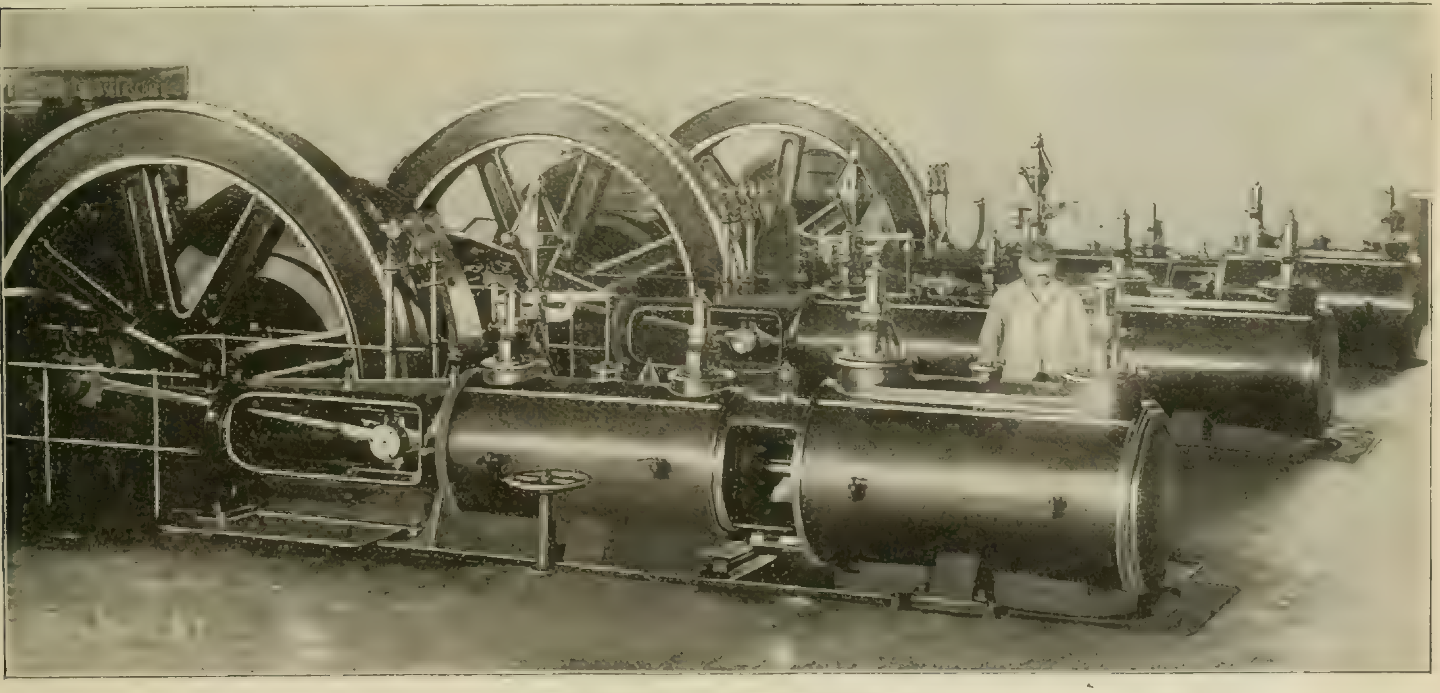
through, the feeder cable for the Pyramid section is laid at the bottom of the river. The overhead line apparatus is similar to that used in this country.

The rolling stock consists at present of forty motor cars and twenty trailers, although more have been contracted for. Each motor car is equipped with two G. E. 800 motors, adapted for the metre gauge, and two series parallel controllers of the K type. Each motor car is capable of hauling two trailers. All the cars were built in Belgium, and carry on both sides of the roof signs in both French and Arabic giving the route of the car, and on the dashboard its number, with the crescent dividing the European from the Oriental numerals. As the climatic conditions in Cairo are of the mildest, no closed cars are necessary; all are open. They are divided into two classes, one for Europeans and one for natives, and the back seat is reserved for the harem women. Side curtains are provided, but are never drawn, and there is no curtain to divide the harem portion from the rest of the car. On an important route the "ceaseless chatter of its black-cloaked, black-veiled occupants, regardless of the silk-robed men in front and the red night-capped hangers on at the sides, gives an hysteric suggestion of a picnic attended by masked mourners."



A View in the Fire Room.

The new system of rapid transit inaugurated August, 1896, is extremely popular, as much with the native population as with the European. The road by no means runs only through the better, or the European, quarters; and the native man, woman and child finds the electric car a distinct improvement on the camel, the frowzy hack, the donkey, or walking. The speed of the cars is 10 kilometres, or about 6.2 miles, per hour. The conservatism of the Arab asserted itself to some extent at first, but only to his serious detriment. It took him some time to seize the inwardness of the warning sound of the gong and occasionally he has paid for his slowness with his life. An extension of the system in a single track as far as the Pyramids is now under construction and rapidly nearing completion. Indeed, by the time this is printed the excursion that has been made from time immemorial on the back of a small ass, pursued by a relentless small boy, is, perhaps, being made in a regulation trolley car. The distance covered by the new line is about 7 miles. It will follow the famous road to the Pyramids, from the head of the Kasr-el-Nil Bridge, crossing the two arms of the Nile, down left bank of river to Ghizeh, then due west to the Mena House, the hotel of the Pyramids.



The Three Main Generating Units.

Where the Pyramid line comes up to the Nile bank, a ferry communicating with the electric tramway terminus directly opposite in Cairo will be established, saving 3 miles' ride by way of the bridges for those who may not desire to ride from or to the Kasr-el-Nil bridge.

The road is operated by the Société Anonyme des Tramways du Cairo, under the general management of Mr. Jules Borel. The electrical equipment was furnished by the Union Electricitäts Gesellschaft, of Berlin.

The Customs Tariff of Japan.

On January 1, 1899, the new customs tariff of Japan will take effect. According to its provisions, as set forth in a pamphlet just published by the Japan-American Commercial and Industrial Association of New York, the following articles of an electrical character will be subject to import duty at the rates specified: Electric light apparatus or instruments and parts thereof, 10 per cent. ad valorem; telephone and parts thereof, 10 per cent.; wire, telegraph or galvanized, 10 per cent.; mica in sheets, 10 per cent.; submarine telegraph cables and underground telegraph cables, 10 per cent.

The Recent Street-Railway Franchise Struggle in Chicago.

Since the famous Jake Sharpe case in New York never has a city been more thoroughly stirred up over a street-railroad matter than Chicago has been for the past three weeks. On Monday, Dec. 5, an ordinance providing a fifty-year extension of the operating rights on the principal systems was introduced into the City Council and referred to the Joint Committee on Streets and Alleys, North, West and South. Since that time a lively fight has been in progress, in which the mayor, newspapers, aldermen, traction companies and the public have all had a hand.

The ordinance which began the excitement in Chicago was designed to take advantage before any possible repeal of the new Allen State law permitting street-railroad franchise grants of fifty years in length. It provided that the ordinances in existence giving privileges to the North Chicago Street Railroad Company, the West Chicago Street Railroad Company, the Chicago City Railway Company, the Chicago General Railway Company and their allied lines should be extended for fifty years in consideration of a certain amount of compensation to be paid to the city by the companies in excess of all existing obligations and burdens. This compensation was to be figured on a basis of gross receipts divided by miles of track, and was to start at 3 per cent. for the North Chicago and Chicago city companies, and 2 per cent. for the West Chicago Company. [illegible] would probably have [illegible] approximately [illegible]

[illegible] Committee [illegible] ordinance was referred [illegible] following the introduction [illegible] the principal street [illegible] the public spoke. A sub-committee [illegible] the books of the companies [illegible] to the city was fair. [illegible] the ordinance was taken from the Streets and Alleys Committee and referred to the Committee on Railroads. The sub-committee of the Streets and Alleys Committee continued its sessions, believing that a substitute street-railroad ordinance introduced at the first meeting was before it. [illegible] Streets and Alleys Committee [illegible] Council on December 19.

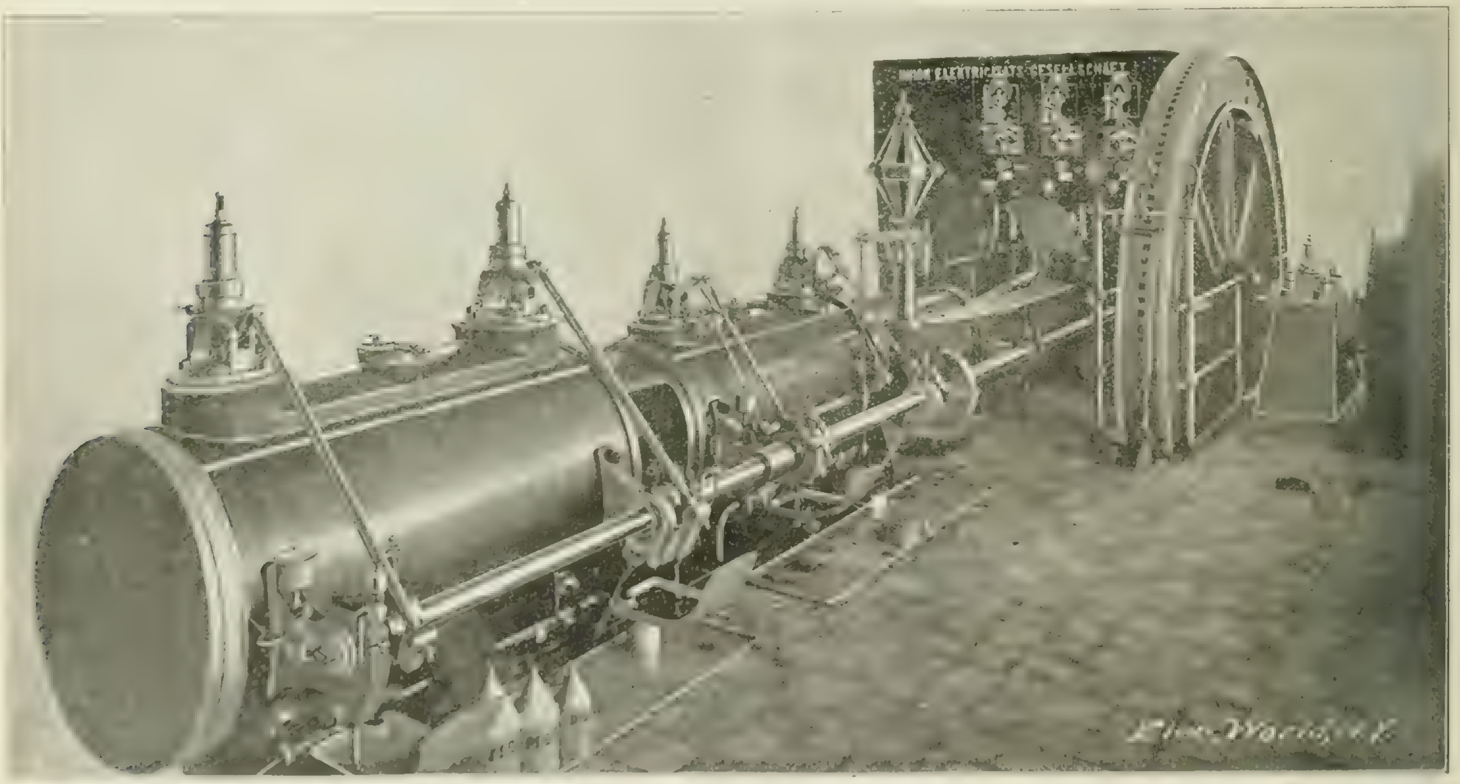
This substitute ordinance was prepared as a popular measure. It provided that the existing ordinances of street-railway companies should be extended until 1930. In return the companies were to pave from curb to curb all streets on which they had tracks. This was to be done within five years. After the first ten years the companies were to pay to the city for the succeeding decade 3 per cent. of their gross receipts; during the next following five years, 4 per cent., and for the remainder of the life of the franchise, 5 per cent. For the first twenty years 5 cents was to be the fare, with six tickets sold for a quarter, good during the hours between 6:30 and 8 o'clock in the morning, and 4:30 to 6 o'clock in the afternoon. One free transfer was to be given with each ride. A further clause was inserted providing for municipal ownership at the expiration of the term set in the ordinance.

In spite of this advantageous bargain offered to the public, however, the mayor and his supporters overruled the measure. The whole subject, with all pending ordinances and amendments, was referred by a majority of one vote to the committee on City Hall. This action has apparently settled the matter for the time being as far as the City Council is concerned. It is now supposed the street railroad companies will apply to the next session of the Illinois Legislature for a law granting the extensions they could not secure from the Council.

The inside motives which have led several of the newspapers, backed by Mayor Harrison, to foster the agitation against the ordinance are stated to be a desire to secure blackmail and chagrin at the failure to do so. President Charles T. Yerkes, of the North and West Chicago street railroad companies, represented this plainly in a statement he made two weeks ago to the New York "Journal." This statement has been published daily in the "Inter Ocean" ever since, but has gone unchallenged as yet. It reads, in part, as follows:

"The officers of the street-car companies have done everything in their power to bring about a proper understanding between the city authorities and their companies, but owing to the action taken by some of the newspapers in Chicago the efforts, up to the present time, have been of no avail.

"The fact is that there is a combination of newspapers in Chicago which levy blackmail on any corporation which they can force to pay tribute. The Chicago 'Tribune,' the Chicago 'Record' and the 'Daily News' are conspicuous in this business. The proprietors of these papers have agents who make demands on the corporations. Demands have been made on the traction companies, which have been refused, and which will continue to be refused.



One of the Engines of the Cairo Electric Railway Plant.

"I know what I am saying when I give you these facts, and know that what I say to you is libelous and I am liable to an action for slander. I wish to say that I defy the proprietors of those papers to bring such an action against me, and there is nothing which would please me more than to have them do so and give me an opportunity to appear in court and expose their nefarious schemes.

"It is also a fact that there has been an arrangement made between these newspaper people and Mayor Harrison, to the effect that if he will prevent the traction companies from obtaining the extension ordinance, they will favor him for mayor at the next election, and also for Governor in 1900. This whole excitement is brought about for the purpose of driving the traction companies to settle with these blackmailing newspapers.

(Signed) "CHARLES T. YERKES."

The Use of Gas Engines for Dynamo Driving.

BY JOHN C. KELLEY.

I have often been asked why it is that gas, gasoline and oil engines are more largely used in England than in this country. For this condition of affairs various reasons may be given, the most obvious, perhaps, being that illuminating gas of, say, 700 heat units value costs about twice as much here as in England. For example, in Manchester, England, such gas costs about 60 cents per thousand cubic feet, while in New York City the present rate is $1.15 per thousand cubic feet. The result is that when any comparison of cost per horse-power hour is made with an economical type of steam engine the figure, 2 cents per horse-power hour, obtained with a gas engine of good design, is much less favorable to the gas engine than its thermic efficiency entitles it to be for engines larger than, say, 40 or 50 horse-power.

If, however, the rates for gas were to be reduced 50 per cent., as I believe might be done when used in large quantities for fuel purposes, the gas engine, even in small sizes, would give power at a cost of 1 cent per horse-power hour, and thus compare very favorably with the steam engine and give a wonderful impetus to the gas-engine business.

In this connection, I might say that in Boston it has recently (October 29, 1898,) been arranged by the Brookline Gas Light Company with the city of Boston to reduce the price of gas for fuel purposes to 75 cents per 1000 cubic feet, and to make graded prices for gas used for power purposes in gas engines, so that they will be for engines up to 100 horse-power 1 1-5 cents per horse-power hour, in gas engines from 100 to 200 horse-power 1 1-10 cents per horse-power hour, and in engines of 200 horse-power and upward 1 cent per horse-power hour. These prices, which are understood to take effect early in the spring when the Massachusetts Pipe Line Gas Company will have completed its immense plant at Everett and will supply by contract coal gas of 18 candle power to the Brookline Company, will at once place gas engines according to size on an equality with steam engines using five to six pounds of coal per horse-power hour, which fairly represents the coal consumption usually met with in steam engines of moderate size working under variable load.

In England not only is illuminating gas lower in price, but there is a much more general use made of producer gas to operate gas engines, even for powers as small as 20 horse-power for factory and other service. Nothing corresponding to this is done here, except that for large powers, say, 100 horse-power and upward a few gas producers are being installed for power stations and like service. Such engines compete in economy with our highest grades of steam engines.

But though progress is still slow, such plants will be widely used when once the fact is generally appreciated in this country as it is in England that a pound of coal gives far more power when made into gas and run through a gas engine than if burned under a boiler to generate steam for a steam engine. That the cost of fuel is almost a controlling factor in the question of installing gas engines is shown by the fact that the demand for large engines suited to our natural gas regions is steadily increasing.

As regards gasoline engines, improvements in the details, and particularly in the electric igniter, have placed this motor in position to compete with high-grade steam engines, yielding as it does power at a cost of ¾ to 1 cent per horse-power hour. The underwriters' requirements, however, restrict the gasoline engine to localities where there is sufficient space available to place the gasoline storage tank 30 feet away from any building. But for country houses and hotels, village water works, factories or lighting stations, the gasoline engine seems just what the conditions demand, and there are a number of engines in use for such service, besides others to operate dynamos to charge storage batteries. The demand for gasoline engines is growing for out-of-town power plants, especially in the larger sizes for electric lighting and factory service.

The lessened sales over former years of the small sizes of gas engines, say, 5 horse-power and under, is, perhaps, due also in great measure to the competition of the electric motor. A small gas engine cannot be sold for the same price as a small motor, because it is a much more difficult and expensive machine to build. But it is found, as a rule, that those who install such machinery consider only the first cost and do not consider at all the cost of operating, which is a matter of vital importance. For example, a 3-hp electric motor may be bought for, approximately, one-half what a first-class 3-hp gas engine will cast. (The motor, it may be remarked, will weigh about 450 pounds, while the gas engine weighs about 1500 pounds.) The difference in price may be, say, $150, while the difference in cost of operating may be, as shown by actual examples, as much as $200 to $240 per year, or nearly enough to pay for a gas engine the first year. In fact, careful comparison of costs of operating gas engines and motors doing the same or equivalent work has shown the motor to cost from two to three times as much to operate as a gas engine.

Were this item of cost based on actual charges for street current more generally known, instead of there being in New York City about ten times as many small motors as gas engines in service, the proportion might be reversed. Abroad the cost of operating is considered very carefully, and first cost in its due proportion, which may account, in part, for gas engines being used so much more largely than here.

As regards the application of gas engines to isolated electric lighting, a few instances may be cited. The direct-connected plant of 500-lights capacity installed at the house of the American Society of Civil Engineers, 220 West Fifty-seventh Street, has been in service nearly a year, and has proved satisfactory, the cost for fuel and attendance being about one-half that of street current, and the quality of light and regulation being excellent.

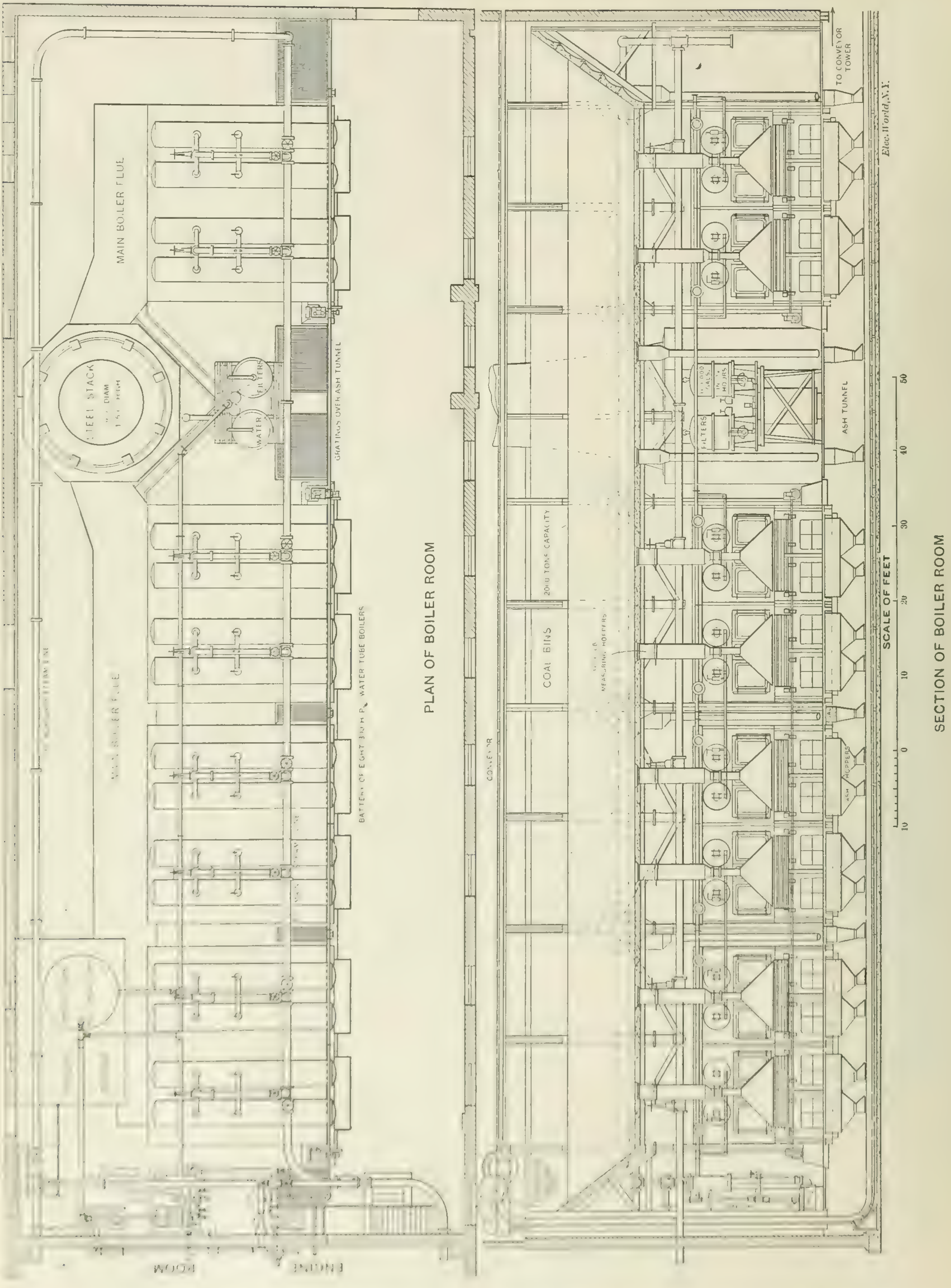
The two-cylinder Nash engine gives two impulses on the crank shaft every two revolutions, instead of only one as in the single cylinder engine, and the governor is so sensitive that it automatically regulates the speed to within 2 per cent. from full load to no load. Besides this, a special coupling, which connects the engine and dynamo, is so adjusted that it is impossible for the speed of dynamo to vary but very slightly either way from normal speed before it is corrected by the coupling and the governor acting jointly. Regulation, in fact, is so close that the voltmeter shows less than one volt variation under changing loads.

At the civil engineer's house they installed a low-pressure steam heating apparatus for warming the building, while gas engines are used only for the electric lighting. Some of our steam heating engineers were disposed to question the wisdom of this arrangement as compared with a steam lighting plant and steam for heating, but the result, in this case, has justified the choice and shown the economy of departing from standard practice which has compelled the use of a steam plant, oftentimes, solely because it provided exhaust steam for heating, and because it was thought no matter how wasteful the steam engine might be, it cost nothing for the steam heating.

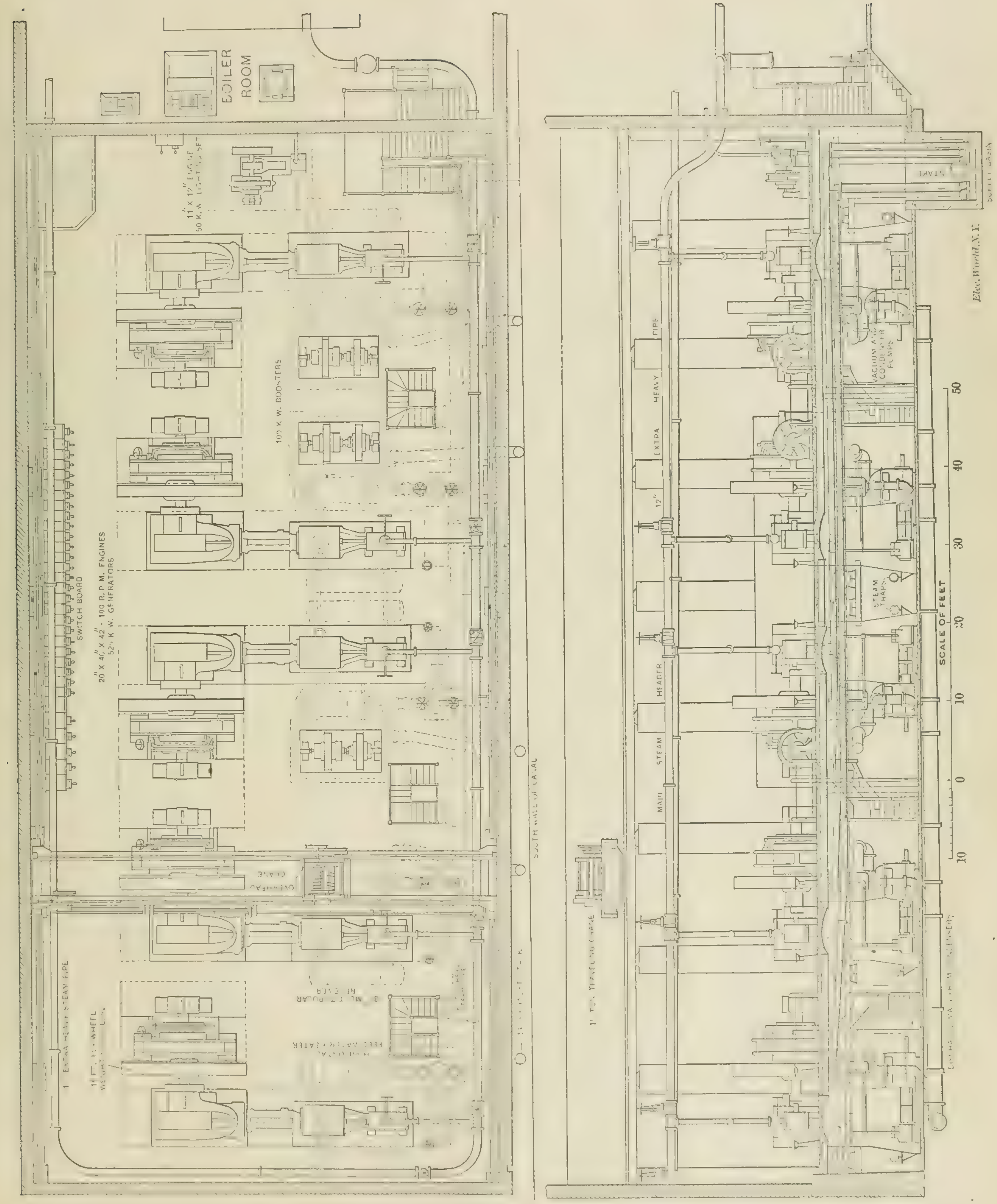
The gasoline engine, particularly, which places country houses in an even more favorable position than those in the city with respect to electric lighting at a very moderate figure. I regard as especially promising. What we need just now is more intelligent appreciation, on the part of architects and owners, of what constitutes first-class gas engine machinery and willingness to pay a fair price for it. The market is flooded with cheap gas engines, as it is with cheap steam engines; but while it is recognized that the severe requirements of electric lighting have wonderfully developed the steam engine, and that nothing but the very best engines will serve, it does not seem yet generally appreciated that in like manner only a high-grade gas engine will answer for electric lighting.

An Automobile Issue.

The English technical journal, "Industries and Iron," devoted its issue of November 25 to the subject of automobile motor cars, describing and illustrating among other classes many interesting electrical vehicles.



Floor Plans and Sectional Elevations of the Power House of the Capital



Traction Company, Washington, D. C. For Description see Pages 707 to 715.

Electric Traction at Lyons, France.

The Lyons Omnibus and Tramway Company, which installed electric traction as an experiment on its inter-urban lines, has become convinced of the advantages of the new form of traction, and has recently changed over its entire system.

The company operates about 35 miles, almost all double track. The old rails of the Marsillon type, 51.6 pounds per yard, were not replaced at the time of the change-over. The Falk cast-welded joint was put in, as it was feared that undue wear would result at the joints from increased weight of the rolling stock. The trolley wire is No. 0, with span suspension, made fast to the walls of the houses or to ornamental metal poles. The method of suspension used on the steel bridges over the Rhone is arranged to bring the poles of the railway to correspond with the pillars supporting the bridge. On the southern bridge no poles are used and, instead, rosettes have been fixed to columns which surmount each pillar of the bridge.

When permission was granted by the city government to substitute electric traction for horses throughout the system overhead wires were forbidden in streets with a total distance of about 2 miles, and here an underground conduit system was put in. Both positive and negative conductors of this portion of the system are insulated from the rails and are connected with the station by special feeders.

The feeder system is underground, and consists of rubber-covered, iron-armored cables, and, owing to the distance of the station from the centre of distribution, the copper cross section is rather large. There are twenty-four positive feeders leaving the station, with a total length of 58,000 feet; all feed points are provided with switches to enable that particular cable to be cut clear of the line in case of a short-circuit somewhere along its length.

The cables which cross the Lafayette Bridge are lead-covered to prevent any action on the rubber due to their exposure to the air. These cables enter a cast-iron junction box at each end of the bridge where they may be got at for the purpose of testing their insulation.

The calculation of the positive feeders was based on Kelvin's formula for greatest economy. The return copper, however, could not be calculated in this way, it being necessary to avoid electrolytic action on water and gas mains, and to comply with the governmental regulation on base conductors in the earth, which require the different points where the latter are bonded to the rails to be all at the same potential. This requires the same drop over each return cable back to the station, and hence the longer cables had to be given a very large cross section.

In addition, pilot wires brought back to instruments at the station permit the existing difference of potential between the various extremities of the cables to be known, which enables them to be adjusted by variable resistances which are kept in circuit.

The rolling stock of the company comprises 175 motor cars and 60 trailers, which are used on the suburban lines on days of heavy traffic. The motor cars are of two kinds, one with seats on the roof, carrying sixty passengers in all, the other without, and having a capacity of forty-five passengers. They have first and second class compartments.

Each motor car is equipped with two G. E. 800-hp motors and B-A controllers, with electric brakes. There is also an automatic circuit breaker instead of a fuse. In compliance with a municipal regulation each car carries two "Volta" speed indicators especially built for this work. A few of the cars are provided both with the overhead trolley pole and a collector or plow to be used when they are running over the underground conduit, and which is pulled up under the car when not in use.

The station, one of the largest yet built in France, is outside the city limits, a little over 2 miles from the centre of the town. It is equipped with four groups of 450-kw generators. The engines were [illegible] horse power, and can [illegible]. They are of [illegible] usual design, simple condensing, with slide valve and variable cut-off. The [illegible] the speed [illegible] in diameter and weighs 45 tons.

[illegible]

The piping is all iron with copper expansion pieces. Both boiler feed water and condenser water can be taken from two large wells, 15 feet in diameter, 40 feet deep, sunk in a very abundantly watered stratum of earth. One well is sufficient to supply all the condenser water needed for the two engines when running at full load; nevertheless, to minimize the chances of an enforced idleness, resulting from a prolonged drought, a "Lee" cooling system was put in, permitting the water which has been used in the condenser to be cooled by being sprayed into the air with centrifugal pumps.

The feed water can be passed through a Green economizer before entering the boiler. There are two of these for each set of six boilers. There are two chimneys, 160 feet high, and with an inside diameter of 8 feet at the top.

The generators were built in Paris. The armature is keyed to the engine shaft. The field has 8 poles, with compound winding, over-compounded so as to give 500 volts at no load and 575 volts at full load. The normal output of each machine is 750 amperes, but they will carry 1100 amperes for several hours without injurious heating.

Before long it is expected to put in a 1 to 1 motor generator, taking current at 550 volts, and delivering at 550 volts, which will be used to feed the underground trolley system, so as to render the latter entirely independent of the rest of the road.

The switchboard is arranged so that all the generators may be run in parallel on all the feeders, or any combination of feeders may be put in any single generator. The four machine panels are provided each with a "Volta" ammeter, two main switches, an automatic circuit breaker, and a shunt field rheostat. The six feeder panels are each provided with an ammeter, two switches and a circuit breaker. They are also provided with lightning arresters, of the magnetic blow-out and impedance-coil type. The centre panel is especially arranged for the underground trolley portion of the road and for measuring instruments. On this panel there is a hand wheel controlling a movable electrode of a water rheostat in the basement.

This rheostat is intended to be used to cut down the voltage on the underground trolley when the latter becomes flooded, and also in case of a short circuit on the line it is to be used to keep the current within the capacity of the machine, while at the same time burning off the ground. The voltmeters connected to the pilot wires mentioned above, are located on this panel. After shutting down the road at night it is possible with the aid of the rheostat to send a heavy current between two points on the rail where two negative cables are bonded on, and determine from the observed drop what the condition of the Falk joints is electrically. These measurements are made regularly, and any necessary repairs carried out at once, which is a large factor in keeping down electrolytic troubles. Two Weston voltmeters complete the switchboard outfit.

In addition, there is a very complete laboratory containing delicate instruments (Thomson and d'Arsonval galvanometers) with which the insulation resistance of both positive and negative feeders may be tested, and also freedom from ground of the generators and the car motors. Every test necessary for the maintenance of such a fine installation is arranged for.

The engine room has a traveling crane of 70 tons capacity and 46 feet span. The mechanical part was furnished by Piquet and Bonnet Spazin, of Lyons, the electrical part by Postel-binay. It is operated by electricity at 110 volts from a special plant, which serves also for the lighting of the station. The controllers for the crane have magnetic blow-outs and resemble the car controllers.

The first electric line started to operate in April, and now the whole road, except the underground trolley portion, is being electrically operated. Since the change over the traffic has increased so much that the facilities provided by the company have proved inadequate, and the number of cars in service is to be considerably increased.

Already the station equipment is receiving an addition of two more generating sets like the first, six more boilers, a chimney and an economizer, and this is probably by no means the last extension that will be made.

When finished this plant will have six sets of 450 kilowatts capacity each, and will be one of the largest put in by the companies who exploit the Thomson-Houston system in Europe.

The Keely Motor.

The stockholders of the Keely Motor Company propose to place the machine and all available data in the hands of F. B. Kinraide, of [illegible] Laboratory, Boston, for a general investigation.

The Most Efficient Thickness of Transformer Plate.*

BY F. BEDELL, R. M. KLEIN AND T. P. THOMPSON.

In a magnetic circuit built up of plates or laminæ of iron, cyclic reversal of magnetism is accompanied by a loss of energy due to hysteresis and eddy currents, the hysteresis loss being proportional to approximately the 1.6 power of the magnetic induction B, and the eddy current loss being proportional to the square of the induction and the square of the thickness of the laminæ. These losses may be expressed by the following formulæ, due to Steinmetz. The hysteresis loss in watts is

$$V \eta n B^{1.6} 10^{-7}.$$

Here V is the volume of cubic centimetres, n the frequency, B the induction per square centimetre, and η a hysteresis coefficient dependent upon the quality of the iron. In the present investigation the value .002 has been assigned to this hysteresis coefficient.

The eddy current loss in watts is

$$V \gamma (t n B)^2 10^{-21},$$

where t is the thickness of the plate in mils, including oxide or insulation. It is 1000 times the reciprocal of the number of plates per inch. The coefficient γ, the conductivity of the iron, is here taken as 10^5.

For very thick plates (so thick that we approximate the condition of a solid core) these formulæ do not hold, but they are substantially correct for the thickness of plate considered in this investigation. According to these formulæ the hysteresis loss is independent of the thickness of plate; the eddy current loss varying, however, as the square of the thickness of plate increases very rapidly as the thickness is increased beyond certain limits. The direct effect, therefore, of decreasing the thickness of plate is to decrease the losses. There is an indirect effect, however, tending to increase the losses as the thickness of plate decreases. For a given value of total magnetic flux in the magnetic circuit the magnetic density increases as the thickness of plate decreases, since the per cent. of space occupied by air space, oxide and other insulation increases. Consequently as the thickness of plate decreases the hysteresis loss increases; the eddy current loss decreases as long as the thickness t is the controlling factor, and suddenly increases when the magnetic density B increases to such a value as to more than counterbalance the effect of the decreased value of t.

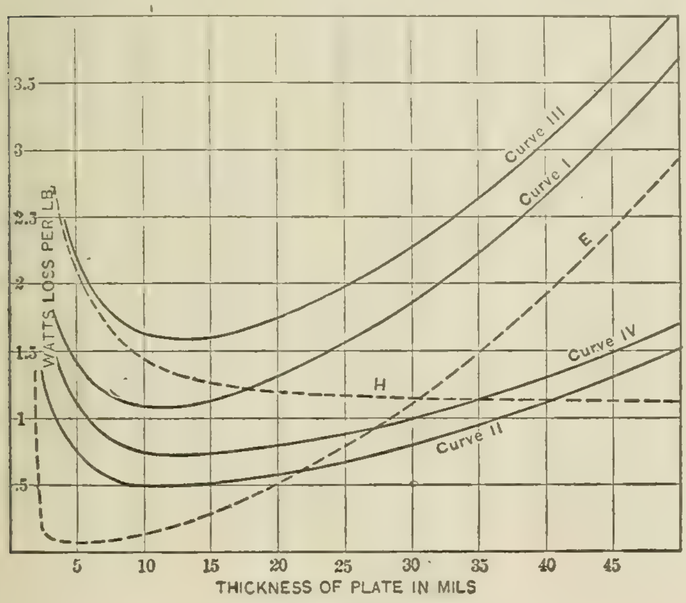


Fig. 1.

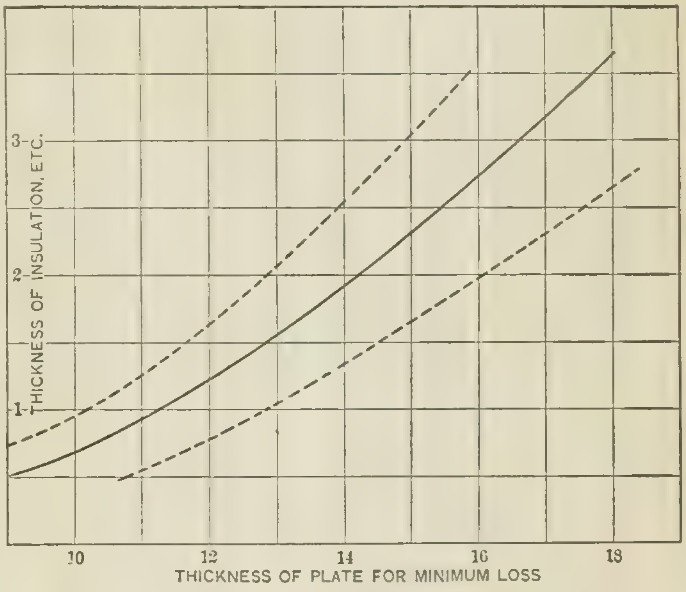


Fig. 2.

It is evident that for some particular value of t there will be a minimum total loss for a given frequency and for a given total flux. It is our purpose to determine if possible the value of t which will make the total loss a minimum.

The curves in Fig. 1 are computed from the formulæ given above, on the assumption that the thickness of air space, oxide and other insulation (designated by a) is 1.83 mils. This was an average value found from a series of measurements on transformer plates. If B represents the magnetic density which we would have in case the plates were solid (B equals the total flux divided by the gross area of core), we will have for any thickness of plate t

$$B_t = B\frac{t-a}{t}.$$

In Fig. 1 we have curves for the following cases which represent considerable range of practice:

Curve I. $B = 3470$; frequency = 125.
Curve II. $B = 2170$; frequency = 125.
Curve III. $B = 7240$; frequency = 60.
Curve IV. $B = 4530$; frequency = 60.

Each of these four curves shows the total loss (in watts per pound) including hysteresis and eddy currents for the particular frequency and induction assumed. These were constructed by first plotting curves of hysteresis and eddy current losses separately; thus, curve III. is the sum of the hysteresis loss curve *H*, and the eddy current loss curve *E*. An inspection of curve *H* shows that the hysteresis loss increases as the thickness of plate decreases, slowly at first and then rapidly. With a decrease in the thickness of plate the eddy current loss is at first rapidly diminished and then suddenly increases for very thin plates.

It is interesting to note that the four curves for total loss have minimum points for about the same thickness of plate, this minimum point being very flat, in fact practically covering the range from 10 to 15 mils.

In order to make the conclusions of value it was deemed necessary to consider the influence of a different value of a, thickness of the insulation and air space, upon the results. Evidently for different values of a the value of t for minimum loss will be changed. The solid curve in Fig. 2 shows the thickness of plate for minimum loss in terms of thickness of insulation a, when B equals 4,170 and frequency equals 60. Data for this curve were obtained by plotting a series of curves, similar to those shown in Fig. 1, each for a different value of a; the minimum points were picked from these curves to construct the curve in Fig. 2. The exact minimum points were difficult to locate on account of the flatness of the curves. But the exact minimum we do not want; it is more important to know the range in the values of t, which gives what is practically a minimum loss. The dotted curves have been drawn in Fig. 2 showing the limits of variation, provided the loss does not exceed the minimum loss by more than (approximately) one per cent. The thickness of insulation a may vary about 50 per cent. without taking us beyond those limiting dotted curves for a particular thickness of plate. The best thickness of plate increases as the insulation space is increased.

We thus see that there is a wide working range for the best thickness of plate, say from 10 to 15 mils, which will be sufficiently near the minimum point for practical purposes, for any ordinary range of induction or frequency, or thickness of insulation.

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*Read at the Boston meeting of the American Association for the Advancement of Science, August, 1898.

The Convention of the Northwestern Electrical Association.

The seventh annual convention of the Northwestern Electrical Association will be held at the Hotel Pfister, Milwaukee, Wis., commencing on Wednesday morning, January 18, 1899.

The following papers will be read and discussed: "Trend of Central Station Design," by B. J. Arnold, Chicago; "Meter-Rate Systems," by E. L. Debell, Sheboygan, Wis.; "Design of Secondary Circuits in Alternating Plants," by George L. Thayer, Belle Plaine, Ia.: "Electricity Direct from Coal," by Prof. A. J. Rogers, Milwaukee; "Inductive Loads on Alternating-Current Transformers," by Prof. D. C. Jackson, Wisconsin University; "Electric Vehicles and Their Relation to Central Stations," by H. M. Maxim, Hartford, Conn.; "Association Management," by H. L. Doherty, Madison, Wis.

The association will, at this meeting, handle the "question box" in a new way, the members and attendants being requested to mail to the secretary, Thomas R. Mercein, 22 Sentinel Building, Milwaukee, before January 10, any question they may desire answered. All questions received will be printed in the final notice of the convention, with a request that prepared answers be ready at the meeting. The usual one-and-one-third fare for railroad transportation has been arranged for, as well as reduced rates at the hotels and the customary amusements.

Improvements in the Ferranti Dynamo.

The alternating-current dynamo of the type provided with a disc armature constructed of a series of flat coils, and without iron in the armature, exxamples of which are the Ferranti and Mordey machines, has never come into any extended service in this country, although quite widely used in England. Improvements in this type of machine have been covered by patent No. 615,265, issued December 6, to S. Z. de Ferranti, of which the following description gives a general idea.

The aim of the improvements is to insulate the frame holding each pair of armature coils from the body of the machine so that the insulation separating the conducting wires of the coils from the frames need not be sufficient to withstand the total voltage of the machine, but only that generated by the pair of coils, the main [illegible] across the [illegible] between these frames [illegible] each pair of coils and the [illegible] the [illegible] the Ferranti machines, or the stationary armature frame [illegible]

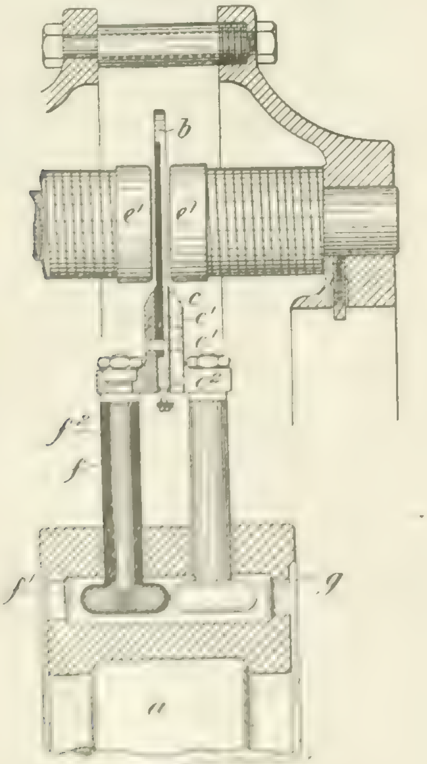


FIG. 1.

between the poles of a rotating field, as in the Mordey machine. The form of construction is shown in Fig. 1, in half-section. The poles e' e' send lines of force across the air-gap, in which runs the flat armature coil b gripped tightly in the frame c by means of bolts c'. The frame carries lugs c^2, engaging with the rods f, which are attached to the rotating wheel a by means of nuts f' bedded in the insulation and cemented into the annular cavity g by means of sulphur or some similar insulating material. The rods f may also be surrounded by insulating tubes of vulcanite, mica or other material, as shown at f^2, to prevent surface leakage. In this way, provided the poles are capped with some insulating material, a very high voltage can be generated in such a machine with a comparatively thin insulation on the armature windings themselves.

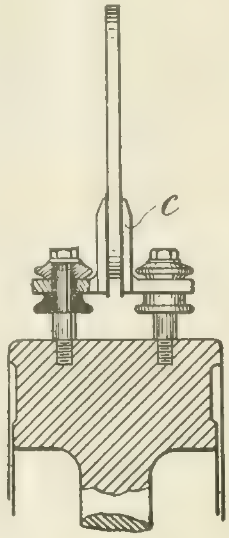


FIG. 2.

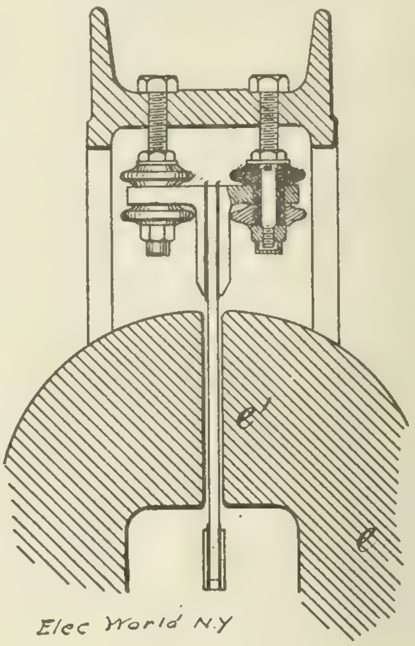


FIG. 3.

Fig. 2 shows a little different arrangement, the lugs of the frames c being insulated from the rods projecting from the wheel-rim by devices closely resembling single-petticoat line insulators. Fig. 3 shows a similar arrangement for a machine, with a stationary inwardly projecting disc armature and rotating field. Fig. 4 shows a modification of this arrangement designed for still higher insulation, the frame of the coils being attached to a lug j cemented into a cavity g in the cast frame a. This design obviously gets around the difficulty found in [illegible] machines generating high voltages direct, as, [illegible] the winding [illegible] well distributed, the greater portion of the volume of the field must be taken up by insulation, leaving a very small space for copper.

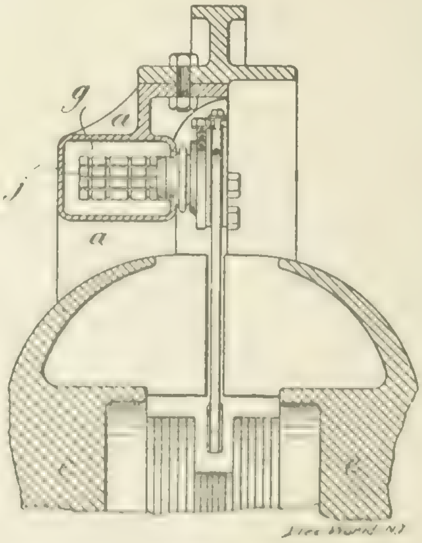


FIG. 4.

DIGEST OF CURRENT ELECTRICAL LITERATURE AMERICAN AND FOREIGN

By Carl Hering.

Dynamos, Motors and Transformers.

ROTARY CONVERTERS.—Lond. "Elec.," Dec. 9.—A brief editorial discussion. The views of the various speakers in the discussion of Thompson's recent paper (see "Digest" last week) are summarized; it seems to be generally admitted that the single-phase rotary converter is not an advantageous machine to use except in small sizes, the experience of Mengarini, at Rome, being taken as a typical instance; there they are being replaced by motor generators on account of the difficulties with sparking and hunting when running in parallel. It is generally considered that if the continuous current must be regulated over more than a few volts, the boosters or similar devices absorb any advantage over the motor generator; except when the frequency is low, 40 or lower, the large number of poles and brushes is a disadvantage; but where three, four, or more phases are used with low-frequency currents, and where no extended regulation is necessary, such converters have given and will continue to give satisfaction. It is offered as a suggestion that whereas in a continuous-current generator the only change in current is that occurring under the brush when the coil is not in circuit, in the case of the rotary converter it occurs during every part of the revolution; this effect of self-induction should receive attention. In the abstract of the discussion as published in the Lond. "Elec." a table offered by Esson is reproduced; it shows the ratio between the alternating and direct currents, as obtained in the experiments which he made.

ROTARY CONVERTER. Miot. "L'Elec.," Dec. 3.—A brief, illustrated description, with some data, of one of those installed in Paris. The voltage is 3,000, which is lowered to 160 by means of transformers; the output of the machine is 88 kw.

THREE-PHASE MOTORS WITH SINGLE-PHASE ARMATURE WINDING. Cahen. "Elek. Zeit.," Dec. 8.—An article giving the theory and offering an explanation of the curious phenomenon noticed by Goerges (see "Digest," Sept. 12 and 19, 1896); this phenomenon was that if a three-phase motor contains an armature having a single-phase winding it will run not only at the normal but also at about half this speed. He begins by describing the observations made by him. The mutual actions of the two windings will be analogous to that in a single-phase motor, except that the action will be manifested in the opposite direction; the reaction of the armature consists not only in the generation of a rotating field opposite to that of the primary circuit, but also in the simultaneous production of pulsations in the primary winding. In conclusion he remarks that there does not seem to be any prospect of making use of such motors in practice; their action is dependent to a great extent on the relations of the total resistance of the primary circuit, and the same motor will therefore act differently according to the condition of the circuit or the primary station to which it is connected; the general theory of such motors, however, is of interest, as it shows among other things what advantages are offered by the application of two rotating fields in alternating-current problems.

THEORY OF GOERGES PHENOMENON. Eichberg. "Zeit. fuer Elek.," Dec. 4.—The first half of an article in which he offers an explanation of this phenomenon (see also abstract above); it is based on two revolving fields in the armature.

REVOLVING FIELD MOTORS. Hanappe. "L'Eclairage Elec.," Nov. 26 and Dec. 3.—The continuation of his long serial. He discusses formulas applicable to non-synchronous motors with revolving multipolar fields. It is of a mathematical nature.

MULTIPHASE ELECTRIC MACHINERY. Stewart. Lond. "El'ty," Nov. 26, Dec. 2 and 9.—An article of a somewhat elementary nature giving the leading features of the system, with special reference to the efficiency and regulation of the generators and motors.

THREE-PHASE PATENTS IN GERMANY.—Lond. "Elec.," Dec. 9.—A note stating that according to a German paper the decision of the German courts as to the invalidity of the Tesla three-phase patents owned in that country by the Helios Company, has been confirmed.

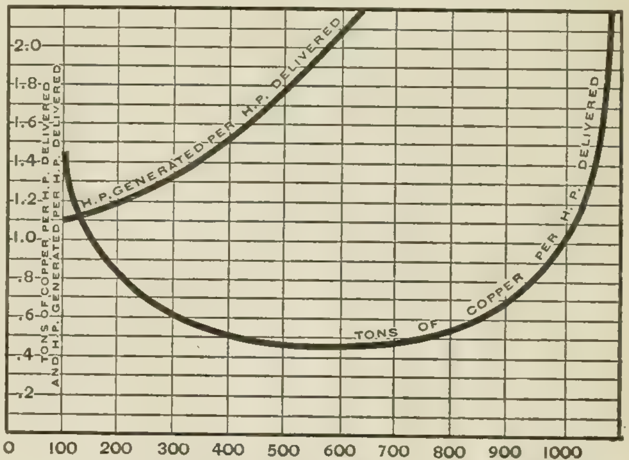
SINGLE-PHASE INDUCTION MOTOR. Baxter. "Power," Dec.—A brief description of the principle of such motors.

Lights and Lighting.

LIFE OF SMALL AND LARGE LAMPS.—Lond. "Elec. Eng.," Dec. 9.—Several answers to a request to compare the efficiencies and life of incandescent lamps of large and small candle-power respectively. A short table is quoted from Preece's Brit. Assn. paper of 1896, giving details of a large number of experiments; this shows that there is a saving of about 15 per cent. in the meter bill when 8-cp lamps are replaced by the equivalent number of 32-cp lamps; if they are replaced by 100-cp lamps there is a saving of nearly 33 per cent.; this saving, however, cannot all be realized, as the distribution of light is not so good. The surface of a bulb for a 16-cp lamp ought to be twice as great as that of an 8-cp lamp, otherwise it will deteriorate more rapidly. If the watts per cp of the various lamps is the same, then the higher the candle-power of the lamp the longer is its life; the larger lamp will also maintain its candle power more steadily than the smaller, but the illumination is not so pleasing. Another answer gives a curve showing the percentage variation in candle power for a given per cent. of variation in the volts over a range of 10 per cent. A table is also given showing the average life at a constant e. m. f., and also at one which varies; at a 4 per cent. variation in pressure almost half the life of the lamp is sacrificed, while a 7 per cent. increase reduces it by two-thirds nearly.

Power.

VERY LONG DISTANCE TRANSMISSION. Forbes. Lond. "Elec. Eng.," Dec. 9 (in abstract in Lond. "Elec.," Dec. 9.—The conclusion of the reprint of his paper (see "Digest" last week). In this portion he describes some quick methods which appear to be quite useful for making preliminary estimates quickly. In all such work on the cost of a long conductor he never takes notice of its resistance, nor of the value of the current, but deals only with the current density and the loss of volts; he never uses the efficiency of the conductor system, but prefers the "inefficiency" or the reciprocal of the efficiency—that is, the horse-power put into the beginning of the line to deliver 1 horse-power at the other end. If the power costs absolutely nothing, the copper would be least and the arrangement the cheapest when the inefficiency is 2 that is the efficiency 50 per cent.; with a greater or less current density more copper would be required to deliver the same quantity of power. This is shown in Fig. 1, which shows that the copper required to transmit 1 horse-power 100 miles at 10,000 volts, with continuous current, falls with the increase of density until the efficiency is 50 per cent., and then rises again; this diagram shows the weight of copper required per horse-power delivered at a distance of 100 miles at 10,000 volts, or 150 miles at 15,000, 200 at 20,000, etc.; it is for continuous currents, and should be corrected only for temperature and sag; it is equally applicable to a single-phase or two-phase alternating current transmission to 100 miles at 10,000 effective volts, or at 5000 effective volts from any wire to the middle of the electric system, or to three-phase transmission to 100 miles at 5000 effective volts from any wire to the middle of the system; but with alternating currents corrections must be made for self-induction and capacity. Another curve may be drawn showing the inefficiency, and this curve constantly rises. From these two a third curve can be deduced which gives in a few minutes all the main features that one wants for any horse-power delivered to any distance at any voltage; this gives the tons of copper per horse-power delivered at 100 miles at 10,000 volts in terms of the horse-power generators per horse-power delivered. This is shown in Fig. 2; the horizontal distances give the inefficiency and the vertical distances the corresponding tons of copper per each horse-power delivered at 100 miles; it also shows the current density in amperes per square inch section of copper. This is the curve which he uses constantly; it is correct for any case in which the volts equal 100 times the miles; the current density and weight of copper per horse-power is the same whether 10,000 volts at 100 miles are used or 100 volts at 1 mile; for any other volts and distance, V and M, divide the volts by the miles and then one-hundredth of this equals D, the multiplier for the current density; the square of this D equals T, the divisor for the tons of copper per horse-power. There is another use for this curve; if the cost of



Elec. World, N.Y.

FIG. 1.

running the station is capitalized and the cost of the generating works added and divided by the horse-power, it gives the capitalized value of 1 horse-power generated; divide the value of the horse-power by that of the tons of copper and draw a line across the axis, so that it cuts the axis in that ratio, and then draw a line parallel to this, touching the curve; this gives, according to Ayrton and Peary's modification of Kelvin's law, the point of maximum economy, giving directly the inefficiency, the tons of copper per horse-power and the current density. Two examples are shown on the curve, one in which the value of 1 horse-power is four times that of a ton of copper, in which case the greatest economy will be with an inefficiency of 1.18, a current density of 180 and 0.91 ton of copper per horse-power delivered at 100 miles at 10,000 initial volts. Another example is shown on the curve when "the horse-power is one-fifth of the cost of a ton of copper:" the efficiency then is 1.58, current density 420, and copper 0.51 ton. To do this for other values of *T* (see above) divide the capitalized value of the horse-power generated by *T*; lay this off vertically and measure the cost of a ton of copper horizontally; join the two points by a line and draw a parallel line touching the curve at the point of maximum economy. This curve, therefore, becomes very valuable for obtaining the very information which an engineer requires in his first examination of any project. Furthermore, by dividing the tons of copper per horse-power by eighteen times the distance in miles, it will give the sectional area in square inches of the conductors per horse-power, and this multiplied by the total horse-power to be delivered gives the size of the conductors. Corrections for temperature, sag and alternating currents must be made. For those who prefer tables instead of curves he reduces these curves to tabular figures, which are given and are accompanied by rules for using them. In conclusion he states that whenever gold mines exist which can afford to pay $1.25 to $1.50 per ton of ore milled, and if there is a good water power within 400 miles, it is quite probable that it would pay well to transmit the power electrically. This is followed by the discussion, which, however, appears to contain nothing of importance.

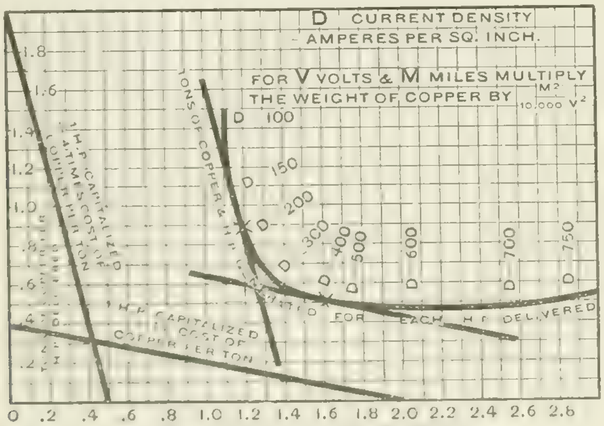


FIG. 2.

In an editorial discussion in the Lond. "Elec. Rev.," Dec. 9, it is questioned whether the copper merchants would be satisfied with a 4 per cent. mortgage on the copper in the line, as suggested by Forbes, as in case of failure the value of the copper as an asset is not equal to the mortgage; 4 per cent. is therefore not a sufficient return; the cost of removal of the copper in case of failure must be considered; moreover, its value will only be that of the raw material at the price which the wire-drawer would have to pay for it, and the mortgage would be limited to that value.

A [illegible] the paper is [illegible] in the "El[illegible] Rev." (N. Y.), [illegible]

POLYPHASE TRANSMISSION OF POWER. Wallis. Lond. "Elec.," Dec. 9.—An article comparing the various systems of transmission with one another, with special reference to the polyphase system. Much that he says has already been published, but it appears to be a good summary. Although the direct current [illegible] urrent circuit, exist; [illegible] for the continuous current, that system is impracticable. The single-phase, alternating-current system is well adapted for long distances, with one receiving station with one or two large motors; according to text books, it requires more copper in the line than the three-phase, in the proportion of 100 to 75, but this is not quite true in practice, as with such motors there is practically no lagging current, whereas with three-phase transmission the power factor rarely exceeds 80 per cent.; the real objections are that the motors must be synchronous, and that rotary converters for transforming them into continuous currents cannot be made of a larger capacity than 50 kw, on account of excessive sparking; the synchronous motors cannot be started without external aid, and they require separate field excitation, although this is not so important for transmitting to a single large motor, while for numerous small motors these complications make it prohibitive; no self-starting induction motors have yet proved themselves sufficiently satisfactory for general adoption for the single-phase system. The self-starting difficulty is entirely overcome by the polyphase system, in which even synchronous motors will start themselves, and they have a power factor of nearly unity when properly excited, and thus there will be a saving of 25 per cent. in the line copper over the single-phase system; in spite of their lower power factor, induction motors are far more generally employed on such circuits, and with these there is no difficulty in starting, even with full load; up to 10 horse-power the motors are generally made with a squirrel-cage rotor, and these take two or three times the normal current when starting under full load; larger machines are provided with a variable resistance in the motor circuit, and will start under full load, taking only the motor current. The polyphase system is well adapted for rotary converters; the tendency to sparking and the demagnetizing effect of the armature is even less than with continuous-current dynamos, since the armature reactions tend to neutralize one another. The limit for a 20-hp motor is about 1000 volts; for smaller ones static transformers must be used. Lamps may be run from the low-pressure polyphase circuits, being preferably connected to a fourth balancing wire, thus involving the star connection; the voltage regulation is then more satisfactory, and the voltage between the mains is raised to the square root of three times that required by the lamps, thus requiring less copper in the mains; motors on such circuits act as automatic regulators for the voltage, due to a slight unbalancing. Many engineers, nevertheless, prefer the two-phase system with four wires. He speaks favorably of the transformation of three-phase to continuous currents by rotaries, which act not only like transformers but also as boosters, for the field winding may be compounded, thus making the full load voltage greater than that at no load. Such a combined system is particularly well adapted for traction purposes; where the distribution is mixed—that is, for both motors and lights on the same circuits; the question is not so easy of solution; wherever regulation will be difficult it will be more economical to use a simpler system, even at an increased first cost. The regulation of speed of the motor is effected by a variation of the resistance in the rotor circuit, or where a large starting torque is not required choking coils may be used; the speed may be altered by changing the number of poles, by changing the connections from star to mesh, and by coupling two motors together, so that the rotor circuit of the one supplies the stator of the second; generally regulation is effected by resistance in the rotary circuit, although it reduces the efficiency considerably. For equal power the weight of the polyphase motor is less than that of the direct-current machine, and it can stand considerable overloading; there is very little difference in efficiency, power factor, starting torque and exciting current between the two-phase and the three-phase motors, the slight difference being in favor of the three-phase. When the load consists chiefly of induction motors the power factor varies between 0.65 and 0.85, being, as a rule, between 0.75 and 0.8; the motors and transformers and not the line are the chief sources of lag; a few large synchronous motors will compensate it to a considerable extent, as when over-excited they will act as condensers, generating a leading current. In power factor the advantage of the three-phase over the two-phase motor is practically negligible; as the load decreases the power factor also decreases. With polyphase motors the frequencies are considerably lower than 100 per second, as high frequencies increase the number of poles, the magnetic leakage, the magnetizing current and the skin effect in conductors; in the majority of the polyphase plants in America the frequency is 25 and a little over, while in Europe it is somewhere over 40.

COMBINED DESTRUCTOR AND LIGHTING PLANTS. Scott. Lond. "Elec. Rev.," Dec. 9.—A short article calling attention to several points in connection with such combined plants. If it is decided to use destructor steam for electric lighting purposes, instead of for sludge cremation, which latter he considers a more legitimate object, then the destructor plant should be considered only a sub-station or as a small station prior to the erection of a larger one; the location of the main lighting station should be considered on its own merit. He does not favor the argument that [illegible] can be used for both stations, each should be controlled by a separate committee and by different managers. On account of the dust, the two stations should be isolated as far as possible. As destructor plants are large, the item of steam piping will be considerable; the irregular supply of refuse involves storage difficulties; under the best conditions the steam pressure will vary considerably.

DESTRUCTOR PLANT. Lond. "Elec. Rev.," Dec. 9.—An editorial discussion of the figures concerning the Shoreditch plant.

[illegible] TURBINES AND UNIPOLAR DYNAMOS.—Lond. "Elec. Rev.," Dec. 9.—A communication from the Parsons Com[illegible] pany stating that that company has constructed unipolar dynamos driven from steam turbines; one of them is working successfully, and is believed to be the first unipolar dynamo in commercial use; its output is 6000 amperes at 1.25 volts, at a speed of 1000. Another combination is shown in their catalogue in which a unipolar dynamo of 150 kw at 5000 revolutions is driven by a steam turbine.

ELECTRIC PUMP.—"L'Eclairage Elec.," Dec. 3.—A description of the arrangement of electric pumps at the d'Anzin mines.

ENGINES.—"Power," Dec.—Brief, illustrated descriptions of several large American engines for European lighting stations.

NIAGARA POWER DEVELOPMENT IN CANADA. Dunlap. "West. Elec.," Dec. 17.—An explanation of the controversy which has led to the present dispute between the Government and the Canadian Niagara Power Company.

Traction.

MIXED ACCUMULATOR AND TROLLEY SYSTEM IN PARIS. de Marchena. "L'Eclairage Elec.," No. 26.—An abstract, with some of the data, of the article recently read before the International Society. The data given in the abstract supplements the article in that journal which was published in its issue of June 11. He made a number of measurements on this line; the weight of the car is 10,000 kg in addition to the battery, which weighs 3800 kg, and passengers weighing 4000 kg, making a total of 18 tons. With the empty car and fifteen stops on the trip of about 5 miles, the energy consumed was 550 watt hours per car km; with a loaded car weighing 17 tons, under similar circumstances, 625 watt hours; these are the figures obtained on the experimental trips; in actual service, with twenty-five to thirty stops, the consumption was 675 to 800 watt hours, or a mean of 750; it appears that this is the energy consumed by the motors, and does not include the losses in the lines or in the accumulators; the consumption at the central station is also given; about one-third of the distance is run by trolley and two-thirds by accumulators; the mean per car kilometre varied during three months from 1122 watt hours to 1462.

CANAL TRACTION.—Lond. "Elec. Rev.," Dec. 9.—The first of a series of abstracts of the article by Van der Wallen from the May issue of the Bul. of the Assn. of Elec. Eng., of Liege, the whole number being entirely devoted to the question of canal traction, both mechanical and electrical; the abstracts are intended to give a summary of the important points in the article. The present portion is devoted almost entirely to mechanical traction in general.

CANAL TRACTION. Galliot system. "Cosmos," Dec. 10.—A popular description of this system, which was recently described in the "Digest" and is in use in France. An outside view of the locomotive is given, as also of the propeller system, in which the propeller is attached to the end of the removable rudder.

ELBEUF. Montpellier. "L'Elec.," Dec. 3.—An illustrated description of this trolley line, one of the features of which is that the trolley wires are on the side of the street, over the curb.

RAILWAY TESTS. Schiemann. "L'Ind. Elec.," Dec. 10.—A long translation in abstract of the article noticed in the "Digest" Oct. 29.

FREIGHT CAR.—"Elek. Zeit.," Dec. 8.—A well-illustrated description, with working drawings, of the freight motor car used on a German trolley line on which there is considerable freight traffic.

RAILWAY ACCOUNTING. Mattersdorff. "Elek. Zeit.," Dec. 8.—An explanation of a graphical method for determining the gross expenses of electric railways. This method is claimed to afford not only a reliable method of determining the result but also for giving a clear idea of the relations of the expenses and giving the limits for other expenses, such as the portion to be paid to the municipality, concerning which there is some choice left; it furthermore enables one to determine other factors which are usually accepted arbitrarily. In his diagram the horizontal distances represent the income per car kilometre and the vertical distances the corresponding income per year.

LOCOMOTIVE.—"Eng. and Min. Jour.," Dec. 17.—A brief, illustrated description of the small, single-motor Jeffrey locomotive for use around iron works and steel mills.

CHICAGO.—"Elec. Eng.," Dec. 15.—A brief, illustrated description of the power house of the Union Elevated Railway, which has recently been completed.

Installations, Systems and Appliances.

THE BRIGHTON BREAKDOWN. Fleming. Lond. "Elec.," Dec. 9.—A short communication discussing the possible causes and making a suggestion. If the feeders of a shunt dynamo are suddenly short-circuited, the circuit having low resistance, but considerable inductance and not a negligible capacity, electrical oscillations will be set up in that circuit, and there will thus be rapid alternations of voltage superimposed on the normal voltage at the terminals of the field coils and armature; its effect will be to enormously increase the armature reaction for the moment, and this alone tends to demagnetize the fields, while the drop in the armature will reduce the normal shunt current; hence the oscillatory currents through the shunt may overpower the normal magnetizing currents, and they are exactly of the character required to demagnetize the iron; the reverse demagnetization sometimes finally left may be due to the final rupture of the short circuit, creating a momentary increase of current through the armature, due to inductance, and sending a wave of current in the reverse direction through the shunt magnets. These current changes are so rapid that no maximum or minimum cut-outs depending on the magnetization of iron have time to act. One remedy is a self-excitation, not from the bus bars, but from a separate exciter, or preferably a storage battery; compounding the fields is a partial remedy. This is followed by a discussion by Philip, who refers to that of Quin noticed last week; he refers to the transformer effect and to an experiment made by him, which he explains. In this the actions are that a sudden increase of current in the armature of the short-circuited dynamo suddenly removes the magnetism from the field coils, and therefore sets up a voltage in these coils, increasing momentarily the original exciting current; if the short-circuit current has been sufficiently large, the e. m. f. set up will increase the current through the exciter armature, and decrease its field current, or even reverse it; the reverse current in the exciter shunt reverses the polarity of the exciter, which in turn reverses the field of the dynamo. There are two methods of avoiding this trouble—to use separately excited machines protected by maximum and reverse current cut-outs, and excite the fields either by secondary batteries or a series dynamo. The transformer effect in shunt-wound dynamos in parallel shows that any short circuit in the armature coils must produce a drop in the voltage in its shunt circuit if the latter is connected to the bars, and it is often conceivable that a reversal of polarity may be caused; and a short circuit on the bars, if all the machines are not working at precisely the same portion of the magnetization curve, may cause some to act as a motor. It has been stated that a sudden increase of load on the bus bars, fed by shunt-wound dynamos in parallel, has caused the machines to cease to excite, while if the same load is applied gradually this will not occur.

The "Elec. Rev.," Dec. 9, contains a communication by H. C. L. In the case of a sudden short circuit the flux will not instantaneously respond to the fall of pressure and to the increasing demagnetizing action of the armature, and therefore a heavy momentary current may be generated, the energy being supplied from the kinetic energy of the machinery, accompanied by a loss of speed. It thus seems possible that the strengthening effect of the demagnetizing winding may overpower the weakening effect of the field winding, so that actually there may be a momentary reversing action which might produce some peculiar magnetic effect. No reversing action, even momentary, exceeding the coercive force of the magnetic circuit, can take place on short circuit, dead or otherwise, if it is assumed that the amperes and volts vary according to the characteristic curve.

LARGE ISOLATED PLANT.—Lond. "Elec. Rev.," Dec. 9.—A brief, illustrated description of a gas engine plant at the Royal Agricultural Hall in Islington. There are five gas engines of 63 horse-power each; a double ignition tube bracket is used, which is said to be one of the most marked recent improvements in gas engines.

PRIVATE PLANT.—Lond. "Elec. Eng.," Dec. 9.—An illustrated description of a private lighting plant in a large country seat known as Knowsley Hall; accumulators are used.

SWITCHES FOR CONTROLLING ACCUMULATORS.—Lond. "Engineering," Dec. 9.—In this continuation of the description of the former Schuckert works illustrated descriptions are given of some of the switches installed by that company for operating the regulating cells, as used at Barmen, Hanover, Duesseldorf and Altona.

Wires, Wiring and Conduits.

LOW-TENSION ACCIDENTS.—Lond. "Elec. Eng.," Dec. 9.—A translation in part of the article noticed in the "Digest" Nov. 19 (E. T. Z.)

Electro-Physics and Magnetism.

MECHANICAL REPRODUCTION OF MAGNETIC PHENOMENA. Weyher. "Comptes Rendus," No. 21; abstracted in Lond. "Elec.," Dec. 9.—A wooden shaft, with paper paddles along its whole length, is made to represent a bar magnet; when rotated it will suck in air at both ends and expel it from the central region, thus producing vortices in the surrounding medium; unlike poles will attract and like poles repel each other. A mill-wheel capable of turning on a fixed spindle represents a magnetic body. There is no attraction by the central region.

VIBRATIONS PER SECOND. Branson. Lond. "Elec. Eng.," Dec. 9.—A brief note on a recent paper in which, after calling attention to the dissimilarity of radiations transmitted by the atmosphere and those transmitted by the ether, he gives the following table showing the number of vibrations of various forms of waves. (The accuracy of some of these is amusing rather than assuring.) Vibrations per second:

288,224,000,000,000,000.	Roentgen rays.
1,125,899,906,842,624.	Photographic limit of solar spectrum.
562,949,953,421,312.	Green light.
281,474,976,710,656.	Infra red (photographic limit).
70,368,744,177,664.	Heat rays of solar spectrum, lowest direct measurement.
67,108,864.	Electric oscillations in Hertz resonator, 70 cm. diameter.
32,768.	Audible vibrations, extreme upper limit.
4,096.	Music, highest note.
32.	Music, lowest note.
16.	Water surface waves of minimum velocity.

STRATIFIED BRUSH DISCHARGE. Toepler. "Wied. Ann.," No. 12; abstracted in Lond. "Elec.," Dec. 9.—By inserting in the circuit a spark gap and a large liquid resistance the capacity being small, he obtains stratification in the brush discharge in air. This is considered another bridge across the gulf that divides the phenomena of electrical discharge in the open air and vacuum respectively.

STRAINS DUE TO MAGNETIZATION. Knott. "Proc. R. S. Edinburgh," No. 2; noticed briefly in Lond. "Elec.," Dec. 9.—He investigated these strains in a series of nickel or iron tubes, boring them out by successive stages.

MAGNETIC PROPERTIES OF SHEET IRON. Rohr. "L'Eclairage Elec.," Dec. 10.—An abstract, with some of the tabular data, of the article noticed in the "Digest" Nov. 26.

CURRENTS MEASURED BY MAGNETIZATION. Pockels. "Annal. Phys. Chem.," 65, p. 458; noticed briefly in "Science Abstracts," Nov.—He endeavored to determine the maximum discharge current by the remanent magnetism induced in magnetic substances acted upon by the current. Ballistic galvanometers give only the average, while the remanent magnetism would indicate the maximum current. He used basalt as the magnetic substance, in order to avoid eddy currents, and the results are claimed to be very favorable. A magnetic field lasting only one-millionth of a second shows the same remanent magnetism as is induced by a field which has been kept a long time at the same strength. Hence the magnetization of the pieces of basalt, he claims, may be used to determine the current strength of lightning discharges.

RESISTANCE OF MOVING ELECTROLYTES. Hall. "Phys. Rev.," Nov.—Bosi, some time ago, described experiments which appeared to show that a velocity of 10 to 12 cm per second of an electrolyte in the direction of or contrary to the direction of an electric current passing through it, makes a very considerable change in the electrical resistance. In the present short article he describes experiments which show that if the effect exist at all it must be very much smaller than the figures given by Rosi.

POLARIZATION AND INTERNAL RESISTANCE OF CELLS. Guthe. "Phys. Rev.," Nov.—A short article showing that Wiedburg's theory of galvanic polarization demands a curve for the internal resistance, decreasing with increasing currents.

DISCHARGE OF A CONDENSER. Smith. "Phys. Rev.," Nov.—A short article on the influence of a short-circuited secondary upon the oscillatory discharge of a condenser; it appears that under certain conditions the presence of a secondary coil causes a diminution of the natural period of vibration of the primary circuit. The article is theoretical in character.

MAGNETIC DEFLECTION OF CATHODE RAYS. Merritt. "Phys. Rev.," Nov.—Descriptions of experiments to determine whether direct or reflected cathode rays are really deflected by the magnet in appreciably equal amount. The results show that if they differ at all the difference is extremely small.

Electro-Chemistry and Batteries.

ACCUMULATOR CONSTRUCTION. FitzGerald. Lond. "Elec. Eng.," Dec. 9.—In this continuation of his long serial he discusses the ampere-hour equivalent and the monad-gram equivalent of peroxide of lead, in connection with which many misapprehensions have arisen. In a previous paper he gave the value as 4.455 grams; Plante gave 4.48; in another article the present author gave 4.442 and also half of that value. The systems of charging accumulators are then discussed; this may be done with constant current, constant potential or constant power; it is not possible to say which of them is best, as it depends on circumstances; it is not only a question of economy of time but also of the equality of the active material energized by the charge; from experiments he believes that there is no doubt that the active material peroxidized or reduced at a high current density differs in quality from that produced by low-current density, the former appearing to be more conductive and possessing a higher specific capacity. Some passages from Treadwell's recent book are then reproduced. In the previous installment in the issue of Sept. 2 he discussed the mean specific gravity of a compounded mass of substances of various specific gravities; also the calculation of the size of a battery to go into a given space.

ACCUMULATORS FOR AUTOMOBILES. Reyval. "L'Eclairage Elec.," Dec. 3; "L'Ind. Elec.," Dec. 10.—Tabulated data of the Valls system of accumulators, of which three types are made, the very light, the light and the normal. It seems to be a modified Faure-Sellon-Volckmar type. For the very light cell the normal [illegible] is 1.5 hours, the output 16.5 amperes, which is 2 amperes per kg of total weight, the power is 30 watts, the capacity [illegible] a battery of 44 cells weight 352 kg [illegible] a carriage weighing 1200 kg for about 60 km at a [illegible]

SOLUTION OF NOBLE METALS. Margules. "Wied. Ann." [illegible] noticed briefly in Lond. "Elec.," Dec. 9.—An improvement of his device for dissolving gold and platinum. It consists of [illegible] the current through [illegible]

the noble metals is evidently connected with some phenomenon of polarization, and if the latter is eliminated the "nobility" disappears.

CALCIUM CARBIDE INDUSTRY.—Lond. "Engineering," Dec. 9.—An article summarizing the progress made in this industry since the previous summary, which was published in July of this year; the original articles are referred to only briefly, but the references to the originals are given.

ASHCROFT PROCESS.—"Eng. and Min. Jour.," Dec. 17.—A note referring to the printed report of the company which has been experimenting unsuccessfully with this process; the principal cause of the difficulty was the formation of moss zinc. Editorially it is thought unlikely that any more will be heard of this process.

CHLORATE WORKS. Kershaw. "Eng. and Min. Jour.," Dec. 17.—An abstract of the description of the St. Michel Works, which was noticed in the 'Digest" Dec. 17.

ELECTRO-CHEMISTRY IN EUROPE.—"Elec. Eng.," Dec. 15.—Illustrated abstracts and reprints of the recent articles by Kershaw in the Lond. "Elec. Rev.," all of which have been duly noticed in the "Digest."

Units, Measurements and Instruments.

APPARATUS FOR MEASURING INSULATION. Heitmann. "Elek. Zeit.," Dec. 1.—A brief description of a probable instrument for this purpose made in Germany.

MEASURING APPARATUS. Armagnat. "L'Eclairage Elec.," Dec. 3.—Illustrated descriptions of various apparatus taken from patent specifications.

INDUCTION COIL INTERRUPTERS.—"L'Eclairage Elec.," Dec. 3; "L'Ind. Elec.," Dec. 10.—Illustrated descriptions of two forms recently shown at the French Physical Society.

HIGH-FREQUENCY CURRENTS.—"Sc. Am. Sup.," Dec. 24.—A reprint from "La Nature" of some of the details of the apparatus used by Dosne in the production of high-frequency currents.

MEASURING SHORT ELECTRIC WAVES. Cole. "Phys. Rev.," Nov.—A short article on these measurements and the transmission of such waves through water cells.

PREPAYMENT METER.—"Elec. Eng.," Dec. 15.—A reprint in abstract of the description of the Long-Schattner meter, noticed in the "Digest" Dec. 17.

Telegraphy, Telephony and Signals.

LIGHT TELEGRAPHY. Zickler. "Elek. Zeit.," Dec. 8.—A short account of some further experiments made with his system of wireless telegraphy with the use of ultra-violet light, as described in the "Digest" Aug. 13. He used a large searchlight with a metallic reflector. When the distance was 60 metres no rarefaction of the air was required in the receiving apparatus in order to give sure and correct signals. In another test the distance was increased to 450 metres, and good results were then obtained when the air pressure was 350 mm; this test was made in bright sunlight. In another test the distance was 1.3 km, and the air-pressure then was 200 mm. The length of the arc and the voltage may have a great effect on the production of ultra-violet rays, but further tests in that direction were not made.

TYPE-PRINTING TELEGRAPH. Higgins system. Lond. "Elec.," Dec. 9.—An illustrated description of the improved form of this instrument. It is claimed that a speed of twenty-five to thirty words per minute is possible, and that the manipulation is easy. Instruments have been working in London on a resistance of 1500 ohms; also between London and Folkestone, a distance of 60 miles; satisfactory tests were also made by the British Post Office.

PROGRESS IN TELEPHONY AND TELEGRAPHY. F. L. "Elek. Anz.," Dec. 4.—A review of the progress made during the third quarter of the present year.

MODERN TELEPHONY. Wehrenalp. "Zeit. fuer Elek.," Dec. 4.—The conclusion of his very long series. In the present portion he discusses telephone centrals and their construction.

UNDERGROUND TELEPHONE CIRCUITS. Zappe. "Elek. Zeit.," Dec. 1.—A long abstract of a recent paper read at Frankfort referring chiefly to the projected underground system for that city.

TRAIN SIGNALS. Hoefer. "Elek. Zeit.," Dec. 1.—A suggestion, illustrated with a diagram, to overcome some of the objections to the present system used on German railways.

SUBMARINE CABLE GRAPNELS. Bright. "Sc. Am. Sup.," Dec. 24.—The beginning of a reprint of the article noticed in the "Digest" Dec. 3.

Miscellaneous.

CARBONS. [illegible] Lond. "Elec.," Dec. 9.—In this continuation of his long serial he describes the gas generators. In the issue of Aug. 26 the [illegible] cutting, grinding and pointing of carbons is discussed and described, illustrations of machinery being given. In the issue [illegible]

ACTION OF ELECTRICITY ON PLANTS. Cook. "Sc. Am. Sup.," Dec. 24.—A long abstract of his Brit. Assn. paper, which was noticed in the "Digest" Oct. 22.

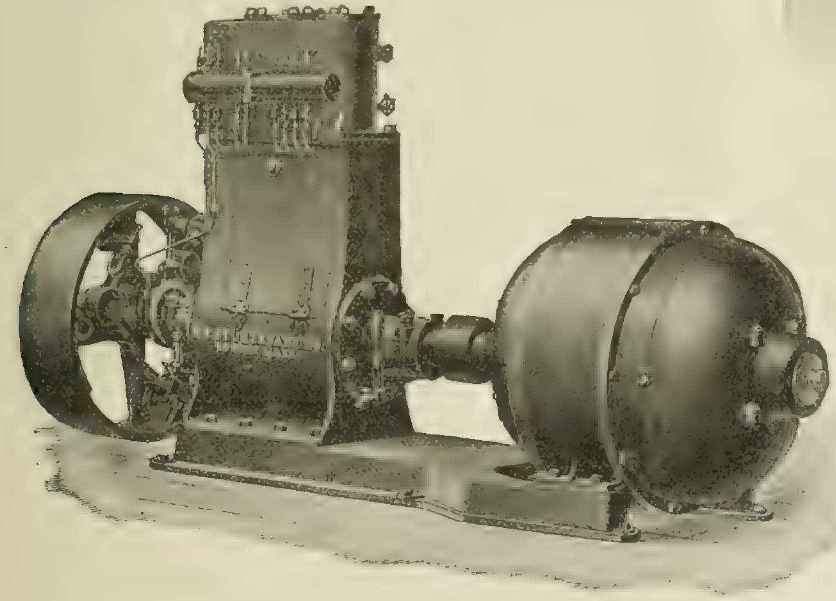
pended. The Campbell system, the invention of Mr. George L. Campbell, of Towanda, Pa., and now being exploited by the Campbell Electrical Traction Company, 451 Greenwich Street, New York, possesses some unique features. The conduit is continuous, both air and water tight, and rests upon the top of the ties. The continuous electrical conductor lies on the bottom of the conduit inside. The metallic top of the conduit is insulated from the rest of the structure, and brought into electrical contact with the conductor within by means of a specially designed trolley or traveler which runs in the conduit, the movement of the trolley being controlled by a pair of strong electromagnets in the car. The metal shoe suspended from the car floor makes contact with the top of the conduit, the current being conveyed to the motor in the usual manner. The points of superiority claimed for this system are absence of switches and other apparatus that might cause trouble. It is claimed that absolutely reliable connection between the motors and conductor can be had and maintained at all times, and there being no "make and break" of the current all the incidental dangers and annoyance arising from arcs are thus avoided. The points of the system that will strongly appeal to the practical man are the claims of low cost of installation and maintenance and ease of access for repairs, which, however, are said to be few and far between. It is stated that this system represents the possibility of perfect service under all fair conditions, and better service than is obtainable at present under the worst conditions.

The Campbell Company is considering a proposition from a local street railway company at Towanda, Pa., to test the system in actual service on 3 miles of track in that place.

Fusible Cut-Out Carbon Lightning Arrester.

Operators of exchange and toll lines and telephone users generally wish to avoid interruption of service which causes loss of revenue, inconvenience, waste of time and expense. The wisdom, therefore, of protecting the apparatus by some efficient device is self-evident.

The fusible cut-out carbon lightning arrester manufactured by the Harvard Electric Company, 52 Dearborn Street, Chicago, it is claimed, affords protection to telephones and switchboards from damage by lightning discharges and from heavy currents escaping from electric light and power circuits. It has been severely tested under all conditions and found to be reliable. The instrument is compact and very simple in construction. Owing to the absence of connections underneath no cross-talk is possible. The metal parts are mounted on a substantial porcelain base, all parts being indestructible with the exception of the fuse links.



Enclosed Direct-Connected Generator.

The carbon lightning arrester used alone does not afford proper protection to telephones or switchboards, neither does a fuse arrester, when used alone. The combination of the two, therefore, should be employed to secure immunity.

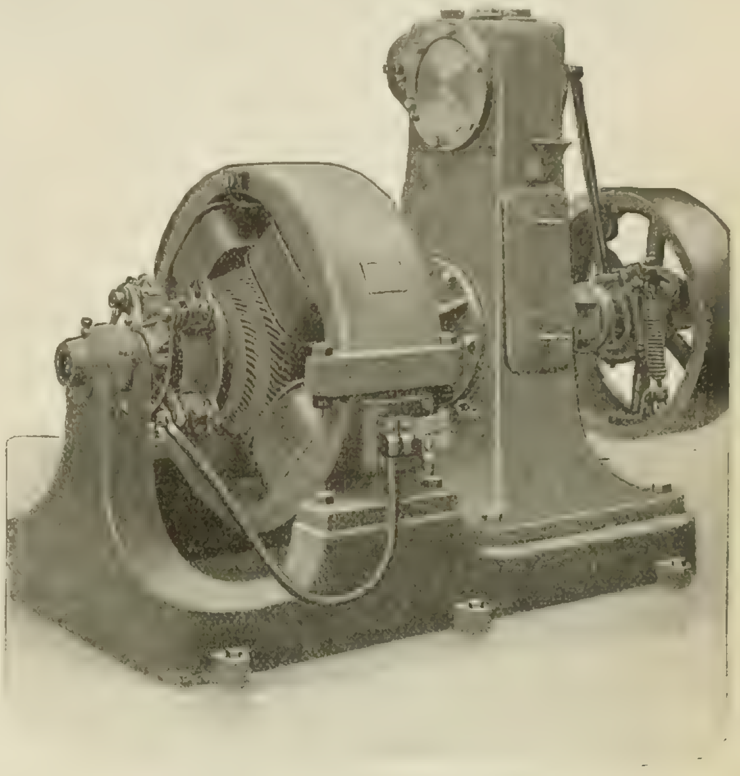
The Harvard Electric Company is prepared to furnish these arresters in any desired quantity.

A Direct-Connected Marine Set.

The accompanying illustration represents a type of marine generating plant which has found considerable favor among the officers of the Navy Department, and has been installed in some of the smaller vessels in the navy. The dynamo is a direct-connected multipolar machine manufactured by the E. G. Bernard Company, Troy, N. Y., and the outfit is similar to the one installed by the Bernard Company on the United States steamer "Mangrove," and the one more recently installed on the United States Coast Survey steamer "Blake." The officers of the "Blake," it is stated, are very much pleased with the plant, which operates so smoothly that a person standing 10 feet away from the engine, when it is running, can hear no noise from it. In some ships the vibrations from the generating plant are very noticeable. The E. G. Bernard Company has just started the work of installing a similar plant on the coast survey steamer "Pathfinder," which the Government is building to send to Alaska to survey the coast of that far-away territory.

These two plants are thoroughly up to date in design, and are complete in every respect. They include searchlight and other modern appliances, such as electric ventilating fans for the ward room, staterooms and cabins.

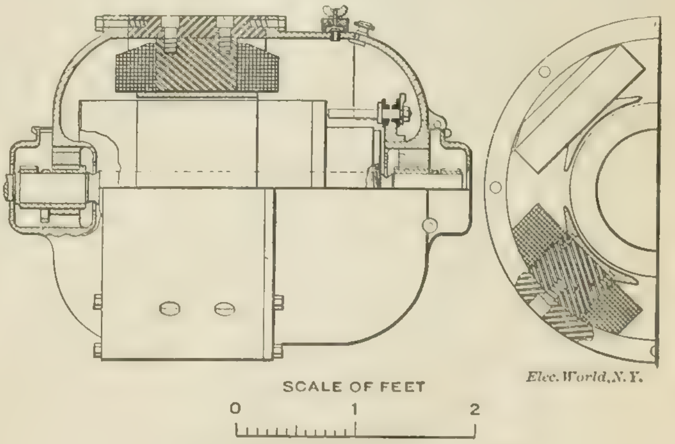
The Bernard Company states that it secured the contract for these plants simply through the satisfactory results obtained on the "Mangrove" and "Vixen," which are equipped with similar outfits. The engineers of the ships, it is stated, have praised the general design of the apparatus. The dynamo runs at 550 r. p. m. It is of the four-pole type, the armature and commutator having a large radiating surface, which keeps the temperature down to an exceedingly low degree. The engine and dynamo base, including the outboard bearing, is one casting.



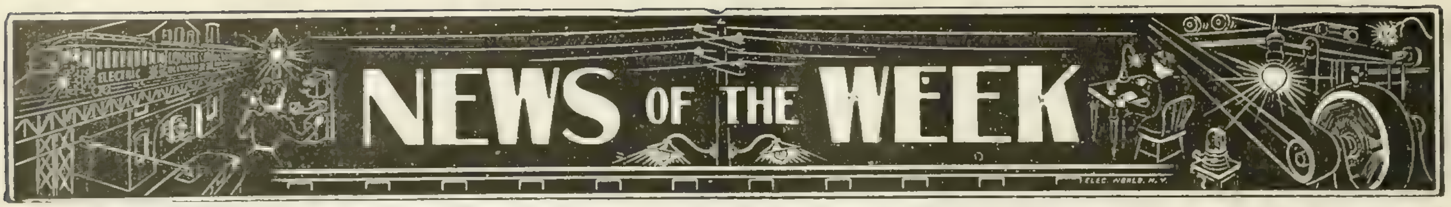
A Compact Marine Generating Plant.

The Sturtevant Enclosed Generating Sets.

A combination of engine and generator particularly suited for locations subjected to dust, grit or moisture, is that shown in the accompanying illustration, made by the B. F. Sturtevant Company, Boston, Mass. The engine is of this company's well-known double-upright type, consisting of two double-acting, single-expansion, short-stroke cylinders placed close together and connected to two cranks set 180 degrees apart, with no journal between the cranks. This gives a very even balancing of the reciprocating action, which permits high speeds without vibration. The steam is controlled by a piston valve at the fly-wheel end of the engine and driven through a rock-arm by a double-weight shaft governor in the fly-wheel. Mounted between the forks of the Y-shaped bed-plate and connected to the engine by a coupling is a four-pole generator, the enclosing shell of which is almost spherical in contour. The magnetic circuit consists of a cast-steel yoke, ring-bolted to which are cast-steel poles with cast-iron pole shoes, holding the field coils in place. The latter are tapered at the outer ends to make use of all available space for windings. The hemispherical enclosing shells are of cast-iron, provided at the commutator end with two doors hinged near the outboard bearing, giving a wide opening for inspection and attention.



Sectional Views of the Generator.


ELEC. WORLD, N. Y.

NEWS OF THE WEEK

Financial Intelligence.

THE BOSTON ELECTRIC LIGHT COMPANY, Boston, Mass., has declared a quarterly dividend of $1.50 per share, payable on January 14 next.

THE AMERICAN BELL TELEPHONE COMPANY has declared a quarterly dividend of 3 per cent. and an extra dividend of 1½ per cent., payable on January 16.

THE CONSOLIDATION OF ELECTRIC LIGHT INTERESTS.—The Boston "News Bureau" states that it learns upon unquestioned authority that the New York Gas, Electric Light, Heat & Power Company has secured control of the Edison Electric Illuminating Company, of New York. The stock of the Edison company, it is stated, will be taken in on a basis of about 210 in exchange for a 4 per cent. bond. The issue of bonds has been underwritten and will be offered to the public within the next fortnight. The subscription price, it is stated, has not yet been determined, but will not be under par. This will insure something more than 8 per cent. on the Edison stock.

Special Correspondence.

NEW YORK NOTES.

"EDUCATION OF ELECTRICAL APPRENTICES AND JOURNEYMEN" was the title of a paper read before the American Institute of Electrical Engineers by Mr. Arthur A. Hamerschlag on Wednesday evening, December 28. The subject was illustrated by lantern slides.

TO FUMIGATE STREET CARS.—Col. M. C. Murphy, president of the Board of Health, has requested the Sanitary Department of the board to request the presidents of the street surface and elevated railways in all the boroughs of the city to fumigate the mats, rugs, etc., on their cars, and otherwise put the vehicles in such a condition that they will not be dangerous to public health. Col. Murphy was impelled to give this order on the strength of the report of several officers of the board, who became convinced that many persons contracted the grip in the street cars.

INSPECTING ELECTRICAL WIRING.—Deputy Commissioner Walton, of the Department of Public Buildings, Lighting and Supplies, has sent notices to all electrical contractors and electrical companies in Greater New York to the effect that before beginning work on any electrical installation in the Borough of Brooklyn they should apply for certificates on forms provided for the purpose. Whenever work of this sort is found after inspection to be satisfactory, certificates covering the same are issued. Electric lighting companies have been requested not to make and not to permit to be made connection with any electric wiring or fixture for which the contractor does not produce a certificate from the department.

A RAILWAY "KICKING MACHINE."—It would be strange indeed to find a street railway that could satisfy everybody that travels on its lines. Every well or poorly-regulated street railway has a complaint department, and in the case of the Metropolitan Street Railway Company, of this city, it is called by the employees the "kicking machine." Some statistics of this bureau of the Metropolitan company show that one passenger out of every 60,000 makes a "kick" about something. As the road carries an average of 600,000 passengers a day, an average of ten complaints is received, copied, filed, indexed, investigated and reported upon each day in the year. It is further found that 97 per cent. of the written complaints are wholly unintelligible, and that 50 per cent. are couched in inflammatory and profane language. A large proportion of the complaints fail to give the number of the car or the conductor, or even the line on which the alleged indignity was suffered. Women are much more [illegible] ng the time, place, car, conductor's number, etc. The largest number of com- [illegible]

[illegible] and that these gentlemen intend to institute radical improvements in the ser- [illegible]

SOUTHERN NOTES.

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Power Company expressed their approval of the measure, and also expressed entire willingness that Congress should give the commissioners full discretion in the matter.

A NEW ELECTRICAL ENTERPRISE FOR RICHMOND.—The Richmond, Va., Council passed an ordinance on December 23 granting franchises to the Virginia Electrical Railway & Development Company. This opens the way for the establishment of one of the most important enterprises inaugurated in Richmond in recent years. The company, composed mainly of Richmond and Baltimore men, has ample capital, and proposes to go into the electrical business on an extensive scale. The plant will be located on a part of the Haxall Hills site, with a river front of a thousand or more yards. The electric company will use the water power of James River for the distribution of electric power, and conditional contracts have been made by a number of the largest manufacturing concerns here. Plans for the buildings, which, with machinery, will cost $300,000, have already been adopted.

BUFFALO AND NIAGARA FALLS NOTES.

THE ELECTROPATHY COMPANY, of Buffalo, has been incorporated, the directors being Alfred C. Scheu, Ellen Rodgers and Elbert Rodgers. The company will engage in the manufacture of electrical apparatus.

DEMAND FOR THE TELEPHOTOS.—The works of the Boughton Telephotos Company, in Buffalo, have received a Government order for ten new sets of this electrical signal apparatus. A letter from Commodore Marix states that the apparatus was found very efficient during the war.

THE BUFFALO FIRE DEPARTMENT is contemplating the changing over of its electric generating apparatus from primary cells to storage battery, but no decision has been reached as to the system to use. The work may be deferred till the headquarters building has been remodeled.

NIAGARA POWER IN BUFFALO.—The Buffalo General Electric Company has so far shut off about 1000 horse-power from the local plants and switched on Niagara power. The work has been carried on with great care, so that no outward evidence of the change has made its appearance.

NIAGARA POWER FOR A STEEL COMPANY.—The latest negotiations for power at Niagara is with a steel company that proposes to locate somewhere in the vicinity of the power house. As yet the proposals have not been carried far enough to warrant the company in giving out direct information in regard to it.

THE CANADIAN POWER FRANCHISE.—The Niagara Falls Power Company has won its case in court at Toronto against the people on that side of the line who were trying to obtain an annulment of the exclusive grant given to that company some years ago for the development of power from the falls. It does not appear that the opposition was in very active existence, for no move has ever been made to do any work. Plans were drawn and a good deal of talking was done. All that the Canadians are supposed to have undertaken was either to spur the company on or to drive it away, so that a new franchise could be obtained for sale to outside parties. The company set forth that for certain reasons beyond its control it was unable to develop the required 25,000 horsepower within the time specified. How long an extension was granted is not reported.

CHICAGO NOTES.

MR. M. B. WHEELER, secretary and treasurer of the M. B. Wheeler Electric Company, Grand Rapids, Mich., paid a visit to Chicago last week on his way home from an extended trip through the South. Mr. Wheeler, while in Chicago, closed several large and important deals in connection with the enlargement of his company's business.

WIRELESS TELEGRAPHY BEFORE THE CHICAGO ELECTRICAL ASSOCIATION.—At the regular meeting of the Chicago Electrical Association on December 16 Mr. Arthur Vaughan Abbott, chief engineer of the Chicago Telephone Company, delivered a lecture on "Wireless Telegraphy." His practical demonstrations with working apparatus were enthusiastically received by a large audience. Mr. Abbott has been experimenting and developing his apparatus during the past year, and now he has established communication between his office and residence, 2 miles distant. In the lecture the principles underlying wireless telegraphy were fully explained, with due credit given to Hertz, and other pioneers and later investigators, including Marconi. After the lecture the annual election of officers was held, with the following result: President, Thomas G. Grier; vice-president, J. M. Hollister; treasurer, Harold Almert; secretary, Cloyd Marshall; directors, F. S. Hickok, E. W. Jewell and [illegible] Building.

INDIANA NOTES.

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Telephone Company, of Green Castle, with a capital stock of $10,000, to operate a plant and line in Putnam, Parke, Clay, Hendricks and Morgan Counties. The board of directors is composed of F. C. Gilmore, C. C. Hart and Jesse Richardson.

THE BUILDING OF AN ELECTRIC line from Hartford City to Franklin, thence to Lapel, Perkinsville and Indianapolis, is now assured, the several townships along the proposed route having pledged the required aid. The citizens along the proposed line are jubilant over the prospects and rights-of-way are readily secured.

AFTER A FIFTY-YEAR RAILWAY FRANCHISE.—Terre Haute capitalists are interested in a project and have asked for a fifty-year franchise for an electric line from Terre Haute to Mattoon, Charleston and Paris, Ill. The latter city has no street-car line, and the establishment of a local plant in connection with the line would be easily accomplished.

MAN AND WIFE GET A TELEPHONE FRANCHISE.—Wm. N. Turner and his wife, Emma B. Turner, have been granted a telephone franchise by the Common Council of North Vernon. Long-distance connection will be made. Business houses are to be charged $1.50, and residences $1 a month. Mr. and Mrs. Turner are being commended for their enterprise.

A NEW ELECTRIC RAILWAY.—Preliminary steps have been taken to build an electric line from Garrett, DeKalb County, to Auburn Junction, and thence to Ashley and Hudson. The project is meeting with opposition by business men in small towns through which the line passes, on the ground that people would have an opportunity to go to the larger towns to do their trading.

Wisconsin Notes.

A NEW PLANT FOR CHIPPEWA.—The Chippewa Valley Electric Railway Company, of Eau Claire, will put in a plant of its own, and will bid on the city lighting.

TO REPEAL AN ELECTRIC RAILWAY FRANCHISE.—An ordinance has been introduced in the Milwaukee Common Council repealing the franchise of the Waukesha-Milwaukee Street Railway Company, obtained some time ago through the efforts of John W. Wagner, but which has never been used.

ELECTRIC RAILWAY FRANCHISE IN KENOSHA.—John W. Wagner, the attorney, who obtained a street railway franchise from the Milwaukee Council a few years ago and never made any practical use of it, has, in behalf of the Kenosha Traction Company, applied for one from the city of Kenosha. A. C. Frost and Geo. H. Ball are building an electric line from Waukegan to Evanston, and Mr. Wagner proposes to build a line through Kenosha and a connecting link between that city and Waukegan. If he obtains the franchise and the line is built there will be a through line of electric cars from Milwaukee to Evanston. Mr. Wagner declines to state who is back of him financially.

INJUNCTION AGAINST THE DISPOSITION OF STOCK.—Edward E. Wagner has begun a suit against William J. Austin and the Milwaukee Rail Joint & Welding Company, and asks for an injunction restraining Mr. Austin from taking any action that will interfere with the work of the company. It is alleged that a patent rail-welding process of Mr. Austin's was taken up by the company under a contract by which Mr. Austin was to receive certain sums. Mr. Wagner, who secured a third of Mr. Austin's interest, alleges that if Mr. Austin were allowed to dispose of his alleged rights on the ground that certain portions of the transfer agreement had been violated the company would suffer loss.

St. Louis Notes.

THE STREET LIGHTING MATTER.—The Lighting Committee of the Board of Public Improvements is considering the question of not naming in the next bill any particular method of lighting the streets. The amount of light is to be specified in candle-power, and the constructor is to be allowed to use any method of light he selects provided he supplies the required amount.

ANOTHER ROAD SOLD TO THE HAMILTON SYNDICATE.—It is reported that the franchise of the Wellston, Creve Cœur Lake & St. Charles Railroad Company has been purchased by the Hamilton Syndicate through Charles F. Orthwein, and it is to extend the Easton American line over the St. Charles road to the Missouri River, where a bridge will be built to St. Charles.

NEW ELECTRIC ROAD.—Work commenced Wednesday on the new railway line of the Fenton & Southwestern Railway Company connecting the town of Fenton, St. Louis County, with St. Louis. The McCoy Construction Company is building it, and announces that the line will be ready for operation by May 1, 1899. The road will be 28 miles long and run through one of the most prosperous portions of St. Louis County. The stockholders are said to be largely prosperous St. Louis County farmers. Besides carrying passengers the road will make a specialty of fast freight cars, which will bring fruit and produce to the St. Louis market.

Pacific Coast Notes.

THE COLUMBIA & NORTHERN TELEPHONE & TELEGRAPH COMPANY, of Colville, Wash., was recently incorporated, with a capital stock of $15,000.

THE SAN PABLO AVENUE cable road, Oakland, Cal., which is owned by the Southern Pacific Railroad Company, will soon be changed over to an electric line. The foundations have been laid for the enlargement of the Temescal power station, which is necessitated by the change. The new line will connect with the end of the Telegraph Avenue line, running via University Avenue. It is said that an electric branch line will be constructed on Park Avenue to the Oakland race track.

THE LOW-WATER DIFFICULTIES RELIEVED.—The recent rains in California have been of great advantage to the water-power electric transmissions of the State. The Sacramento Electric, Gas & Railway Company, which some months ago suffered from the unprecedentedly low stage of the American River near its generating station in Folsom with water, soon made arrangements to fill nearly all of its contracts. A large steam plant which was provided for in the original plans was finished in time to take care of a large part of the load while affected by the shortage of water. At no time were the patrons of the company seriously inconvenienced for any great length of time. The Fresno plant, which, also, is operated with General Electric apparatus, soon recovered to a great extent from the effects of the drouth.

Canadian Notes.

MR. WALLABERG, of Montreal, has been in Ottawa negotiating with the Canada Atlantic Railway Company to have the new shops of the company which it is about to erect at Ottawa fitted up in a modern manner and similar to the shops recently completed at Sherbrooke, Que. There the power is supplied by electric motors. The Buffalo Forge Company's system of fans has been adopted for heating purposes.

THE METROPOLITAN ELECTRIC LIGHT COMPANY, of Ottawa, is now an incorporated body. Letters patent have been issued to the company, and extensive operations will begin at once to promote the building of the lighting plant. The canal for the development of the water power to be utilized will be 180 feet wide, 9 feet deep and 2000 feet long. The reservoir will extend up the lake for a distance of 30 miles, and will be 1½ to 3 miles wide and 40 feet from shore. The power house will be erected at the foot of the Deschene Rapids.

TO DEVELOP THE FENELON FALLS WATER POWER.—For some time past the town of Lindsay, Ont., has been trying to secure a cheap electric power. Culverwell & White-Fraser, of Toronto, undertook to form a company and transmit the power from Fenelon Falls to Lindsay, but were unable to make the financial arrangements necessary to the undertaking. The matter has now been taken up by some of the citizens of Lindsay. An electrical expert is to be employed to look into the subject, and if it is endorsed by him the plan will be carried through.

English Notes.

ANNUAL DINNER OF THE INSTITUTION OF ELECTRICAL ENGINEERS.—Over 250 members attended the annual dinner of the institution at the Hotel Cecil on December 7. After the usual loyal toasts had been duly honored, the Attorney-General proposed "The Institution of Electrical Engineers," and in the course of his speech said that the institution was an embodiment of the extraordinary development of the science of electrical engineering, whose practical application was contemporaneous with the Victorian era, and concluded with a tribute of praise to the President, Mr. J. W. Swan. In returning thanks, Mr. Swan stated that the electrical undertakings due to British capital had absorbed close on 100 millions sterling. The number of miles of electric railway and tramway in the world could be counted by thousands, the horse-power transformed into electric power by hundred of thousands, the miles of telephone and telegraph lines by millions and the incandescent lamps by tens of millions. "The Navy, Army and Reserve Forces" was proposed by the President and replied to by Admiral Sir W. J. L. Wharton, Gen. Sir Richard Harrison and Mr. R. E. B. Crompton, the latter as commanding officer of the Electrical Engineers Volunteers. This corps could, said Mr. Crompton, fill its ranks to-morrow, but its care must be to fill them with the right men. Mr. Crompton also alluded to the repulse of an attack, on Tesla's principle, in the upper regions of the atmosphere; in fact, Tesla's latest journalistic sensations afforded material for joke in nearly all the speeches.

OVERLOADED ELECTRIC LIGHT PLANTS.—The rapid increase to the number of connections to the electric lighting networks in our large towns, taken in conjunction with the rush of orders during the past two years on manufacturers of electrical plants, has resulted this winter in a most serious overloading and consequent drop of pressure in many districts. In Edinburgh a circular from the corporation electricity works had to be sent out to all consumers, asking them to use as little light as possible during the hours of heaviest load, as, owing to the contractors having failed to deliver the necessary machinery, the plant was considerably overloaded, and pressure could not be kept up during certain hours of the evening. By strenuous exertion on the part of the engineer and his staff temporary arrangements have been made by which the pressure has now reached its normal value at Edinburgh. At Manchester, however, some of the plant which was ordered as long ago as October, 1897 (during the engineering strike) is not yet running. Relying on the assurances of the contractors that the plant would be delivered by the end of the summer, a very large number of consumers were connected to the mains this year, with the result that during the last fortnight the pressure has at times dropped from 100 to 87 volts. Glasgow is in a similar predicament, through delay in erecting a new generating station there. Here the course has been adopted of only connecting new consumers on the understanding that the supply to them might have to be discontinued, so that a serious lowering in the pressure has been avoided in that town. Last, but not least, during the last few days in the city of London the pressure has occasionally dropped to a very low value between 4 and 5 in the afternoon and during fogs, the lowest recorded being 85 volts. Here the cause is the non-delivery of steam pipes, which have been on order since last August. Sufficient machinery is in place and running, but only two out of five boilers recently erected can be used, and consequently the steam pressure could not be maintained at times of full load.

ELECTRIC LIGHTING IN THE CITY OF LONDON.—A libel action brought by Sir Joseph Savory against the proprietors of a paper called "London" has aroused considerable interest in the electrical world. It will be remembered that when the electric lighting of the city of London was first decided on, the city was divided into three districts, and contracts were awarded to the Brush Electrical Engineering Company for two of these districts, and to Messrs. Lang, Wharton & Down for the third. This happened to be just about the time of the Baring crisis, and the contractors found it extremely difficult to obtain the large capital necessary to undertake a work of this description. There was, in consequence, danger of the provisional orders lapsing, owing to the work not having been commenced, when a group of financiers calling themselves the City of London Pioneer Company bought the contracts and the provisional orders from the firms in question, and succeeded in floating the City of London Electric Lighting Company, which at present provides the city with both public and private lighting. The result of this deal was, of course, considerable profit to the Pioneer Company and its promoters, which, in spite of the financial risk incurred, some people considered to be excessive. Sir Joseph Savory, who was then Lord Mayor, and, in consequence, ex-officio Chairman of the Commissioners of Sewers, who awarded the contracts for electric lighting, had a considerable interest in the Pioneer Company, and an article in "London," published last June, commented adversely upon the part Sir Joseph had then taken, referring to the transaction as very discreditable, and combining the characteristics of Hooleyism and Tammanyism. It was, stated the article, one of the worst jobs which had tarnished the municipal history of London. Sir Joseph Savory naturally brought a libel action against the paper, but as a result it was declared that the facts stated were true, and that the comment was made in good faith and without personal malice. Mr. Justice Day, in summing up, stated that while there was no reason to think that Sir Joseph Savory had not acted in an honorable manner, yet there was no doubt that he had been extremely indiscreet. This action is of special interest at the present time, as no less than three companies who are lighting other parts of London, viz., the Metropolitan Electric Supply Company, the Charing Cross & Strand Electricity Supply Corporation and the Smithfield Markets Electric Supply Company, have applied to the Corporation of London for the necessary permission to enable them to acquire provisional orders, and it has been refused. The agreement, in fact, between the city authorities and the City of London Company makes the refusal necessary until 1911. The Charing Cross & Strand Electricity Corporation are, in the meantime, circulating an enormous petition of ratepayers in favor of consent being given to their desired provisional order, this petition having been signed by 5,000 ratepayers, and the final result of the movement is being awaited with interest.

FRENCH NOTES.

SAD DEATH OF M. DE MERITENS.—Another name has been added to the roll of martyred inventors. M. de Meritens, well known in Paris and to the scientific world by reason of his numerous inventions and especially for his apparatus for lighthouses, killed himself in despair after the sale of his furniture, at Eragny-Neuville, near Pontoise. The unfortunate inventor fell into want and was without shelter. His wife committed suicide at the same time, both taking poison. M. de Meritens was 65 years of age and his wife 35.

MESSAGES BY TELEPHONE.—M. Mongeot, Under-Secretary of State for Posts and Telegraphs, has matured a plan for the extension of the telephone service. This plan contemplates the notification of any person, whether renting a telephone or not, that some one wishes to talk with him at a given public telephone booth. The message will be carried to the recipient's house like a telegram. Within a radius of twenty-five kilometres the charge will be 5 cents, and must be paid by the sender of the message. The charge will be increased for any distance over twenty-five kilometres, but will in no case exceed 10 cents. The message will be a regular form somewhat as follows: "You are notified that Mr. X, living at ——, requests that you will come to telephone booth No.—— at—— o'clock." Each message will be numbered in the order of its receipt, and the number will entitle the recipient to the use of the booth at the time specified. It will be possible to avail one's self of this new arrangement only at stated hours in the day.

THE EXTINCTION OF THE BULLIER PATENTS IN GERMANY.—The Berlin patent office has recently declared the Bullier German patent to be void. This patent was taken out in 1894 by a French chemist, an assistant of Professor Moissan, on the only known practical process for making calcium carbide by heat generated electrically. This patent is owned in Germany by a company, which is controlled by the General Electric Company, and owns an [illegible] at [illegible] and an electro-chemical plant at Bitterfeld. Owing to the unwillingness of this company to permit the manufacture of calcium carbide under license this patent has been a great obstacle to the introduction of the acetylene light in Germany. The recent action of the patent office will doubtless soon be followed by a substantial reduction in the price of calcium carbide. This process was invented in exactly the same way [illegible] in England and the United States. But even these patents seem shaky, as it has been proved that Borchers, a German scientist, was the first successful experimenter in the electro-thermic production of calcium carbide nearly ten years previously. The [illegible] However, [illegible] by the foregoing work in making its decision. Suit has been brought in France on the same [illegible]

[illegible]

burg, Munich, Nuremberg, Strasbourg, 14 cents. These prices are all subject to discounts. The average price of 14 cents per kw-hour puts the cost of a lamp hour at 0.8 cents. In England the rates are even better. At Birmingham the price is 14 cents per kw-hour; at Edinburgh, 12 cents, and at Liverpool 14 cents. In London, where gas is 56 cents per 100 cubic feet, the cost of a kw-hour ranges between 10 and 16 cents. At Manchester the price is 4 cents per kw-hour, the lowest price known. In France the cost of electric light is increased 50 per cent. by taxation. The best situated towns as regards price are Nancy, where it is 12 cents per kw-hour, and Saint Etienne, where it is 14 cents. At Havre 16 cents is paid per kw-hour; other towns have to pay 22 cents and 24 cents per kw-hour.

ELECTRICAL "HYDRANTS" FOR AUTOMOBILES.—A commission selected from the Electrical Industries Association, the Engineers' Club, the Automobile Club and the Electrical Manufacturers' Association has drawn up a set of specifications to govern a competition for a prize of $80, to be awarded to the designer of the most satisfactory electrical "hydrant," or supply box, from which automobiles may be recharged. Each person desiring to enter the competitions must send his apparatus, accompanied by a full description, to the "President du Syndicat Professionel des Industries Electriques, Hotel des Ingénieurs Civil, 19 Rue Blanche, Paris, before March 1, 1899." The apparatus will remain the property of the designers, but the commission reserves the right to publish descriptions and to put the hydrants on exhibition. Neither the apparatus nor the accompanying description should bear the name of the inventor, but simply some distinguishing mark, the name and address of the inventor being enclosed in a sealed paper sent with the description. Requirements: The box itself must be made for out-of-town use, and arranged so that the contents will be protected from the weather and from accidental short circuiting. It must contain: First, a voltmeter, with pole changer, to read the voltage and polarity of both supply terminals and battery; second, a wattmeter; third, a rheostat and double pole switch; fourth, universal supply terminals, with cables having two conductors (each conductor must have the same kind of junction piece on each end, but the junction pieces of the two conductors must differ); fifth, everything connected with the supply box must be designed to stand 70 to 80 amperes at 120 volts; sixth, the whole box must be designed as compactly as possible, and must be perfectly insulated; seventh, the selling price of the entire outfit and of the single terminals must accompany each apparatus. The designer may make any additions he pleases, so long as the conditions of the competition are all met.

THE ELBEUF ELECTRIC STREET RAILWAY SYSTEM.—The tramway system of Elbeuf, which has recently been opened for traffic, is the sixth railway to be equippped with electricity by the General Tractions Company. Elbeuf is one of the chief manufacturing towns of Normandy. It has numerous thread, cloth and woolen mills and novelty factories. The city is very much drawn out, being about four miles long by one and a half wide. The centre of the town is about a mile and a half from the Saint-Aubin depot. The industrial activity forces the inhabitants to travel constantly. Workmen, factory hands, clerks, drummers, dealers and consumers must go from one part of the city to another according to the necessity of their business. Up to the present this busy hive has been utterly without any system of either rapid or economical transit. The company operates about six miles of railway in two lines, one running the length of the city and the other running across the city. The system is double tracked and the two trolley wires are bonded together every 1,500 feet. A feeder runs from the switchboard to the Rue des Traités, and feeds into the trolley near Calvary Square, where the two lines cross. The feeder has a figure-8 section and is split in the middle at the end, each half being soldered to one of the trolley wires. The drop in voltage to various parts of the line may be read at the stations by means of pilot wires. A return cable is laid from Calvary Square back to the station in a trench filled with asphaltum. This cable is in four strands, each strand being bonded to one of the four rails. On the bridge it was necessary to make special construction to secure good insulation. The Dickinson system of trolley suspension is used at Elbeuf. The great adaptability and superiority of this system in tortuous streets and sharp turns often met with in small cities is well established. The rolling stock comprises twelve motor cars and five trailer cars. Each car is equipped with two 25 horse-power motors, and is divided into first and second class compartments by a movable partition. There are eighteen second-class seats and six first, and room for ten more on each platform, making a total capacity of forty-four passengers.

General News.

NEW INCORPORATIONS.

THE PINE BLUFF ELECTRIC LIGHT & STREET RAILWAY COMPANY, Prescott, Ariz., has been incorporated.

THE LEXINGTON TELEPHONE COMPANY, Lexington, Tenn., has been formed with a capital stock of $200,000. The incorporators are J. E. Mcleall, H. E. Gruper, E. J. Timberlake, C. G. Gathing and W. T. Watson.

THE COLUMBIA TELEPHONE COMPANY, Columbia, Mo., has been incorporated, with a capital stock of $5000. The incorporators are James A. Hudson, Julia A. Hudson, Ethel A. Hudson, Macon; E. W. Stephens and A. W. McAllister, Columbia.

THE SPRINGFIELD TELEPHONE COMPANY, Springfield, Ohio, has filed articles of incorporation with the Secretary of State at Columbus. The [illegible] Robert C. Gotwald, C. H. Pierce, F. C. [illegible] Capital stock, [illegible]

THE COLUMBUS CITIZENS' TELEPHONE COMPANY, Columbus, Ohio, has been incorporated with a capital stock of $500,000. The incorporators are H. D. Critchfield, E. R. Sharp, J. B. Hanna, J. B. Hoge, F. A. Davis, W. A. Hardesty and H. A. Landman.

THE PENNSYLVANIA TELEGRAPH & TELEPHONE COMPANY, Beaver, Pa., has been formed by Stephen P. Stone, Daniel H. Stone and Charles H. Stone, of Beaver, and H. C. Patterson, H. H. Patterson and James P. Stone, of Beaver Falls, for the purpose of consolidating the independent lines operating in New Castle, Youngstown, Butler, Erie and down the Ohio River as far as Wheeling, including Hookstown, East Liverpool, Wellsville and Steubenville.

THE INTERURBAN RAILWAY COMPANY has been incorporated at Westchester, Pa., for the purpose of building an electric road from Philadelphia to Lancaster by way of Williston Inn, Westchester, Unionville and Quarryville to Lancaster. The officers of the company are as follows: President and general manager, Winslow Mason; vice-president, John A. Heaney; secretary, M. E. Gibson; treasurer, H. E. Hiles; chief engineer, W. T. Forsythe; and the directors are Thomas Bromley, H. W. Lambirth, S. M. Hess, J. Preston Thomas, Dr. G. Morris Philips, S. W. Smith, M. E. Gibson, C. T. Shields, William Garrett, A. F. Johnson, Charles O. Beaumont, M. S. Way, I. G. Le Fevre, W. Mason and W. M. Franklin.

THE TELEGRAPH AND TELEPHONE.

TIFFIN, OHIO.—The Home Telephone Company has completed its line to Berwick, McCutchenville and New Riegel and until January 1 will give free service to all of its patrons.

WASHINGTON, D. C.—A bill has been introduced in the House having for its object the prohibition of the use of telegraph and telephone lines for the purpose of lottery and horse-race gambling. The bill was considered by the House Judiciary Committee on December 16.

UTICA, N. Y.—The Central New York Telephone & Telegraph Company has purchased some property on Bleecker Street, in this city, on which it proposes to erect a steel-frame building six or seven stories high. The new structure will be mostly occupied by the exchange and offices of the company.

OMAHA, NEB.—The Iowa Telephone Company has had a large force of men at work on the new private telephone of the Cudahy Packing Company between Sioux City and Omaha, which is now in operation. General Manager Frazee said this new service would be of great advantage to the company.

GREENVILLE, PA.—A deal has been consummated whereby the independent telephone companies of Mercer, Lawrence, Butler, Erie, Crawford and Beaver Counties, in Pennsylvania, and in Turnbull County, in Ohio, are to be interconnected. The work of making the connections will be commenced at once.

LAKEWOOD, N. J.—The Delaware & Atlantic Telephone Company has made application for a franchise through the borough of Point Pleasant. An ordinance has been introduced and a public hearing will be given upon it. It is said that the proposed line will run from Point Pleasant to Lakewood, Toms River, Mount Holly and Philadelphia.

PEORIA, ILL.—The Central Union Telephone Company has decided upon and will put in force a new schedule of rates for telephone service in the city of Peoria. The new schedule provides for a reduction of from 10 to 33 1-3 per cent. For distances of one mile or less a reduction of 10 per cent. is made, and the reduction continues until for two miles or more the reduction is 33 1-3 per cent.

SAN FRANCISCO, CAL.—Prof. Albert Vandernaillen, who has been making some experiments here with wireless telegraphy, claims to have achieved some extraordinary results. It is stated that messages were transmitted with accuracy, and the sharpness of the characters on the sounder are said to have been very good. At recent trials of the apparatus the sending and receiving instruments were placed at a distance of several hundred feet apart.

COLUMBIA, MO.—The proprietors of telephone exchanges in Missouri met at Glasgow recently and organized the Missouri Independent Telephone Association. About thirty exchanges were represented. A committee consisting of the chairman and secretary and Theo. Gray, of Macon; E. D. Graham, of Mexico, and D. F. Vincent, of Slater, was appointed to report a form of constitution and by-laws at the next meeting, to be held in St. Louis December 27.

LAFAYETTE, IND.—The Bell Telephone Company has, it is reported, been endeavoring for some time to get the control of the Western Indiana and the Jasper County Telephone companies, which control a large number of exchanges and many miles of toll lines. At a recent meeting the Bell proposition was considered and rejected, and a twenty-five year contract was entered into with the Lafayette Independent Telephone Company and the new long-distance telephone company of Indianapolis.

URBANA, OHIO.—The Urbana Telephone Company held its first annual meeting and elected a board of directors and permanent officers. The following gentlemen were elected members of the board of directors: James B. Johnson, J. I. Blose, C. H. Marvin, J. C. Powers, D. B. McDonald, J. H. E. Dimond, Edwin M. S. Houston, Ed. L. Barber and James Brailey, Jr. The board then organized by electing the following officers: James B. Johnson, president; J. H. E. Dimond, vice-president; C. H. Marvin, secretary; John C. Powers, treasurer. It was decided to continue the line to Westville as far as St. Paris, and a number of other improvements were considered. The report of the secretary showed that the company had 257 subscribers, with prospect of 300 by the first of the year.

BOSTON, MASS.—It is stated that the Western Electric Telephone Company has purchased the charter of the Standard Telephone Company in Missouri, and is building a system of toll lines in that section of the country in opposition to the Bell company. Ex-Governor Thomas F. Crittenden is president of the new Standard Telephone Company, and Charles Webster is vice-president and general manager. The company's capital is $300,000, which is issued as the lines are built. Up to the present time it is stated that 980 miles of lines have been completed and material for 80 additional miles is on the ground. The new company has started to build a trunk line from Kansas City to St. Louis, connecting independent exchanges in those cities. The construction is similar to that in the Northwest, namely, 35-foot poles in cities, 25-foot poles in the country, and twenty-five to thirty poles to the mile. Nos. 9 and 10 wire are used for the lines.

COLUMBUS, OHIO.—The Co-operative Telephone Company, of this city, has elected officers and subscribed the necessary 10 per cent. of the stock, and has completed all preliminaries to the active work of putting in the new plant as soon as the City Council and Board of Public Works gives permission to use the streets. The following directors of the company were elected: Captain Alfred E. Lee, George Riddle, George D. Jones, O. B. Summers, O. H. S. Eberly, M. L. Boyd, W. B. Childers, Charles F. Galloway, Moses B. Earnhart, W. M. Payne, Justus Herrick, Charles W. Grau, J. B. Shook, J. F. Fergus and G. D. Owens. After the election of the board of directors the directors held a meeting and elected the following officers: Geo. D. Jones, president; Alfred E. Lee, vice-president; Frank H. Howe, secretary; Charles A. Spenney, treasurer.

THE PACIFIC CABLE PROJECT.—A bill was introduced in the national House of Representatives on December 20 to secure the construction and laying of a cable between the United States, Hawaii, the Philippines, Japan and China. It appropriates a sufficient sum to provide a cable that will carry at least fifteen words a minute, and when the cable is completed it shall be turned over to the Post Office Department and operated as a part of the postal service. Private messages may be transmitted at a rate to be fixed by the Postmaster-General, not exceeding one dollar a word, press messages to be carried at half rates. All receipts of the cable service in excess of the cost of operation shall be deposited in the treasury. Representative Corliss, of Michigan, who introduced the bill, has called the attention of the Secretary of State to the fact that the Scrymser concession for a Pacific cable will become binding, and give the Pacific Cable Company exclusive rights to land cables on Hawaiian soil for twenty years, unless the department interferes before January 2 next. Bills are now pending in both houses of Congress granting aid to the Pacific Cable Company, which now owns the Scrymser concession.

ELECTRIC LIGHT AND POWER.

MONCTON, N. B.—Extensive changes will probably be made in the electric light plant of this town.

MITCHELL, ONT.—The ratepayers have defeated the by-law to raise $5000 by debentures for the purpose of improving the electric light plant.

BINGHAMTON, N. Y.—The Binghamton General Electric Company has declared a semi-annual dividend of 2 per cent., payable on January 2 next.

ACTON, ONT.—The ratepayers have sanctioned the by-law to provide $6000 for the purchase of an electric light plant. Arrangements will be made immediately for the installation of the plant.

MUNCIE, IND.—The electric light plant power house, owned by the city, was damaged to the extent of $3000 by an explosion of natural gas on December 16, and Superintendent William Warner probably fatally injured.

SHERBROOKE, QUE.—The North Hatley Electric Light Company has purchased the water power on the Magog River, which it will utilize in driving electric generators for the purpose of supplying light and power to this city.

HALIFAX, N. S.—The city electrician and engineer have been instructed to prepare plans and invite tenders for a city electric light plant. This action is the result of a report of a special committee which investigated the subject of municipal lighting.

DAYTON, OHIO.—The contract with the Dayton Electric Light Company, under which the city is paying $100 per year for each street light, expires on November 24, 1899. The Independent Light, Heat & Power Company has been organized for the purpose of building and operating an electric light plant in the city, and desires to secure a franchise so that it may be in position to bid for the city lighting when the present contract expires.

CANANDAIGUA, N. Y.—On October 7 last Mr. M. D. Munger applied to the Board of Trustees of Canandaigua for an electric lighting franchise. After careful consideration of the subject the trustees declined to grant the petition on the ground that the present company, the Canandaigua Electric Light & Railroad Company, was giving good service, and that it was not for the best interests of Canandaigua to give another franchise.

BRIDGEPORT, CONN.—The Housatonic Power Company has given notice that it will petition the General Assembly for an amendment to its charter giving it the right to build a dam across the Housatonic River between the towns of Bridgewater and Brookfield, at or near the village of Southville, and the right to conduct electricity from New Haven County to points within Hartford County. It is the intention of the company to obtain power from the waterfall to be created by the construction of one or more dams for the purpose of generating electricity.

THE ELECTRIC RAILWAY.

CINCINNATI, OHIO.—A stock company was organized here, with a capital of $500,000, to build an electric road from Cincinnati to Lebanon, a distance of 25 miles.

EASTON, PA.—The Easton, Palmer & Bethlehem Electric Railway Company will carry mail between Easton and Bethlehem and the intervening towns along its road. There will be two dispatches each way daily except Sunday.

PERKASIE, PA.—The Borough Council of Perkasie has passed an ordinance giving the right-of-way in the town to the Inland Traction Company, which proposes to construct a trolley line from Perkasie to Lansdale. The company must give a bond of $10,000 to complete the line within a year.

CINCINNATI, OHIO.—The Cincinnati Street Railway Company is preparing to adopt improvements in the operation of the Cincinnati street cars. Superintendent John Harris is making a tour of Eastern cities, including New York, Boston, and Philadelphia, for the purpose of noting any improvements which will be an advantage to the public here.

TORRINGTON, CONN.—The Torrington & Hartford Tramway Company gives notice that it will apply to the General Assembly for a petition to extend its line [illegible] from the [illegible] [illegible] in Torrington to East Litchfield and westward from there to Bantam Lake. The company also intends to build a line from the Centre Bridge, in Torrington, to run along the Litchfield road, intersecting with the first named line at a convenient point.

NEW YORK, N. Y.—President Johnson, of the Nassau Electric Railroad Company, of Brooklyn, has given orders for the withdrawal from service of the so-called "coffin cars" on that line, to which so much objection has been recently raised by the traveling public. The name "coffin" was applied to the combination cars introduced on the Nassau lines. These cars have side doors, and while they were not objectionable in warm weather, they were decidedly so in cold weather.

HARTFORD, CONN.—A petition to the General Assembly has been filed praying for a charter for an electric street railway to run between Somers and Enfield and to be called the Enfield & Somers Electric Railway Company. The company also desires to supply electricity and electric light in the town of Somers and the villages of Hazardville and Scitico. The petition also asks that any other corporation may be permitted to subscribe to the stock of the road, and that the towns of Enfield and Somers may be allowed to subscribe to the stock to an amount not to exceed $15,000 in each case. The petition is signed by George E. Keeney, James W. Wood, R. Keeney, L. Keeney, A. E. Brainard and James A. Thompson.

POTTSVILLE, PA.—Work will be commenced shortly on a trolley line between Phœnixville and Spring City, which eventually is expected to be continued to Limerick Square, and then to Pottstown. The part between Phœnixville and Spring City, a distance of six miles, will probably be put in operation by May next. The right-of-way has been secured almost the entire distance, and application will be made to the Councils of Spring City and Royersford next month for street rghts. John J. Ridgway, of Philadelphia, is president of the Montgomery & Chester Electric Railway Company, which will build the road. A charter for this road has been granted in Westchester. Mr. George F. P. Wanger is one of the promoters of the enterprise.

NIAGARA FALLS, N. Y.—It has been definitely decided to carry forward the winter carnival scheme and erect an ice palace in this city. The three trolley lines centering here and the line on the Canadian side of the river have offered very liberal encouragement to the project. The Gorge road offers to give $100 toward defraying the expenses and also 5 per cent. of the gross receipts during the existence of the palace. The Niagara Falls & Suspension Bridge Street Railroad Company will subscribe $100 and give 10 per cent. of the local business realized during the same period. The Niagara Falls Park & River Railway offers 5 per cent. of its gross receipts, and the Buffalo & Niagara Falls Railway offers to sell coupon tickets with an admission to the palace at the regular railroad fare.

AKRON, OHIO.—The new company which is to take over the property and business of the Akron Street Railway & Illuminating Company will be capitalized at $2,000,000, and it is stated that it will at once begin making permanent improvements. Practically the entire system will be rebuilt, and new cars and equipments will be ordered at once. The property of the old company has been appraised at $932,000. The present outstanding bonded indebtedness amounts to $1,200,000. One-half of this amount, or 6000 bonds, will, it is stated, be wiped out, and nothing will be paid on these. The present bondholders will be given 5 per cent. stock to the amount of $600,000 in place of the amount of bonds now held. It is reported that in addition to this bonds to the amount of $300,000 will be issued to provide for improvements.

OBITUARY NOTES.

MR. RONALD TREVOR McDONALD, president of the Fort Wayne Electric Corporation, Fort Wayne, Ind., and one of the most widely-known men in the electrical manufacturing business, died suddenly of pneumonia in Dallas, Tex., on the morning of December 24. Mr. McDonald was born in Allegheny City, Pa., on June 24, 1849. He was of Scotch descent, but of American parentage. During the civil war he was a drummer boy, and after his military service he returned to Fort Wayne, and entered business as a clerk in a dry goods store, afterwards becoming a partner in the firm of Evans & McDonald, wholesale dry goods merchants. In 1881 he, with other gentlemen, incorporated the Jenney Electric Light Company for [illegible] apparatus in Fort Wayne under the Langley patents. He was general manager and leading spirit of this concern. The Jenney patents were bought in the [illegible] Nothing but the enthusiasm, confidence [illegible] McDonald carried the infant industry through its fight for existence in the [illegible] between that time and until his death encouraging news was received as to the condition of the patient. The news of his death was therefore a profound shock to his friends. The remains were buried in Fort Wayne on December 27.

R. T. McDonald.

Mr. McDonald was happily situated in his domestic relations. He was married in 1876 to Miss Lillie Morse, of Angola, Ind. The deceased was a very genial, hospitable man, and although his varied business interests occupied the greater part of his time what little opportunity he had for social intercourse he loved to spend in the company of his friends. He was a member of prominent clubs in New York, Chicago, New Orleans and Fort Wayne, and was a Freemason of high degree. Among the electrical interests with which Mr. McDonald was connected, besides the Fort Wayne Electrical Corporation, may be mentioned the Fort Wayne Consolidated Electric Railway Company; the electric railway and lighting company, of Ironton, Ohio; the electric light company at Dallas, where he met his death; an electric railway at Houston, Tex.; the Broad Ripple & Indianapolis Electric Railway; electric railways at New Orleans, and many others throughout the country. Mr. McDonald's fidelity to his friends was one of the principal traits of his character. He was a manly opponent, intense, aggressive and progressive, and necessarily these meet with opposition. He expected it, however, and he had no fear; he was never deterred from doing his duty as he saw it. The Electrical World is informed that from present indications Mr. McDonald's death will have no effect whatever upon the affairs of the corporation of which he was the head.

DR. WELLINGTON ADAMS, of St. Louis, Mo., who came into prominence in 1892 through his scheme to build a high-speed electric railroad between St. Louis and Chicago, died at his home in that city on December 19, of pneumonia. Dr. Adams was born in Brooklyn, N. Y., in 1856, and was, consequently, forty-two years of age.

MR. FREDERICK CULVER WHITMORE, of the railway engineering department of the General Electric Company, died, at the early age of twenty-six years, of typhoid fever at his home in Hartford, Conn., on December 7. Mr. Whitmore began his career with the Thomson-Houston Company on the "students' course" at the Lynn factory, from which he was advanced to the power and mining department, where he was engaged chiefly in design. In 1894 he was transferred to the Scranton, Pa., office of the General Electric Company, where he was general consulting engineer in power and mining work till 1898, at which time he returned to the home office in Schenectady. His work at Schenectady was wholly with the railway engineering department, in which at the time of his death he was filling with conspicuous success an important post in connection with the design of special railway apparatus. Mr. Whitmore was a man of uncommon gifts, and possessed unlimited energy and enthusiasm in his work. He had, beside, a manly and straightforward character and numerous qualities of personal charm which won him friends and gained him universal esteem.

PERSONAL NOTES.

PROF. ALEXANDER GRAHAM BELL arrived in San Francisco on December 26 in the steamer "China" from Japan and China. While in Japan Professor Bell received many attentions at the hands of the Japanese.

MR. HIRAM PERCY MAXIM, mechanical and electrical engineer of the Pope Manufacturing Company, Hartford, Conn., was married on December 21 to Miss Josephine Hamilton, daughter of the late Governor Hamilton. The ceremony took place at Hagerstown, Md.

Trade and Industrial Notes.

THE GARRETT BUILDING, Chicago, is to have an electric plant designed on the Arnold system. The Ball Engine Company, of Erie, Pa., will furnish therefor one 250-hp and one 175-hp engine.

THE HOUSE OF CORRECTION, Baltimore, Md., has recently started up a direct-connected plant which consists of generators of the Fort Wayne Electric Corporation direct-connected to two 60-hp engines built by the Ball Engine Company, of Erie, Pa.

THE VICTOR TELEPHONE MANUFACTURING COMPANY, 166-174 South Clinton Street, Chicago, has sold to the Chequamegon Telephone Company, of Ashland, Wis., a full 400-number exchange, including everything in the way of telephone equipment.

THE CENTRAL ELECTRIC COMPANY is receiving many flattering compliments from the trade on its new general catalogue. The catalogue contains a quantity of valuable data outside of the merchandise illustrated, and is worthy of careful examination and preservation.

MR. JOHN S. NOWOTNY is now established at 313 West Second Street, [illegible], Ohio. In addition to furnishing the Nowotny semi-vacuum, long-burning, enclosed arc lamp, of which he is the inventor, Mr. Nowotny carries standard makes of dynamos and motors for all purposes and other electrical apparatus.

MR. EDWARD P. THOMPSON, solicitor of patents, 81 and 83 Fulton Street, New York, has issued a pamphlet on the subject of obtaining patents [illegible]. Mr. Thompson has associated with him Mr. Alfred C. [illegible] as [illegible] legal counsel, and Prof. William A. Anthony as associate technical counsel.

THE BALL ENGINE COMPANY, of Erie, Pa., has contracted to supply [illegible] engines of [illegible] horse-power each for the Norfolk Navy Yard at Portsmouth, Va. The engines will be direct-connected to two [illegible] kw General Electric Company generators, and the new equipment will go in the [illegible].

[illegible] The American [illegible] Manufacturing Company, 311 [illegible] Street, [illegible], has published a leaflet containing endorsements from a number of [illegible] regarding the satisfaction given by the [illegible]. Among the testimonials is one of the

John Stephenson Company, Limited, in which it states that these silk wipers have been used by that concern for over three years, and they have been found to be satisfactory.

MR. DUNCAN BOND, Denver agent for the Ball Engine Company, of Erie, Pa., has closed a contract with the Mountain Electric Company, in Denver, covering the engines for the electrical plant of the new Arapahoe County Poor Farm buildings. The Mountain Electric Company, acting as district manager for the Westinghouse Electric & Manufacturing Company, has contracted with the County Commissioners to furnish the necessary electrical and steam equipment. The units will be direct-connected and of the latest types of the respective makers.

THE LOMBARD WATERWHEEL GOVERNOR COMPANY, 61 Hampshire Street, Boston, Mass., reports that the demand for its governors is constantly on the increase. During last month orders were received for upward of twenty governors to regulate forty-one waterwheels, which will develop 15,750 horse-power. More than half of this machinery will be used in electric stations—principally in power transmission plants and electric railway stations—the balance being in textile and other manufacturing plants driven by water power.

THE MASON TELEPHONE PAY STATION COMPANY, Ludington, Mich., has in preparation a new catalogue to be ready about February 1, which will give full information as to the styles of prepayment instruments manufactured by this concern and details of their use. This catalogue will be very attractive, and anyone desiring a copy may forward an order to the office of the company at Ludington, and as soon as the catalogue is ready for distribution a copy will be sent. The Mason Company manufactures portable, soundproof booths and various styles of pay-station signs as well as automatic prepayment instruments.

THE WATSON-STILLMAN COMPANY, 204-210 East Forty-third Street, New York, has issued an illustrated index which is intended to show the large variety of tools manufactured by that concern. Each illustration represents from one to about twenty sizes of tools, a full and complete description of which is kept by the company in the form of loose sheets for distribution as required. The catalogue includes machinery and tools for a great many lines of business. This index, which is also known as Catalogue No. 51, will no doubt be found very convenient to those interested. The company expects soon to issue Catalogue No. 52, which will be devoted to street railway appliances. It intends to issue these special or group catalogues at frequent intervals, a dozen different ones being laid out at the present time for future issue.

IRONCLAD DYNAMOS AND MOTORS, generating sets, etc., constitute the subject of Bulletin No. 127 just issued by the C & C Electric Company, of New York. Perspective views and dimensional diagrams of the various machines of the enclosed type are given, together with a brief description of their construction. The electric hoist with open-type ironclad motor, the electric drill cutter equipped with special type C & C ironclad motor, and generating sets with open-type, ironclad dynamo and Forbes engines are also illustrated and briefly described. A direct-connected generating set with closed-type, ironclad dynamo and Case engine is shown. The improved C & C reaction brush-holder, C & C automatic starting box and C & C field regulator are also illustrated.

THE NEW NO. 44 TRANSMITTER of the Eureka Electric Company, 157 South Canal Street, Chicago, Ill., is claimed to be unequalled for volume of tone and clearness of articulation. It is also attractive in design and symmetry, and it is of the best construction in every particular. The diaphragm is of metal, no other substances being employed in its construction other than carbon and metals. It is of the solid-back type, full nickeled, and is built to be mounted either upon the magnetic box or on long-distance arms. It is claimed that packing with this instrument is impossible, and the company guarantees each transmitter for an indefinite period. This instrument, in connection with the Eureka company's new double-pole receiver, makes a set that is adapted to any long-distance work that may be required of it. Further particulars regarding the apparatus may be obtained by addressing the company.

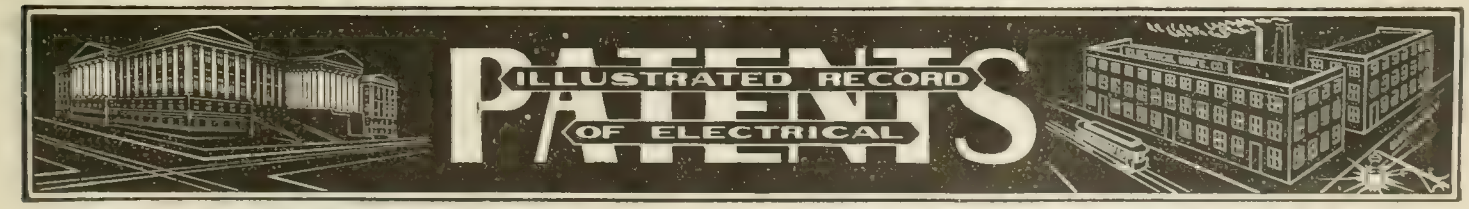
THE CHICAGO PUBLIC LIBRARY BUILDING LIGHTING PLANT.—In the last issue of THE ELECTRICAL WORLD was described and illustrated the lighting and power plant of the Chicago Public Library Building, Chicago, Ill. In this connection the Warren Electric & Specialty Company, Warren, Ohio, calls attention to the fact that the 13,000 incandescent lamps used in this building are of that company's make. The company furnished the lamps for the library last year and again, after careful tests, secured the contract for this year's supply. This library is said to be one of the most technical customers in the country, and the lamps supplied to it must be exact as to efficiency, maintenance of candle-power and must not vary more than 2 watts in a 16-cp lamp. Naturally the Warren Electric & Specialty Company feels that its product has received high endorsement in having been selected for use in this building.

THE ELECTROSE MANUFACTURING COMPANY, No. 127 North Tenth Street, Brooklyn Borough, New York City, reports the largest business in the history of the concern, and a constantly growing demand for its products in every branch of the electrical trade. Electrose, which is recognized as one of the best substitutes for hard rubber, has become a standard article in the electrical trade, especially among telephone manufacturers, for receiver cases, mouthpieces, etc. Mr. Louis Steinberger, the president of the company, who is also the inventor of electrose, has developed this material to its present high standard, and is still at work improving its qualities. Electrose is not only an insulating substance but it also has many of the other qualities of hard rubber. It is said to possess other qualities not found in the latter. The best evidence of the Electrose Company's success is the fact that it counts among its best patrons many of the leading electrical manufacturers throughout the United States and abroad.

SOME LARGE TRANSFORMERS.—The Wagner Electric Manufacturing Company, St. Louis, Mo., has secured through its manager of sales, Mr. E. H. Abadie, what is said to be the largest transformer order ever placed in this country. The contract was given by the Union Carbide Company for seven transformers of 2000-hp output capacity each and two of 500 horse-power each, complete with switchboards, for their operation. These transformers are to go into the Carbide company's works at Niagara Falls, N. Y., and are to be of the oil-type, with water coils for lowering the temperature of the oil. The contract was closed on definite specifications as to iron and copper losses, full load, three-quarters, one-half, one-quarter and one-tenth load efficiency, guaranteed as to temperature rise and also as to insulation test, and guarantees made as to 50 per cent. overload in current. As the electrical apparatus installed by the Union Carbide Company is subject to the approval of the Niagara Falls Power Company, and since Mr. L. B. Stillwell, the managing director of the latter company, has approved of the specifications agreed upon, this contract, it is claimed by the Wagner company, places it on record as the builder of the largest power-transmission transformers in the world. These tranformers, together with the 40,000-volt, high-tension transformers now operating at Provo, Utah, and Telluride, Col., the Wagner company claims, gives it a leading position among builders of large single-unit transformers for extremely high voltages. The company states that it is getting some very large orders for high-potential transmission transformers where the units range from 100 to 500 horse-power and the voltage as high as 40,000 volts.

Business Notice.

TO THE LAND OF SUNSHINE.—Take the Sunshine Route from Chicago to Los Angeles, San Francisco and other points in California, and escape the rigors of winter in the East and North. Pullman tourist cars for first and second-class passengers leave Chicago every Saturday at 2 o'clock P. M. via the Chicago, Milwaukee & St. Paul Railway to Kansas City, thence to California via the Atchison, Topeka & Santa Fé Railway—a real sunshine route. This is the earliest afternoon train leaving Chicago for the West after arrival of morning trains from the East, thus avoiding tedious delay. The Sunshine Route is essentially the best and most patronized through car line for men, women and children. Every attention paid to the needs of passengers en route. Send for a Sunshine Route timetable folder. It costs nothing. Address William Kelly, Jr., General Eastern Passenger Agent, 381 Broadway, N. Y.



UNITED STATES PATENTS, ISSUED DECEMBER 20, 1898.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

616,079. ELECTRICAL BURGLAR-ALARM. C. Coleman, of Chicago, Ill. App. filed June 29, 1896. In an electrical burglar-alarm system the combination, with a closed controlling circuit, of a plurality of interrupted circuits laid in reverse directions and charged with electricity at the same potential as is the controlling circuit, all of said circuits being insulated from each other and braided together.

616,082. THERMOSTATIC AUXILIARY FIRE-ALARM SYSTEM. A. H. Cross, of New York, N. Y. App. filed June 1, 1898. In an auxiliary fire-alarm system the combination with a street box of a normally closed auxiliary circuit, including a section of fusible wire extending throughout a building, and a compound of thermostatic wire arranged parallel to said fusible wire and normally disconnected from the auxiliary circuit, substantially as described.

616,104. PERMUTATION LOCK FOR BOXES. H. Hinterholzner, of New York, N. Y. App. filed Jan. 10, 1898. A locking device for locking a shiftable lid upon a box, comprising a base, integral with the box, a pivot turnably secured in the base, a slot and a circular recess at the end of the slot provided in the lid; a soft iron tumbler fitted into the circular recess, a block turnably mounted upon the pivot and provided with a bore corresponding in size and position relatively to the pivot with the circular recess in the lid; a disc or cover secured to the pivot, and a magnet affixed to the disc in corresponding position with the bore in block.

616,110. ELECTRIC SWITCH. W. J. Kelley, of Boston, Mass. App. filed May 1, 1897. In an electric switch, the combination of the following instrumentalities, viz., a rotatable shaft, a plurality of commutators loose thereon, means to rotate said commutators on said shaft, and means to connect the said commutators to said shaft to rotate therewith, substantially as described.

616,111. ARC-LIGHT REGULATOR. W. J. Kelley, of Boston, Mass. App. filed Jan. 29, 1896. In a regulator for automatic arc lights, the combination with a variable resistance composed of a series of resistances, increasing and diminishing irregularly, as described, to enable the arc lamp to be regulated without interfering with its functions, and a circuit controller co-operating with the said variable resistances, substantially as described.

616,136. AUXILIARY FIRE-ALARM TELEGRAPH APPARATUS. B. Oehmen, of New York, N. Y. App. filed Jan. 14, 1898. An improved double magnet, comprising two parallel coils, an armature co-operating with the poles of said coils at one end and being attracted so as to actually engage said poles to close the magnetic field, and a second armature co-operating with the poles of the magnets at the other end.

616,148. MAGNETIC SWITCH. C. E. Scribner, of Chicago, Ill. App. filed April 23, 1897. The combination of a permanent magnet, an armature therefor, switch contacts controlled by the armature, a pole-piece of soft iron for said magnet presented to the armature, said pole-piece being removable and associated with a movable appliance, substantially as described.

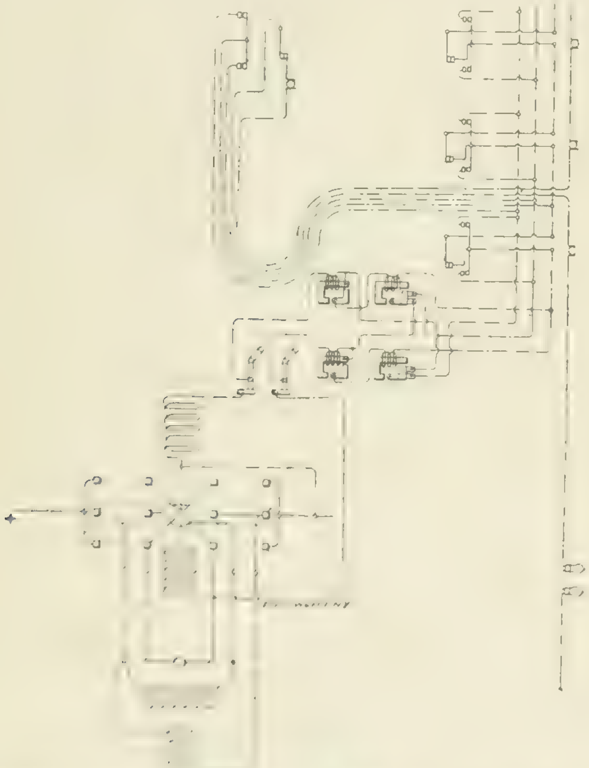
616,190. ELECTRIC OPERATING OF ELEVATORS BY THREE-BUTTON PUSH SYSTEMS. J. D. Ihlder, of Yonkers, N. Y. App. filed Dec. 16, 1897. In a system for the electrical operation of elevators, the combination with a motor and a reversing switch controlling the motor of a circuit including two sets of push-buttons, circuit-maintaining magnets, and non-interfering magnets controlling said circuit, substantially as described.

616,232. RAIL-BOND. W. E. Harrington, of Camden, N. J. App. filed April 9, 1898. In combination with abutting ends of railway rails a bonding member with smooth contacting surface adapted to contact therewith, and set-screws adapted to act upon said bonding member to maintain pressure between it and the rails, substantially as described.

616,265. FIELD MAGNET FOR ELECTRIC MACHINES. S. H. Short, of Cleveland, Ohio. App. filed July 28, 1898. A field magnet for electric machines having grooves formed in the pole-surfaces thereof, in combination with a grid arranged to be received in said grooves, substantially as described.

616,276. ILLUMINANT FOR INCANDESCENT ELECTRIC LAMPS AND PROCESS OF MAKING. O. W. Thowless, of Newark, N. J. App. filed Jan. 31, 1896. An illuminant for incandescent electric lamps, consisting of a carbon filament and a surrounding sheath or covering of oxide or other compound of thorium.

616,301. PNEUMATIC MOTOR FOR ELECTRIC APPLIANCES FOR CARS. C. A. Evans, of Upland, Pa. App. filed July 13, 1897. A car hav-



No. 616,190.—Electric Operation of Elevators by Three-Button Push Systems.

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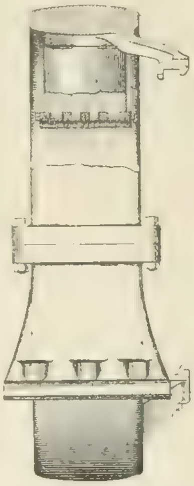
[illegible]

[illegible]

[illegible]

616,403. SYSTEM OF ELECTRIC TRACTION. M. Cattori, of Rome, Italy. App. filed Dec. 24, 1897. An electric railway provided with two substantially parallel sectional conductors, arranged in two circuits, an independent generator included in each circuit, terminal switches whereby one pole of each generator may be connected with the corresponding terminal of either conductor of the same circuit, and junction switches whereby the other pole of each generator may be connected with the other end of either conductor of the same circuit.



No. 616,265.—Field Magnet for Electric Machines.

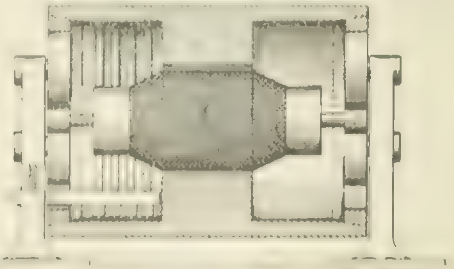
616,405. AUTOMATIC MAGNETIC CIRCUIT BREAKER. C. M. Clark, of New York, N. Y. App. filed May 27, 1898. A circuit breaker, comprising a rotary disc of insulating material, a contact block seated in said disc and extended through the same; fixed brushes normally engaging said block, one at each side of the disc, the said brushes being in an electric circuit; a solenoid in the circuit, a pivoted latch having connection with the solenoid core and normally engaging with a part on the disc, to hold said disc; a spring for moving the disc when released by the latch, and a blow-out in the form of a plate, having an opening through which the disc may move, the said plate being secured near the brushes.

616,417. INDICATOR. F. Hackmann, of Milwaukee, Wis. App. filed Nov. 26, 1897. In an indicator the combination of a printing wheel, a shaft on which said wheel is mounted, a spring connected at one end to said shaft and having its opposite end connected to the wheel, and a contact pin extending laterally from a recess of the printing wheel, and adapted, when the wheel is turned in a direction to wind the spring, to be pressed inwardly into the recess in order to clear a fixed point or stop of a framework.

616,165. CARBON FOR ELECTRIC WELDING. G. W. de Tunzelmann, of London, England. App. filed Feb. 25, 1898. An electrode for electric welding, brazing and the like purposes, composed of carbon and metallic oxides, combined together by admixture, substantially as described.

616,174. ELECTRIC VOTING MACHINE. F. S. Wood, of Boston, Mass. App. filed Jan. 16, 1897. In an electric voting machine, the combination in series of a plurality of first circuits adapted to transmit volting impulses whereby said circuits are made interdependent, one circuit of said series having its switching device adapted to open all the circuits when operated, while the other circuits have an auxiliary device co-operating therewith and producing the same result.

616,186. MICROPHONE CONTAINING GRANULAR CARBON FOR RETAINING MATERIAL IN POSITION. L. M. Ericsson, of Stockholm, Sweden. App. filed April 6, 1898. In combination, a microphone, a disc, a ring of elastic material surrounding the same and projecting beyond the face thereof, a diaphragm opposite the disc, carbon granules in the space bounded by the elastic ring, the disc and the diaphragm, and the spring for pressing the elastic ring toward the diaphragm, substantially as described.



No. [illegible].—Combined Bearing and Power Transmitting Device.

[illegible] ELECTRIC WELDING. H. F. A. [illegible], of Johnstown, Pa. App. filed [illegible] welding, bars to the sides [illegible] transversely through [illegible] connecting the bars [illegible] under compression [illegible] they have cooled sufficiently [illegible]

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